COMMENT RESPONSE DOCUMENT (CRD) TO NOTICE OF PROPOSED AMENDMENT (NPA) 2009-11

for amending the Executive Director Decision No. 2003/10/RM of 24 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for European Technical Standard Orders (« CS-ETSO »)

and

Amending the Annex to Decision No. 2003/01/RM of the Executive Director of the Agency of 17 October 2003 on acceptable means of compliance and guidance material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations («AMC and GM to Part-21»)

"Systematic review and transposition of existing FAA TSO standards for parts and appliances into EASA ETSO"

Explanatory Note

I. General

1. The purpose of the Notice of Proposed Amendment (NPA) 2009-11, dated 17 October 2009 was to propose an amendment to Decision 2003/10/RM of the Executive Director of the European Aviation Safety Agency of 24 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for European Technical Standard Orders (CS-ETSO)[1] and decision No. 2003/01/RM of the Executive Director of the Agency of 17 October 2003 on acceptable means of compliance and guidance material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (AMC and GM to Part-21)[2]. The NPA proposed introduction of new ETSO specifications that are, where possible, technically similar to existing Federal Aviation Administration (FAA) TSO.

II. Consultation

2. The draft Executive Director Decision amending Decision 2003/10/RM and Decision 2003/01/RM was published on the web site (http://www.easa.europa.eu/) on 20 October 2009.

   By the closing date of 20 January 2010, the European Aviation Safety Agency ("the Agency") had received 91 comments from 16 National Aviation Authorities, professional organisations and private companies.

III. Publication of the CRD

3. All comments received have been acknowledged and incorporated into this Comment Response Document (CRD) with the responses of the Agency.

4. In responding to comments, a standard terminology has been applied to attest the Agency's acceptance of the comment. This terminology is as follows:

   - **Accepted** – The comment is agreed by the Agency and any proposed amendment is wholly transferred to the revised text.
   - **Partially Accepted** – Either the comment is only agreed in part by the Agency, or the comment is agreed by the Agency but any proposed amendment is partially transferred to the revised text.
   - **Noted** – The comment is acknowledged by the Agency but no change to the existing text is considered necessary.
   - **Not Accepted** - The comment or proposed amendment is not shared by the Agency

   The resulting text highlights the changes as compared to the current rule (see Appendix A).

5. The Executive Director Decision will be issued at least two months after the publication of this CRD to allow for any possible reactions of stakeholders regarding possible misunderstandings of the comments received and answers provided.

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1 Decision as last amended by Decision 2009/015/R of 1 December 2009.
2 Decision as last amended by Decision 2010/001/R of 23 March 2010.

6. Such reactions should be received by the Agency not later than **01 December 2010** and should be submitted using the Comment-Response Tool at http://hub.easa.europa.eu/crt.

IV. CRD table of comments and responses

(General Comments)	-

comment	*5* comment by: *MOT Austria* The NPA is supported. No further comments.
response	*Noted*

comment	*67* comment by: *THALES Avionics* As active participant in the EUROCAE task in charge of preparing elements for this NPA, THALES AVIONICS concurs with the general intent of this NPA. It will have a positive impact on safety and will contribute to an easier validation of ETSO parts and appliances by FAA for issuing TSO.
response	*Noted*

comment	*82* comment by: *Luftfahrt-Bundesamt* The LBA has no comments on NPA 2009-11.
response	*Noted*

comment	*83* comment by: *Swiss International Airlines / Bruno Pfister* SWISS Internatinal Air Lines has no further comments to be made in reference to NPA 2009-11.
response	*Noted*

comment	*88* comment by: *UK CAA* Please be advised that the UK CAA has no comments to make on NPA 2009-11.
response	*Noted*

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comment	*10* comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)* The Swedish Transport Agency, Civil Aviation Department is supporting the content of NPA 2009-11.
response	*Noted*

comment	*87* comment by: *CAA-NL* CAA-NL has no comment to this NPA
response	*Noted*

A. EXPLANATORY NOTE - IV. Content of the draft decisions p. 4-9

comment *69* comment by: *Airbus SAS*

Airbus General Comment:
With this A-NPA, EASA in fact proposes to introduce several revisions to FAA TSOs into CS-ETSO Index 1 ETSOs.
Airbus would like to get clarifcation why a transfer of FAA TSO C-62e is not included in this A-NPA.
It has to be reminded that CS-ETSO Index 1 currently includes C-62d, a standard that stems from Year 1990. FAA TSO C-62e has been published in Year 2006. It is difficult ot understand why it takes more than 3 years to convert a FAA TSO into its CS-ETSO Index 1 equivalent which, by definition,is technically similar to the initial document.
Airbus is requesting clarification because any tire need to be qualified for use on airplane, and being forced to qualify according to 2 technical standards creates administrative burden without any safety benefit.
Further, Airbus would highly appreciate if TSO C-62e would be added to Index 1 with this NPA, or EASA would state that C-62e will be part of the next CS-ETSO revision.

response *Not accepted*

The Terms of Reference for this rulemaking task did not include the update of ETSO-C62d. Consequently, an update of that ETSO could not be expected within this rulemaking task. The rulemaking task ETSO.008 includes an update of ETSO-C62d. See the published Terms of Reference ToR ETSO.008. We would like to draw industry's attention to the use of our Rulemaking Proposal Form to request rulemaking activities.

comment *91* comment by: *UK CAA (SRG)*

Dear Sirs,

The UK Civil Aviation Authority respectfully request that EASA kindly accept for your through consideration, the following comments on your proposal for a harmonised ETSO for VHF Radio Communications Transceiver Equipment...

1. The CAA recognises and appreciates the need for harmonised standards but EASA should be aware that FAA TSO C169a, identified on page 7 of NPA 2009-11, was re-issued at the specific request of the UK CAA. The reason for our request was the urgent need to address, and correct, the omission of a test for the feature described (in ED-23B) as "Receiver Muting". The incorporation and adjustment of this function is vital to ensure that the aircraft transceiver will operate successfully in the presence of an offset-carrier transmission on an Air Traffic Control (ATC) frequency. The need to test, and if necessary, adjust this feature was unfortunately absent from the relevant RTCA MOPS for many years and European airlines were expected to either pay to have this feature adjusted by the manufacturer or subsequent to delivery either by their in-house avionic workshop or by the manufacturers' representative in Europe because the "ReceiverMuting" function was described as a "Customer Preference" feature.

2. It should also be remembered that incorporation of the requirement for

"Receiver Muting" into TSO-169a, in September 2007, merely brought the RTCA MOPS into line with Eurocae document (ED-23B) which was first published in March 1995 (i.e more than 12 years earlier). Equipment built to comply with TSO-169a would also ensure adequate performance in the presence of an 8.33 channel which became mandatory for communication above FL 195 wef July 2008. This was communicated to all European ATC providers via the Single European Sky (SES) Implementing Rule for "Voice Channel Spacing" (EC) 1265/2007.

3. However paragraph 4 of Article 3 in (EC) 1265/2007 states that this requirement " shall not apply to sectors where 25 kHz offset-carrier is utilised". But this statement merely reflects the fact that modern aircraft transceivers were designed to comply with "Receiver Class E" in ED-23B and "to be used in a 8.33 kHz channel separation environment but NOT intended for off-set carrier operation".

4. So in 2007 Eurocontrol was aware that the continued use of off-set carrier in 25 kHz channels would be a serious limiting factor in their desire to increase the usage of 8.33 and thereby to release more spectrum for re-use elsewhere in Europe. *(Please note that the "gap" between Class E and Class H is fully explained in the text of ED-23C)*. A Eurocae Task Force was therefore established in 2008 to investigate and prepare any additional text which might be required to ensure adequate performance from an aircraft transceiver which was a) intended to receive a voice transmission using the now well established 8.33 kHz channel spacing and b) when this transmission was broadcast simultaneously from two ATC ground stations.

5. This technique, known as "Climax in 8.33", was devised and researched by several ATC providers in order to increase the number of ATC frequencies which might be transferred from a 25 kHz frequency assignment to an 8.33 voice channel. The Task Force comprised of experts drawn from avionics manufacturers, from Europe and the United States plus representatives from European regulators and ATC service providers. The final document issued as ED-23C in June 2009, includes two new classes of airborne receivers (H1 & H2) and the expectation is that a majority of 8.33 transceivers will probably meet the requirements for H1. But since "Climax in 8.33" utilises a much reduced frequency separation (just 5 kHz) between to two contributing and collaborative carrier signals, it is important that the transceiver manufacturers should test and if successful, endorse their receivers for operation in Class H1.

6. Eurocae endeavoured to work closely with RTCA SC-172 during the preparation of ED-23C and the Task Force have recommended that the FAA TSO should be revised to reflect the new requirements in ED-23C. This would suggest that the FAA TSO be re-issued as '169b and the recommendation from the UK CAA is therefore that, with respect to the proposal regarding "VHF Radio Communication Transceiver Equipment Operating Within the Radio Frequency Range 117.975 to 137.000 Megahertz", a new (combined) ETSO-2C169b, based upon ED-23C should be issued.

7. The resulting (new) text and rationale currently shown on page 7 of the NPA, would therefore read as follows:

"Newly designed VHF communications transceiver (transmitter/receiver) equipment must meet the MPS requirements of EUROCAE document ED-23C..... dated June 2009".

	This ETSO cancels ETSO-2C37e.....and ETSO-2C38e.....as they are combined and updated in the new ETSO-2C169b".
response	*Partially accepted* EASA agrees to adopt EUROCAE ED-23C as the appropriate MOPS as the "Climax" function is needed to extend the 8.33 kHz channel spacing use different from the proposal. As a consequence, the ETSO is moved to index 2. EASA will use ETSO-2C169a as the ETSO reference indicating technical differences to the FAA standard. In case the FAA will update TSO-C169a as expected by the commenter, we could easily follow by updating the ETSO number.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart A - General p. 12

comment	*4* comment by: *Tenencia Ltd* The removal of RTCA DO-160 will impose additional costs and resources for ETSO applicants, due to additional regulations and compliance issues. Companies will now have to comply with ED-14 and in some instances, for european and international customers, ED-14 and DO-160 for the same product.
response	*Partially accepted* It is well known in the community that it is stated in the foreword of recently published EUROCAE documents when there is a correspondent RTCA or SAE document available and if the content is identical or which main differences exist. EUROCAE is considered as European aviation standardisation organisation by the Commission. Consequently, we are referring to European documents in the first place. To ease readability, we agree to provide reference to other identical standards as well mentioned within the NPA.

comment	*7* comment by: *Cobham Avionics (Communications)* Section 2.1 Environmental Standards The proposed change allows use of the environmental standards in ED-14D, ED-14E or ED-14F for ETSO applications. Does that mean that the applicant is permitted to choose among these options unless a specific document revision is called out in the specific ETSO standard? Do we have to justify our decision, or are we at liberty to select based on our own convenience?
response	*Noted* The approach is understood correctly and no justification is requested. The applicant declares the selected environmental test standard in the DDP. We recommend using the latest revision. The approach is harmonised with the FAA and is in line with the latest TSO template. See as well FAA AC21-16F describing main differences between the environmental standard revisions and potential resulting installation restrictions. During installation it has to be checked if the demonstrated environment meets the expected conditions at the installation location.

comment	*8* comment by: *Cobham Avionics (Communications)* Section 2.1 and 2.3 EASA is removing the reference to RTCA DO-160. Will EASA continue to accept applications where DO-160X has been used to indicate environmental standards, or will it be necessary to generate new paperwork which contains references to the applicable sections of ED-14X? Similarly, the reference to ED-80 doesn't include a reference to DO-254. Will it be necessary to produce new documentation, or can we rely on any existing documentation which refers to DO-254? It is noted that Subpart A para 2.2, which refers to ED-12B and DO-178B has not been changed, so software certification continues to permit use of ED12B or DO-178B.
response	*Accepted* See answer to comment 4.

comment	*9* comment by: *Cobham Avionics (Communications)* Section 2.3 Electronic Hardware The language in Subpart A para 2.3 needs to be reworded. It currently says that the applicant should inform EASA of complex electronic hardware at the time of ETSO application, and EASA will then come up with SOME standards to be applied which may or may not be based on EUROCAE ED-80, and which may or may not be limited to that standard. This wording makes it difficult for an applicant to create a useful plan for developing any avionics product, and allows different standards to be applied to different applicants without justification from the regulatory authority. Either the obligation of the applicant should be clearly specified here or the requirement to use ED-80 should be removed altogether from this NPA.
response	*Accepted* We follow the comment and implement a more stringent requirement in line with the wording used in recent published TSOs. Meanwhile, the EASA Certification Memo MEMO-SWCEH-002 "Electronic Hardware Development Assurance" Issue 1 Rev.: 2 dated 02/06/08 is available providing guidance on when and how ED80/DO-254 is to be used. We limit the applicability to complex custom microcoded components while ED-80/DO254 has extended applicability including circuit board and box level. We recommend providing the Plan for Hardware Aspects of Certification (PHAC) at an early stage of the design.

comment	*11* comment by: *Garmin International* Subpart A - General paragraph 2.4 includes the following statement: "When required, any failure condition should be classified according to the severity of its effect as defined in CS-25 AMC 25.1309." As written, the statement is qualified with "When required," but there is no guidance as to when the qualifier should be applied. Does this mean that CS-25 AMC 25.1309 failure classifications will override the failure classifications already defined by a ETSO? Does this mean that CS-25 AMC 25.1309 failure classifications must be used

even when the appliance is being installed in a CS-23, CS-27 or CS-29 aircraft? In such cases, this could lead to higher failure classifications and higher design assurance than required (e.g., fuel flow failures classifications are not the same on all aircraft types).

Clarify the intent of this statement such that it does not impose a higher failure classification than is required by the actual installation.

response *Accepted*

"When required" has been replaced by "When applicable" as the 1309 approach is not used in all areas, e.g. not for mechanical malfunction due to stress. It is up to the applicant to identify if the failure classification is applicable, and the applicability will be verified during the installation certification latest.

Clarification is added allowing translating the failure classification into a lower DAL level on ETSO level. The reference to AMC 25.1309 is provided for further guidance and identified as such.

comment *81* comment by: *THALES Avionics*

Comment #1 :§2.1

Regarding the environmental standards, it may be necessary, in order to satisfy both ETSO and installation needs, to mix different versions of ED-14 in the qualification program or to supplement ED 14 by specific test conditions.

Proposal :
Delete the note "*it is not permissible* ..."
Replace it by
" *it is permissible to mix versions within a given qualification programme.*
In such case the applicant should identify in the qualification programme and the DDP :
- those tests for which compliance is claimed for the ETSO approval (those test shall not mix ED 14 versions)
- the additional tests or test categories that are out of the scope of the ETSO"

Comment #2 : §2.1
unless otherwise specified, RTCA DO 160 should be accepted as an applicable environmental standard.

Comment #3 : §2.4
The classification of failure condition highly depends on the operational aspects (which functions, which flight phase or which flight condition are considered) and on system design architecture. Therefore, this classification goes beyond the scope of the ETSO project.

Section 3.2.1 of ETSO identifies a failure condition classification that must be considered as a minimum since the actual failure condition may be different depending on the way the equipment is installed and operated.

As a general comment : the §3.2.1 of each ETSO states that "Failure of the function defined in §3.1.1 is of such or such criticality" wheras §3.1.1 does not identify precisely which function is concerned. In addition, several failure conditions (such as loss or misleading) may affect the same function.

The applicant should make assumptions on the failure condition of each function embedded in the article and inform EASA about this classification.
In turn, EASA should review these assumptions (as a miminum, those related to functions covered by the ETSO) and review the safety assessment data accordingly.

Proposal :
The §2.4 should be supplemented as follows. "*If appropriate, the article Plans for Hardware and Software Aspects of Certification should clearly identify the failure condition classification retained by the applicant for the article design*"

response *Partially accepted*

Comment 81.1: Not accepted.
Comment 81.2: Partially Accepted.
Comment 81.3: Partially Accepted.

Comment 81.1: ED-14()/DO-160() includes in Appendix A methods for environmental test identification including a method providing a short form. This whole approach is based on the need to have all testing done in accordance with one revision of the standard to enable proper decoding and linkage to the test condition performed. This does not preclude that additional testing is done using a different revision of the test standard or other test procedures. It is requested to demonstrate compliance to one of the proposed standards. This may be achieved by comparison including potential retesting in special areas.

Comment 81.2: The equivalent revisions of DO-160 to ED-14 will be accepted. See answer to comment 4

Comment 81.3: We agree that in specific cases lower selections of Design Assurance levels are possible and modified the wording accordingly. This introduces the risk that there are installation restrictions as well.

A detailed review of the assumptions on the ETSO level is not possible as the equipment is embedded in the aircraft systems and a proper safety assessment can only be performed on the aircraft system level. As the guidance for the Plans for Hardware and/or Software Aspects of Certification ED-14B respectively ED-80 already require to specify the selected Design Assurance Level, the proposed text is not included in the paragraph.

comment *84* comment by: *Garmin International*

Subpart A - General paragraph 2.3 includes the following statement:

"If the article contains complex electronic hardware, the applicant should inform the EASA at the time of ETSO application in order that the EASA can determine the standards to be applied."

Although there is some "common industry knowledge" regarding the definition of what "complex electronic hardware" is, it would be appropriate to either define it here or add a reference that points to the definition in EUROCAE ED-80.

response *Partially accepted*

Unfortunately ED-80 includes the circuit and box level in its applicability. See answer to comment 9.

comment 85 comment by: *Garmin International*

Subpart A - General paragraph 2.4 includes the following statement:

"To develop system design assurance guidance for failure condition classifications, use EUROCAE document ED-79 "Certification Considerations for Highly-Integrated or Complex Aircraft Systems" dated November 1996."

It is not clear if this statement intends to require the use of ED-79 if design assurance guidance is needed or if it is a permissive statement to reference ED-79. If the former, a prescriptive requirement is not congruent with the notion of "guidance". If the latter it would be appropriate to add the word "may" as follows:

"To develop system design assurance guidance for failure condition classifications, the applicant may use EUROCAE document ED-79 "Certification Considerations for Highly-Integrated or Complex Aircraft Systems" dated November 1996."

Further, it may be appropriate to indicate "or later published revision" after the date reference so that the CS need not be changed to incorporate later versions of the document.

response *Partially accepted*

The proposal is accepted beside the mentioning of future revisions of the document. It is against our policy to recommend something unknown and unverified.

comment 94 comment by: *DRS Technologies*

Is DO-160 still considered to be equivalent to ED-14? Can different versions of ED-14 be applied when product evolution or minor design upgrades necessitates regression testing and requalification to select ED-14 requirements at a newer revision than the original qualification?

response *Partially accepted*

The equivalent revisions of DO-160 to ED-14 will be accepted. See answer to comment 4.

In case of major changes, a new certification basis may be applicable and a different environmental test standard may or must be selected. That standard is then applicable for all tests.

In case of minor changes introducing new part numbers, a change of the originally used environmental test standard requires a justification that a substantially complete investigation is not necessary and may need the approval of a deviation. All tests have to demonstrate meeting one accepted revision of ED-14, e.g. by similarity or by performing more severe test conditions.

In case of no part number change, the approach would only be possible if it

could be demonstrated that the new testing performed is more severe than the originally performed testing. Otherwise existing installation approvals would potentially be invalidated. Please consider that test conditions can be different and not always more severe or interchangeable when considering various revisions of ED-14.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C6e - Direction instrument, magnetic p. 14-15 **(gyroscopically stabilized)**

comment *12* comment by: *Garmin International*

ETSO-C6e paragraph 3.1.1 contains the reference to:

'AS 8013A, "Direction Instruments, Magnetic (Gyroscopically Stabilized)"'

Suggest changing to:

'AS 8013A, "Direction Instrument, Magnetic (Gyroscopically Stabilized)"'

(remove the "s" from "Instruments") to be consistent with actual SAE AS 8013A document title.

response *Accepted*

comment *13* comment by: *Garmin International*

ETSO-C6e paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition."

These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be

	included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance: "Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1." (Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)
response	*Partially accepted* The explanation regarding the translation of failure classification into a Design Assurance Level has been moved to Subpart A of CS-ETSO section 2.4 and further explanation has been added. See resulting text in answer to comment 85.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C8e - Vertical velocity instrument (rate of climb) p. 17-18

comment	*14* comment by: *Garmin International* ETSO-C8e Subject is: "VERTICAL VELOCITY INSTRUMENT (RATE OF CLIMB)" Suggest changing to: "VERTICAL VELOCITY INSTRUMENTS (RATE-OF-CLIMB)" to be consistent with FAA TSO title. Additionally, paragraph 3.1.1 contains the reference to: 'AS 8016A, "Vertical Velocity Instrument (Rate of Climb)"' Suggest changing to: 'AS 8016A, "Vertical Velocity Instrument (Rate-of-Climb)"' to be consistent with actual SAE AS 8016A document title.
response	*Partially accepted* We agree to change to Rate-of-Climb but keep the title consistent with the SAE document title referring to "Instrument".

comment	*15* comment by: *Garmin International* ETSO-C8e paragraph 3.2.1 includes the following: "Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the

system to at least the design assurance level commensurate with this failure condition."

These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance:

"Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)

response *Partially accepted*

The explanation regarding the translation of failure classification into a Design Assurance Level has been moved to Subpart A of CS-ETSO section 2.4 and further explanation has been added. See resulting text in answer to comment 85.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C112c - Air traffic control radar beacon system / mode select (ATCRBS / mode S) airborne equipment p. 22-23

comment *1* comment by: *Becker Flugfunkwerk GmbH*

The ED-73C defines in chapter 3.29 the requirements for ELS compliant transponders.

In chapter 3.29 point c is written:
"In addition, the Mode S transponder must be capable of ACAS operation in accordance with all requirements defined in paragraph 3.27."

Looking into chapter 3.27 we find several requirements. Two of them are:

"Antenna diversity (paragraph 3.16)"
"The ability to interface with ACAS (TCAS Version 7 or higher) compatible units."

In other words it is required that an ELS compliant transponder has: Antenna diversity and an Interface to ACAS equipment.
Becker not belives that it is the intention of EUROCAE or EASA to require such things like Antenna Diversity or ACAS interface for ELS compliant transponders because:
-> it is a very big change and would mean that a lot of transponders flying today in Europe would be not compatible to ELS in the sense of ED-73C.
-> It seems unlikely that for a small aircraft, ACAS is required.

In opinion of Becker a clarification is needed.
May be chapter 3.27 is completly not required for ELS compliant transponder.
Or if chapter 3.27 is partly required for ELS compliant transponder, than it should be clearly specified what subpart of chapter 3.27 is applicable for ELS compliant transponder.

response

Accepted

It is not the intention to require an ACAS interface for all transponders. The following text is added to § 3.1.1 of ETSO-C112c:

The following correction applies to: EUROCAE ED-73C. The paragraph 3.29 c. is extended as follows: "In case the optional ACAS interface is not provided, the transponder must set Bit 16 of the Data Link Capability Report (BDS 1,0) to zero (0) indicating that no ACAS interface is available."

We have informed the responsible EUROCAE Working Group to consider a change in the next revision of ED-73C currently under preparation.

comment

2 comment by: *Becker Flugfunkwerk GmbH*

The broadcast rate for "Extended Squitter Aircraft Status" (Type 28), "Emergency/Priority Status"defined in ED-73C is not compatible to the broadcast rate as defined in DO-260A.

ED-73C chapter 3.28.3 i:
"The "Extended Squitter Aircraft Status" (Type 28), "Emergency/Priority Status" (ADS-B Event – Driven Message Subtype = 1) shall be broadcast at random intervals that are uniformly distributed over the range of 0.8 to 1.2 seconds [...]"

DO-260A document chapter 2.2.3.3.1.4.3 provides quite complex timing for "Extended Squitter Aircraft Status":
"The rate at which the "Extended Squitter Aircraft Status" (TYPE=28), "Emergency/Priority Status" ADS-B Message (SUBTYPE=1) (see §2.2.3.2.7.8) using the Event–Driven protocol **shall** be broadcast, varies depending on whether the "Target State and Status Message" (§2.2.3.2.7.1) with SUBTYPE=0 is not being broadcast, versus being broadcast.

a. In the case where the "Target State and Status Message" with SUBTYPE=0 is not being broadcast, then the "Emergency/Priority Status" **shall** be broadcast at random intervals that are uniformly distributed over the range of 0.7 to 0.9 seconds relative to the previous Emergency/Priority Status Message for the duration of the emergency condition established in accordance with

	Appendix A, Figure A-8, Note 2. b. In the case where the "Target State and Status Message" with SUBTYPE=0 is being broadcast, then the "Emergency/Priority Status" **shall** be broadcast at random intervals that are uniformly distributed over the range of 2.4 to 2.6 seconds relative to the previous Emergency/Priority Status Message for the duration of the emergency condition established in accordance with Appendix A, Figure A-8, Note 2."
response	*Noted* The ADS-B MOPS DO-260A has been recently updated to the harmonised DO-260B/ED-102A. As a follow-on to this activity, ED-73C needs further updating to be in line with the most current ADS-B requirements, and Working Group 49 is tasked to update ED-73C accordingly. Until that update is available, EASA intends to solve the addressed issue by means of deviations, if necessary. The respective section in DO-260B has been changed.

comment	*16* comment by: *Garmin International* ETSO-C112c paragraph 3.2.1 includes the following: "Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition." In this case, it is appropriate to include failure classification/DAL requirement in the ETSO as the transponder failures have the potential to impact aircraft other than the aircraft the appliance is installed on; in other words, the transponder failures have an impact on the airspace as a whole and are not localized to a single aircraft.
response	*Noted*

comment	*17* comment by: *Garmin International* ETSO-C112c paragraph 3.1.1 contains the reference to: 'ED-73C, Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders dated September 2008' Suggest changing to: 'ED-73C, "Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders" dated September 2008.' (add " marks and period) to be consistent with ETSO-C6e and ETSO-C8e references.
response	*Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C123b - Cockpit voice recorder systems p. 24-25

comment	*18* comment by: *Garmin International* ETSO-C123b paragraph 3.1.1 contains a reference to: "EUROCAE document ED-112, dated March 2003" The cover page for the most recently published EUROCAE ED-112 does indicate that it is dated March 2003. However, the cover page also includes the following note: "*This version includes amendment 1 of 25 July, 2003 and amendment 2 of 22 September, 2003*" Does the reference to ED-112 need to also include the references to amendment 1 and amendment 2?
response	*Not accepted* The aim is to harmonise with the FAA. If amendment 1 and 2 were included, that aim would not be reached. We would like to ask the industry in this case to ask for deviations if they want to make use of amendment 1 and/or 2 in the phase of development.

comment	*19* comment by: *Garmin International* ETSO-C123b paragraph 4.2.1 references: "EUROCAE ED112-Chapter 2-1 paragraph 2-11.6.3" This reference should be: "EUROCAE ED112-Chapter 2-1 paragraph 2-1.16.3" (change "2-11.6.3" to "2-1.16.3")
response	*Accepted*

comment	*27* comment by: *Garmin International* ETSO-C123b paragraph 3.2.1 includes the following: "Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition." It is difficult to understand what impact a CVR failure can have on the aircraft, crew or passengers that would drive the determination that the CVR function warrants a minor failure condition instead of no safety effect. However, there may be a desire to require design assurance equivalent to a minor failure condition for other reasons such as ensuring the recorded information is available to assist with an accident investigation. We recommend that no failure classification/DAL requirement be included in the ETSO or at most provide the following general guidance:

"To assist with ensuring recorded information is available for accident investigation, we require the design assurance for the function defined in paragraph 3.1.1 of this ETSO to be commensurate with a minor failure condition even if the installation assesses the equipment failure to have no safety effect."

response *Partially accepted*

A note has been added:
Note: The failure classification is driven by the accident investigation need.

comment *79* comment by: *Garmin International*

ETSO-C123b paragraph 3.1.1 is inconsistent with ETSO-C124b, ETSO-C176 and ETSO-C177 paragraph 3.1.1, all of which include a table that defines the specific ED-112 sections and parts containing the MPS.
Recommend revising ETSO-C123b paragraph 3.1.1 to include the following:

"Table 1 below lists recorder types and the ED-112 section and part containing the MPS for each type:

Table 1. Recorder MPS Requirements

Recorder Type	**ED-112 Reference**
Single CVR	Section 2 and Part I
CVR function in a deployable recorder	Section 2, Section 3 and Part I
CVR function in a combined recorder	Section 2, Section 4, and Part I

response *Accepted*

The proposed change helps to improve readability without implementing changes in the requirements.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C123b - Cockpit voice recorder systems - Appendix 1 - Standards for crash protected enclosure p. 26-28

comment *20* comment by: *Garmin International*

ETSO-C123b Appendix 1 paragraph 1 contains the following phrase:

"Each of the major dimensions must be 5.cm ..."

Suggest changing "5.cm" to "5 cm" in this phrase.

response *Accepted*

comment *21* comment by: *Garmin International*

ETSO-C123b Appendix 1 paragraph 2 contains the following phrase describing the spherical crash enclosure:

"... the diameter of the sphere which must be equal to or greater than 7.5 cm (3.0 inches) because of the, a + b + c >= 23 cm (9 inches), requirement."

7.5 cm in each of the a, b, c dimensions is less than 23 cm. The diameter of the sphere must be equal to or greater than 7.7 cm in each of the dimensions to be >= 23 cm.

If the diameter is changed to 7.7 cm then the same change should be made for the:

"di >= 7.5 cm (3 inches)"

formula next to the figure.

response

Accepted

It was the intent to keep conversion problems as little as possible without implementing unwanted accuracy. Unfortunately, the approach does not work.

comment

22 comment by: *Garmin International*

ETSO-C123b Appendix 1 paragraph 2 includes two instances of an extraneous "a" near the formulae next to the generically shaped crash enclosure figure. These should be removed.

Additionally, there is no figure title under the generically shaped crash enclosure figure. To be consistent with FAA TSO-C123b, the figure title should be "**Figure 5. Crash enclosure is generically shaped.**"

response

Accepted

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C124b - Light data recorder systems p. 29-30

comment

23 comment by: *Garmin International*

ETSO-C124b paragraph 3.1.1 contains a reference to:

"EUROCAE document ED-112, dated March 2003"

The cover page for the most recently published EUROCAE ED-112 does indicate that it is dated March 2003. However, the cover page also includes the following note:

"*This version includes amendment 1 of 25 July, 2003 and amendment 2 of 22 September, 2003*"

Does the reference to ED-112 need to also include the references to amendment 1 and amendment 2?

response

Not accepted

See response to comment 18.

comment *24* comment by: *Garmin International*

ETSO-C124b paragraph 4.2.1 references:

"EUROCAE ED112-Chapter 2-1 paragraph 2-11.6.3"

This reference should be:

"EUROCAE ED112-Chapter 2-1 paragraph 2-1.16.3"

(change "2-11.6.3" to "2-1.16.3")

response *Accepted*

comment *28* comment by: *Garmin International*

ETSO-C124b paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition."

It is difficult to understand what impact a FDR failure can have on the aircraft, crew or passengers that would drive the determination that the FDR function warrants a minor failure condition instead of no safety effect. However, there may be a desire to require design assurance equivalent to a minor failure condition for other reasons such as ensuring the recorded information is available to assist with an accident investigation.

We recommend that no failure classification/DAL requirement be included in the ETSO or at most provide the following general guidance:

"To assist with ensuring recorded information is available for accident investigation, we require the design assurance for the function defined in paragraph 3.1.1 of this ETSO to be commensurate with a minor failure condition even if the installation assesses the equipment failure to have no safety effect."

response *Partially accepted*

See response to comment 27.

comment *78* comment by: *Garmin International*

ETSO-C124b paragraph 3.1.1 includes the following (with ***emphasis***):

"Table 1 below lists recorder types and the ED-112 ***chapter*** and part containing the MPS for each type:

Table 1. Recorder MPS Requirements

Recorder Type	**ED-112 Reference**
Single FDR	***Chapter*** 2 and Part II
FDR function in a deployable recorder	***Chapter*** 2, ***Chapter*** 3 and Part II

FDR function in a combined recorder	***Chapter*** 2, ***Chapter*** 4, and Part II

Recommend changing "chapter" to "section" (1 instance) and "Chapter" to "Section" (5 instances) when referring to ED-112 specifics so that there is consistency with the ED-112 table of contents. See also ETSO-C176 paragraph 3.1.1 which makes correct references to ED-112 specifics.

response *Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C124b - Light data recorder systems - p. 31-33 **Appendix 1 - Standard for crash protected enclosure**

comment *25* comment by: *Garmin International*

ETSO-C124b Appendix 1 paragraph 1 contains the following phrase:

"Each of the major dimensions must be 5.cm ..."

Suggest changing "5.cm" to "5 cm" in this phrase.

response *Accepted*

comment *26* comment by: *Garmin International*

ETSO-C124b Appendix 1 paragraph 2 contains the following:

"Paint the crash enclosure according to CS 23.1457(g), 25.1457(g), 27.1457(g), or 29.1457(g) ..."

Each of the instances (4) of "1457" should be changed to "1459" to be consistent with the CS regulations for Flight Data Recorders.

response *Accepted*

comment *29* comment by: *Garmin International*

ETSO-C124b Appendix 1 paragraph 2 contains the following phrase describing the spherical crash enclosure:

"... the diameter of the sphere which must be equal to or greater than 7.5 cm (3.0 inches) because of the, a + b + c >= 23 cm (9 inches), requirement."

7.5 cm in each of the a, b, c dimensions is less than 23 cm. The diameter of the sphere must be equal to or greater than 7.7 cm in each of the dimensions to be >= 23 cm.

If the diameter is changed to 7.7 cm then the same change should be made for the:

"di >= 7.5 cm (3 inches)"

formula next to the figure.

response	*Accepted*

comment	*30* comment by: *Garmin International* ETSO-C124b Appendix 1 paragraph 2 includes two instances of an extraneous "a" near the formulae next to the generically shaped crash enclosure figure. These should be removed. Additionally, there is no figure title under the generically shaped crash enclosure figure. To be consistent with FAA TSO-C124b, the figure title should be "**Figure 5. Crash enclosure is generically shaped.**"
response	*Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C135a - Minimum performance specification for large aeroplane wheels, brakes, and wheel and brake assemblies - Appendix 2 - Chapter 1 - Introduction p. 55-58

comment	*70* comment by: *Airbus SAS* Airbus editorial comments on ETSO-C135a: For consistency reasons, - in Appendix 2, Chapter 1.4.30, in the term "KERT", the letters "RT" should be written in subscript style like in "VRT" at the beginning of the sentence, and - in appendix 2, Chapter 1.4.31, in the term "KESS", the letters "SS" shouild be written in subscript style like in "VSS" at the beginning of the sentence.
response	*Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C139 - Aircraft audio systems and equipment p. 72-73

comment	*6* comment by: *Cobham Avionics (Communications)* ETSO-C139 Aircraft Audio Systems and Equipment The draft of ETSO-C139 includes the text of a deviation that has been accepted by EASA in section 3.1.1 (deviation for crosstalk RTCA/DO-214 sections 2.8.2.7.1 and 2.8.2.7.2). The result is that the ETSO and FAA TSO are not identical, which appears to go against the intent of harmonizing regulations where ever practical. Additionally Transport Canada have adopted TSO-C139 without change as the airworthiness standard for CANTSO-C139, so the CANTSO and ETSO also differ. Additional information: The deviation has been accepted by the FAA NY ACO. It has also bee reviewed by TCCA and accepted against FAA TSO-C139 (but it has not been considered against CANTSO-C139).
response	*Noted* We consider the clarification as necessary to define a proper requirement. We have not classified the ETSO as different from the FAA TSO-C139 since the basic requirements are the same and not all applicants will need the deviation

as the related paragraph may not be applicable for each case. By removing the clarification each case need to process a deviation to clarify the unclear requirement.

comment 31 comment by: *Garmin International*

ETSO-C139 paragraph 3.1.1 includes the following reference:

"In sub-paragraph 2.8.7.2.1"

This reference should be:

"In sub-paragraph 2.8.2.7.1"

(change "2.8.7.2.1" to "2.8.2.7.1")

response *Accepted*

comment 32 comment by: *Garmin International*

ETSO-C139 paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition."

These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance:

"Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be

	appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)
response	*Accepted* See response to comment 85.

comment	*33* comment by: *Garmin International* ETSO-C139 paragraph 4.2 should include the following below the header to be consistent with other ETSOs: "None"
response	*Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C144a - Passive airborne global navigation satellite system (GNSS) antenna p. 74-75

comment	*34* comment by: *Garmin International* ETSO-C144a paragraph 3.2.1 includes the following: "Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition." These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems. Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary. It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation. As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance: "Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)

response *Accepted*

See response to comment 85.

comment *35* comment by: *Garmin International*

ETSO-C144a paragraph 4.2 includes the following:
"
At least one major component must be permanently and legibly marked with the operational equipment class as defined in Section 1.4.2 of RTCA document DO-229D (e.g., Class 2). A marking of Class 4 indicates compliance to Delta-4 requirements. The functional equipment class defined in Section 1.4.1 of RTCA document DO-229D (e.g. Gamma, Delta) is not required to be marked.

It is sufficient to declare the proper functional equipment class in the DDP.
"
ETSO-C144a paragraph 3.1.1 indicates the Minimum Performance Standard is RTCA/***DO-228*** not RTCA/***DO-229D***. It is inappropriate to impose DO-229D operational class marking requirements because the DO-228 antenna can be used by all of the DO-229D operational classes. Furthermore, FAA TSO-C144a does not impose these marking requirements.

Recommend restoring the ETSO-C144a paragraph 4.2 guidance to:

"None"

response *Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C145c - Airborne navigation sensors using the global positioning system augmented by the satellite based augmentation system p. 76-77

comment *36* comment by: *Garmin International*

ETSO-C145c paragraph 1 suggests the following revisions:

"... (GPS) augmented ~~by the Wide Area~~ Satellite Based ..."

Recommend not deleting the phrase "by the" from the quoted text.

response *Accepted*

comment *37* comment by: *Garmin International*

ETSO-C145c paragraph 3.2.1 includes the following:
"
Failure of the function defined in paragraph 3.1.1 of this ETSO is a:

· *Major* failure condition for loss of function and malfunction of en route,

terminal, approach lateral navigation (LNAV), and approach LNAV/vertical navigation (VNAV) position data,

· *Major* failure condition for loss of function of approach localiser performance without vertical guidance (LP), and approach localiser performance with vertical guidance (LPV) position data, and

· *Hazardous* failure condition for malfunction of approach (LP and LPV) position data.

The applicant must develop the system to, at least, the design assurance level commensurate with these failure conditions
"
These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance:

"Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)

response

Partially accepted

See response to comment 85.

comment

38 comment by: *Garmin International*

ETSO-C145c paragraph 4.2 includes the following:

"It is sufficient to declare the proper functional equipment class in the DDP."

It is not necessary to declare a functional equipment class in the DDP. The combination of ETSO-C145c and operational equipment class are sufficient to

	define the functional equipment class. E.g., a marking of ETSO-C145c Class 1 implies the Beta functional equipment class. Recommend removing this sentence.
response	*Not accepted* Some AMC material e.g. AMc 20-27 is referring to the functional classes. 21A.608 (a) 6 requires declaring the level of compliance.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C145c - Airborne navigation sensors using the global positioning system augmented by the satellite based augmentation system - Appendix 1 - MPS for airborne navigation sensors using GPS augmented by SBAS p. 78-79

comment	*39* comment by: *Garmin International* ETSO-C145c Appendix 1 paragraph 1.a contains three uses of the phrase "(IExt, Test)". In each of these phrases, the text should be "($I_{Ext,\ Test}$)" (subscript "Ext, Test") to be consistent with FAA TSO-C145c Appendix 1 modifications to RTCA/DO-229D and the original text in RTCA/DO-229D.
response	*Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C146c - Stand alone airborne navigation equipment using the global positioning system augmented by the satellite based augmentation system p. 80-82

comment	*40* comment by: *Garmin International* ETSO-C146c paragraph 1 suggests the following revisions: "... ~~Global Positioning System (GPS)~~ Airborne Navigation Sensors ..." Recommend restoring the text to its original form; i.e., retaining "Global Positioning System (GPS)" and removing "Airborne Navigation Sensors". As written, this implies that ETSO-C146c equipment must use ETSO-C145c equipment as the source of position, velocity and time (PVT) information, which is not the case since ETSO-C146c equipment is defined as "Stand Alone".
response	*Accepted*

comment	*41* comment by: *Garmin International* ETSO-C146c paragraph 3.2.1 includes the following: " Failure of the function defined in paragraph 3.1.1 of this ETSO is a: · *Major* failure condition for loss of function and malfunction of en route,

terminal, approach lateral navigation (LNAV), and approach LNAV/vertical navigation (VNAV) position data,

· *Major* failure condition for loss of function of approach localiser performance without vertical guidance (LP), and approach localiser performance with vertical guidance (LPV) position data, and

· *Hazardous* failure condition for malfunction of approach (LP and LPV) position data.

The applicant must develop the system to, at least, the design assurance level commensurate with these failure conditions
"
These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance:

"Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)

response

Partially accepted

See response to comment 85.

comment

42 comment by: *Garmin International*

ETSO-C145c paragraph 4.2 includes the following:

"It is sufficient to declare the proper functional equipment class in the DDP."

It is not necessary to declare a functional equipment class in the DDP. The combination of ETSO-C146c and operational equipment class are sufficient to

	define the functional equipment class. E.g., a marking of ETSO-C146c Class 1 implies the Gamma functional equipment class; a marking of ETSO-C146c Class 4 implies the Delta functional equipment class. Recommend removing this sentence.
response	*Not accepted* Some AMC material, e.g. AMC 20-27 is referring to the functional classes. 21A.608(a)6 requires to declare the level of compliance.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C146c - Stand alone airborne navigation equipment using the global positioning system augmented by the satellite based augmentation system - Appendix 1 - MPS for stand-alone airborne navigation equipment using GPS augmented by SBAS p. 83-84

comment	*43* comment by: *Garmin International* ETSO-C146c Appendix 1 paragraph 1.a contains three uses of the phrase "(IExt, Test)". In each of these phrases, the text should be "($I_{Ext, Test}$)" (subscript "Ext, Test") to be consistent with FAA TSO-C146c Appendix 1 modifications to RTCA/DO-229D and the original text in RTCA/DO-229D.
response	*Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C155 - Recorder independent power supply p. 85-86

comment	*44* comment by: *Garmin International* ETSO-C155 paragraph 3.2.1 includes the following: "Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition." It is difficult to understand what impact a recorder independent power supply (RIPS) failure can have on the aircraft, crew or passengers that would drive the determination that the RIPS function warrants a minor failure condition instead of no safety effect. However, there may be a desire to require design assurance equivalent to a minor failure condition for other reasons such as ensuring the recorded information is available to assist with an accident investigation. We recommend that no failure classification/DAL requirement be included in the ETSO or at most provide the following general guidance: "To assist with ensuring recorded information is available for accident investigation, we require the design assurance for the function defined in paragraph 3.1.1 of this ETSO to be commensurate with a minor failure

	condition even if the installation assesses the equipment failure to have no safety effect.”
response	*Partially accepted* See response to comment 85.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C155 - Recorder independent power supply - Appendix 1 - Minimum performance standard (MPS) for recorder independent power supply (RIPS) p. 87-89

comment	*45* comment by: *Garmin International* ETSO-C155 Appendix 1 table item 4. Maintenance Warning contains the following: "Resistance greater than 100,000 ohms or voltage greater that 18 V_{DC} (36VDC Max ..." Recommend changing this text to: "Resistance greater than 100,000 ohms or voltage greater than 18 V_{DC} (36V_{DC} Max) ..." (change "that" to "than", subscript DC in phrase "36VDC" and add close parenthesis after "Max").
response	*Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C155 - Recorder independent power supply - Appendix 2 - Environmental qualification equipment category/class p. 90

comment	*95* comment by: *DRS Technologies* Heading "…ED() Category…" implies that OEM may select ED-14D, E or F as desired. Is this a correct interpretation?
response	*Noted* The interpretation is correct. In paragraph 3.1.2 reference is made to CS-ETSO Subpart A paragraph 2.1. In that paragraph, it is defined that it is up to the applicants' selection which version of ED-14 is used within the given restrictions. Once a revision is selected, that revision has to be used for all tests.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C165 - Electronic MAP display equipment for graphical depiction of aircraft position p. 91-92

comment	*46* comment by: *Garmin International*

	ETSO-C165 paragraph 3.2.1 includes the following: " Failure of the functions defined in paragraph 3.1.1 of this ETSO for Electronic Map Displays used in flight and VSD equipment (airborne applications) have been determined to be a major failure condition for malfunctions causing the display of misleading information. Loss of function for Electronic Map Displays used in flight and VSD equipment (airborne applications) have been determined to be a minor failure condition. Failure of the function defined in paragraph 3.1.1 of this ETSO for Electronic Map Displays used on the airport surface (ground applications) have been determined to be a minor failure condition for malfunctions causing the display of misleading information. Loss of function for Electronic Map Displays used on the airport surface (ground applications) is determined to be a no safety effect failure condition. The applicant must develop the system to at least the design assurance level commensurate with these failure conditions. " These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems. Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary. It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation. As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance: "Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1." (Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)
response	*Partially accepted* See answer to comment 85.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C169 - VHF radio communications transceiver equipment operating withing the radio frequency range 117.975 to 137.000 Megahertz p. 93-94

comment *47* comment by: *Garmin International*

ETSO-C169a paragraph 3.1.1 contains a reference to:

"EUROCARE document ED-23B ... dated March 1995"

Recommend correcting "EUROCARE" to "EUROCAE".

Also, the cover page for the most recently published EUROCAE ED-23B does indicate that it is dated March 1995. However, the cover page also includes the following note:
"
Edition n° 3 : Amendement # 1, 2 and 3 are included in the text. For information they are also attached to the document.
"
Does the reference to ED-23B need to also include the references to amendments 1, 2 and 3?

response *Partially accepted*

The typing error is corrected. Instead of referencing ED-23B, ED-23C will be referenced. This ETSO is renumbered to ETSO-2C169a, refer to the answer to comment 91.

comment *48* comment by: *Garmin International*

ETSO-C169a paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition."

These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the

required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance:

"Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)

response *Partially accepted*

See answer to comment 85. This ETSO is renumbered to ETSO-2C169a, refer to the answer to comment 91.

comment *90* comment by: *NATS*

Attachment #1

The following comments in response to NPA No 2009-11 are submitted on behalf of NATS and also in the capacity as former secretary of the EuroCAE 8.33 CLIMAX Task Force (TF) - responsible for the publication of ED-23C (June 2009).

The 8.33 CLIMAX TF was formed in 2007 with the brief to up-issue ED-23B to accomodate CLIMAX multi-carrier operation with 8.33kHz voice channel spacing.
TORs for the TF were subsequently broadened by the EuroCAE Technical Council in order to address generic issues affecting 25kHz CLIMAX operation as follows:-

* Spontaneous receiver muting in the presence of multiple RF carriers (below Carrier Override threshold)
* Weak and distorted audio in the presence of multiple RF carriers of near equal amplitude

These above issues are widespread and generic to both Civil and Military CLIMAX operations as a result of harmonised and equivalent MOPS standards e.g. DO-186, NATO STANAG 4205 etc.

Multiple reports of 'Loss of Communication' are being filed by civil and military users throughout Europe in areas utilising CLIMAX multi-carrier transmissions.
NATS has issued 'Safety Notice EXT 3 / 2007 - Loss of Communication and the Multi-Carrier Effect' (see attached) in response to the perceived safety hazard.

In response to the NPA, NATS would recommend in the strongest possible terms the adoption of **ED-23C (June 2009) in preference to ED-23B (March 1995).**

Additional benefits inherent in the adoption of ED-23C are the wider potential

rollout of 8.33kHz channel operation in UK airspace if 8.33 CLIMAX operation is implemented. Initial estimates suggest that approximately 20, 25kHz CLIMAX channels in use for intermediate altitude area coverage could be converted to 8.33kHz CLIMAX operation.
This would result in approximately 40, 8.33kHz frequencies being released for re-use across Europe.

The detailed comments below, provided by Mr Tom Perry at the UK CAA(SRG) are fully endorsed by NATS.

1. The CAA recognises and appreciates the need for harmonised standards but EASA should be aware that FAA TSO C169a, identified on page 7 of NPA 2009-11, was re-issued at the specific request of the UK CAA. The reason for our request was the urgent need to address, and correct, the omission of a test for the feature described (in ED-23B) as "Receiver Muting". The incorporation and adjustment of this function is vital to ensure that the aircraft transceiver will operate successfully in the presence of an offset-carrier transmission on an Air Traffic Control (ATC) frequency. The need to test, and if necessary, adjust this feature was unfortunately absent from the relevant RTCA MOPS for many years and European airlines were expected to either pay to have this feature adjusted by the manufacturer or subsequent to delivery either by their in-house avionic workshop or by the manufacturers' representative in Europe because the "Receiver Muting" function was described as a "Customer Preference" feature.

2. It should also be remembered that incorporation of the requirement for "Receiver Muting" into TSO-169a, in September 2007, merely brought the RTCA MOPS into line with Eurocae document (ED-23B) which was first published in March 1995 (i.e more than 12 years earlier). Equipment built to comply with TSO-169a would also ensure adequate performance in the presence of an 8.33 channel which became mandatory for communication above FL 195 wef July 2008. This was communicated to all European ATC providers via the Single European Sky (SES) Implementing Rule for "Voice Channel Spacing" (EC) 1265/2007.

3. However paragraph 4 of Article 3 in (EC) 1265/2007 states that this requirement " shall not apply to sectors where 25 kHz offset-carrier is utilised". But this statement merely reflects the fact that modern aircraft transceivers were designed to comply with "Receiver Class E" in ED-23B and "to be used in a 8.33 kHz channel separation environment but NOT intended for off-set carrier operation".

4. So in 2007 Eurocontrol was aware that the continued use of off-set carrier in 25 kHz channels would be a serious limiting factor in their desire to increase the usage of 8.33 and thereby to release more spectrum for re-use elsewhere in Europe. *(Please note that the "gap" between Class E and Class H is fully explained in the text of ED-23C)*. A Eurocae Task Force was therefore established in 2008 to investigate and prepare any additional text which might be required to ensure adequate performance from an aircraft transceiver which was a) intended to receive a voice transmission using the now well established 8.33 kHz channel spacing and b) when this transmission was broadcast simultaneously from two ATC ground stations.

5. This technique, known as "Climax in 8.33", was devised and researched by several ATC providers in order to increase the number of ATC frequencies which might be transferred from a 25 kHz frequency assignment to an 8.33

voice channel. The Task Force comprised of experts drawn from avionics manufacturers, from Europe and the United States plus representatives from European regulators and ATC service providers. The final document issued as ED-23C in June 2009, includes two new classes of airborne receivers (H1 & H2) and the expectation is that a majority of 8.33 transceivers will probably meet the requirements for H1. But since "Climax in 8.33" utilises a much reduced frequency separation (just 5 kHz) between to two contributing and collaborative carrier signals, it is important that the transceiver manufacturers should test and if successful, endorse their receivers for operation in Class H1.

6. Eurocae endeavoured to work closely with RTCA SC-172 during the preparation of ED-23C and the Task Force have recommended that the FAA TSO should be revised to reflect the new requirements in ED-23C. This would suggest that the FAA TSO be re-issued as '169b and the recommendation from the UK CAA is therefore that, with respect to the proposal regarding "VHF Radio Communication Transceiver Equipment Operating Within the Radio Frequency Range 117.975 to 137.000 Megahertz", a new (combined) ETSO-2C169b, based upon ED-23C should be issued.

7. The resulting (new) text and rationale currently shown on page 7 of the NPA, would therefore read as follows:

"Newly designed VHF communications transceiver (transmitter/receiver) equipment must meet the MPS requirements of EUROCAE document ED-23C..... dated June 2009".

This ETSO cancels ETSO-2C37e.....and ETSO-2C38e.....as they are combined and updated in the new ETSO-2C169b".

response

Accepted

This ETSO is renumbered to ETSO-2C169a, refer to the answer to comment 91.

comment

92 comment by: *DSNA/DTI*

Off-set carrier operation in 25kHz channel:
DSNA experiences many loss of voice communication in airspace where Off-set/multi-carrier signals in 25 kHz channels are operated. Such hazard are very critical in terms of safety as the contact with the aircraft can not be maintained for several minutes.
Technical studies have proven that this safety issue is due to an inappropriate working of the airborne receiver in presence of off-set carriers (climax environment).
The working in climax environment is currently addressed in the ED-23B with the "Receiver muting" requirement. Nevertheless, operation and additional laboratory experiments have proved that the compliance with such requirement is not sufficient to ensure a safe use of off-set carriers: despite that the VHF ground stations radiate an ICAO compliant electric field (75 µV/m), loss of contact with ED-23B class C receiver (which are to be used in a 25 kHz channel separation environment and intended for off-set carrier operation with two to five carriers) is still likely.
Aware of this safety issue, the Eurocae Task Force, in charge of introducing new receiver classes for operation in off-set carrier 8.33 kHz environment, took the opportunity to also improve the requirements applicable to class C

receivers (introduction of multi-carrier sensitivity and multi-carrier distortion). Compliance with the ED-23C class C receiver will ensure a much safer use of climax in 25 kHz.
As off-set carriers operation is the most efficient mean to provide ATS in lower airspace and in mountainous region, it is very important to ensure that its use is safe.

Off-set carrier operation in 8.33 kHz channel:
In 2007, Eurocontrol ran a detailed study about the potential vertical extension of the usage of 8.33 channels below FL 195. One of the results of this study was that the continued use of off-set carrier in 25 kHz channels below FL195 would be a serious limiting factor in their desire to increase the usage of 8.33 and thereby to release more spectrum for re-use elsewhere in Europe.
A Eurocae Task Force, comprising experts drawn from avionics manufacturers, from Europe and the United States plus representatives from European regulators and ATC service providers, was created to introduce "climax in 8.33" in the ED-23 document.
The final document issued as ED-23C in June 2009, includes thus two new classes of airborne receivers (H1 & H2) and the expectation is that a majority of **current** 8.33 transceivers will probably meet the requirements for H1.

Consequently, as compliance with ED-23C will, in the short term make the use of climax in 25 kHz safer, and will also pave the way to a future vertical extension of 8.33 channels, DSNA strongly recommends to refer ED-23C instead of ED-23B in the proposed ETSO C169a.

response *Accepted*

This ETSO is renumbered to ETSO-2C169a, refer to the answer to comment 91.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C176 - Aircraft cockpit image recorder systems p. 95-96

comment *49* comment by: *Garmin International*

ETSO-C176 paragraph 3.1.1 contains a reference to:

"EUROCAE document ED-112, ... dated March 2003"

The cover page for the most recently published EUROCAE ED-112 does indicate that it is dated March 2003. However, the cover page also includes the following note:

"*This version includes amendment 1 of 25 July, 2003 and amendment 2 of 22 September, 2003*"

Does the reference to ED-112 need to also include the references to amendment 1 and amendment 2?

response *Accepted*

The FAA TSO references the most current version and includes the amendments.

comment 50 comment by: *Garmin International*

ETSO-C176 paragraph 3.1.1 includes the following:

"... except that compliance with ED-112 chapters 2-5, 3-4, and 5-6 are not required for this ETSO."

ETSO-C123b and ETSO-C124b that also use ED-112 as their Minimum Performance Specification include the following exclusion:

"*Recorder start and stop times, Chapter 2-1.5.* Start and stop times must comply with applicable operational regulations."

Are there operational regulations for Cockpit Image Recorders which would warrent including this exclusion in ETSO-C176?

Additionally, ETSO-C123b and ETSO-C124b that also use ED-112 as their Minimum Performance Specification include the following exclusion:

"A*ll ED-112 requirements* for aircraft level equipment installation, test, and maintenance."

Part III is referenced in the ETSO-C176 3.1.1 table and Part III includes Installation, test, and maintenance requirements. Suggest including the following exclusion in ETSO-C176:

"A*ll ED-112 requirements* for aircraft level equipment installation, test, and maintenance."

response *Partially accepted*

So far no specific operational requirements for cockpit image recorders have been developed. The OPS regulation is still in the transition to become EASA material.

Installation related requirements were excluded.

comment 52 comment by: *Garmin International*

ETSO-C176 paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraph 3.1.1 depends on the aircraft installation. The applicant must develop the system to at least the design assurance level commensurate with this failure condition classification in the table below:

Classifications of Failure Conditions for Recorders	
Recorder type	**Failure Classification**
Single CIR	Minor
CIR function in deployable recorder	Major
CIR function in combined recorder function:	

· Aeroplane or rotorcraft with two recorders	Minor
· Rotorcraft with one combined recorder	Major

It is concerning that the ETSO-C176 CIR failure table includes a major failure condition as this is entirely inconsistent with the proposed ETSO-C123b, ETSO-C124b, ETSO-C155 and ETSO-C177 worst-case failure conditions.

Additionally, it is difficult to understand what impact a CIR failure can have on the aircraft, crew or passengers that would drive the determination that the CIR function warrants a minor failure condition, let alone a major failure condition, instead of no safety effect. However, there may be a desire to require design assurance equivalent to a minor failure condition for other reasons such as ensuring the recorded information is available to assist with an accident investigation.

We recommend that no failure classification/DAL requirement be included in the ETSO or at most provide the following general guidance:

"To assist with ensuring recorded information is available for accident investigation, we require the design assurance for the function defined in paragraph 3.1.1 of this ETSO to be commensurate with a minor failure condition even if the installation assesses the equipment failure to have no safety effect."

response *Not accepted*

In this specific case, the failure classification is not driven from the aircraft system level but from the accident investigation need. The following note is added:

Note: The failure classification is driven by the accident investigation need.

comment *96* comment by: *DRS Technologies*

Deployable CIR will be a second redundant recorder, thus shouldn't its failure classification be "Minor"?

response *Not accepted*

Deployable recording does have specific aspects and we want to keep harmonised with the FAA.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C177 - Data link recorder systems p. 97-98

comment *53* comment by: *Garmin International*

ETSO-C177 paragraph 3.1.1 contains a reference to:

"EUROCAE document ED-112 ... dated March 2003"

The cover page for the most recently published EUROCAE ED-112 does indicate that it is dated March 2003. However, the cover page also includes the following note:

"*This version includes amendment 1 of 25 July, 2003 and amendment 2 of 22 September, 2003*"

Does the reference to ED-112 need to also include the references to amendment 1 and amendment 2?

response *Not accepted*

The FAA TSO references only the initial revision of the document.

comment *54* comment by: *Garmin International*

ETSO-C177 paragraph 3.1.1 includes the following:

"... except that compliance with ED-112 chapters 2-5, 3-4, and 5-6 are not required for this ETSO."

ETSO-C123b and ETSO-C124b that also use ED-112 as their Minimum Performance Specification include the following exclusion:

"*Recorder start and stop times, Chapter 2-1.5.* Start and stop times must comply with applicable operational regulations."

Are there operational regulations for Data Link Recorders which would warrent including this exclusion in ETSO-C177?

Additionally, ETSO-C123b and ETSO-C124b that also use ED-112 as their Minimum Performance Specification include the following exclusion:

"A*ll ED-112 requirements* for aircraft level equipment installation, test, and maintenance."

Part IV is referenced in the ETSO-C177 3.1.1 table and Part IV includes Installation, test, and maintenance requirements. Additionally, TSO-C177 includes the following blanket statement:

"NOTE: Requirements pertaining to aircraft level equipment installation, test, and maintenance are not minimum operational performance specifications for DLR systems. Therefore, they have been excluded."

Suggest including the following exclusion in ETSO-C177:

"A*ll ED-112 requirements* for aircraft level equipment installation, test, and maintenance."

response *Accepted*

comment *55* comment by: *Garmin International*

ETSO-C177 paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition."

It is difficult to understand what impact a DLR failure can have on the aircraft, crew or passengers that would drive the determination that the DLR function warrants a minor failure condition instead of no safety effect. However, there may be a desire to require design assurance equivalent to a minor failure condition for other reasons such as ensuring the recorded information is available to assist with an accident investigation.

We recommend that no failure classification/DAL requirement be included in the ETSO or at most provide the following general guidance:

"To assist with ensuring recorded information is available for accident investigation, we require the design assurance for the function defined in paragraph 3.1.1 of this ETSO to be commensurate with a minor failure condition even if the installation assesses the equipment failure to have no safety effect."

response *Partially accepted*

"Note: The failure classification is driven by the accident investigation need." has been added.

comment *77* comment by: *Garmin International*

"The table below lists recorder types and the ED-112 ***chapter*** and part containing the Minimum Performance Specification for each:

Recorder MPS Requirements, Excluding Aircraft Level Requirements	
Recorder Type	ED-112 Reference
Single DLR	***Chapter*** 2 and Part IV
DLR function in a deployable recorder	***Chapter*** 2, ***Chapter*** 3 and Part IV
DLR function in a combined recorder	***Chapter*** 2, ***Chapter*** 4 and Part IV

"

Recommend changing "chapter" to "section" (1 instance) and "Chapter" to "Section" (5 instances) when referring to ED-112 specifics so that there is consistency with the ED-112 table of contents. See also ETSO-C176 paragraph 3.1.1 which makes correct references to ED-112 specifics.

response *Accepted*

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-C190 - Active airborne global navigation satellite systems (GNSS) antenna p. 99-100

comment *56* comment by: *Garmin International*

ETSO-C190 paragraph 3.1.1 contains the following phrase:

"This ETSO standard apply to ..."

Recommend revising this to:

"This ETSO's standard applies to ..."

response *Partially accepted*

Standard deleted and paragraph moved to paragraph 1 'applicability'.

comment *57* comment by: *Garmin International*

ETSO-C190 paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraphs 3.1.1 of this ETSO constitutes a loss of navigation which is a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition."

Per ETSO-C190 paragraph 3.1.1, ETSO-C190 antennas may be "intended to receive and provide signals to global positioning system (GPS)/satellite based augmentation system (SBAS) sensors or systems of all operational classes, and GPS/ground based augmentation system (GBAS) sensors or systems that will provide flight path deviation commands to the pilot or autopilot." However, there may be other suitable uses for ETSO-C190 antennas that are not related to navigation like ADS-B position information. Consequently, the major failure condition associated with a loss of navigation may not be applicable for all installations.

Further, the ETSO-C190 paragraph 3.2.1 statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance:

"Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)

response *Partially accepted*

See answer to comment 85.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-2C48a - Carbon monoxide detector instruments p. 101-102

comment *58* comment by: *Garmin International*

ETSO-2C48a paragraph 1.1 contains the following:

"This ETSO gives the requirements for carbon monoxide detector instruments, which are manufactured on or after the date of this ETSO, must meet in order to be identified with the applicable ETSO marking."

For consistency with other ETSOs, recommend revising this to:

"This ETSO gives the requirements which new models of carbon monoxide detector instruments that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking."

response *Accepted*

New text is used for revised standards.

comment *59* comment by: *Garmin International*

ETSO-2C48a paragraph 3.2.1 includes the following:

"Failure of the function defined in paragraphs 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition."

These statements mean the failure condition classification of an appliance is determined by the ETSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems.

Unless the DAL can not be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA utimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary.

It is possible to build and certify a ETSOA appliance that can not be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets an ETSO DAL does not mean it can be approved for installation.

As such, we recommend that no failure classification/DAL requirement be included in an ETSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3.2.1 in this ETSO to the following general guidance:

"Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3.1.1."

(Note that ETSO-C112c is an example where a classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)

response

Partially accepted

See response to comment 85.

comment

60 comment by: *Garmin International*

ETSO-2C48a paragraph 4.1 proposes to change the text to:

"At least one major component permanently and legibly must be marked as detailed in CS-ETSO Subpart A paragraph 1.2"

For consistency with other ETSOs, recommend restoring this to:

"Marking is detailed in CS-ETSO Subpart A paragraph 1.2"

response

Accepted

comment

61 comment by: *Garmin International*

ETSO-2C48a paragraph 4.2 proposes numerous changes to the text which are better suited to installation manual , flight manual, or pilot's guide than to equipment marking.

In particular, paragraph 4.2.1 indicates "The packaging ... must make it clear which categories of aircraft ...". Other ETSOs indicate such information via an equipment class, which is proposed in ETSO-2C48a paragraph 1.2.

For consistency with other ETSOs, recommend revising paragraph 4.2 to:

"The component must be permanently and legibly marked with the equipment class as defined in paragraph 1.2 of this ETSO."

and moving the remainder of the proposed paragraph 4.2 text to an appendix on installation guidance, if such an appendix must be provided.

response

Accepted

The resulting new section 7 to Appendix 1 reads:

7 – Documentation

The supplier shall provide written guidance in the following areas:

7.1 - Operation

General description including the principle of operation including:

- Details of and interpretation of warnings.
- Details of and interpretation of test indications.
- Limitations.
- Battery changing procedure if applicable.

Action in the event of receiving a warning

Suggest generic actions helping the installer defining appropriate AFM procedures.

7.2 - Installation

The installation instruction must make it clear which categories of aircraft the instrument is suitable for, and any restrictions in its use must also be clearly stated.

A general description of

- the optimum position for the instrument in different aircraft types and
- the positions to be avoided to ensure reliable air sampling and to avoid compass interference.

7.3 – Continued Airworthiness

Cleaning and other instructions as required.

comment

65 comment by: *Garmin International*

ETSO-2C48a paragraph 1.2 defines two types of detector instruments. Both of the types of instruments envisioned include "their own ... warning system".

However, some existing CO monitoring instruments are connected to an integrated cockpit that provides the actual visual and aural warnings when CO is detected.

Recommend revising paragraph 1.2 to define a Type C instrument that does not have its own warning system but provides an output that can be used to trigger a visual and aural warning when CO is detected. This will also require revising the Appendix 1 requirements accordingly.

response

Partially accepted

No new type is defined as the incomplete system approach would allow using Type B for the described case. The requirements are modified to allow the use of multiple boxes for the equipment without implementing detailed requirements.

B. DRAFT DECISION - I Draft Decision CS-ETSO - Subpart B - List of ETSO (Index 1 and Index 2) - ETSO-2C48a - Carbon monoxide detector instruments - Appendix 1 - Minimum performance standard p. 103-106

comment 62 comment by: *Garmin International*

ETSO-2C48a Appendix 1 paragraph 1 includes the following:

"a. The Instrument shall trigger its own visual and aural warnings when CO is detected."

In some aircraft, the CO monitoring instrument is connected to an integrated cockpit that provides the actual visual and aural warnings when CO is detected. Recommend revising this to:

"a. The Instrument shall have the capability to trigger a visual and aural warning when CO is detected."

response *Partially accepted*

The new text reads: The Instrument shall trigger visual and aural warnings when CO is detected.

comment 63 comment by: *Garmin International*

ETSO-2C48a Appendix 1 paragraph 2 includes the following:

"a. There shall be a flashing AMBER indication, visible within the angle shown in Figure 1 below, whenever any of the criteria, described in Table 1, are met."

In some aircraft, the CO monitoring instrument is connected to an integrated cockpit that provides the actual visual indication. Furthermore, this indication may be configured to be displayed in either amber or red depending upon the aircraft's cockpit philosophy. Lastly, the Figure 1 visibility requirements are installation requirements that are outside the scope of an MPS but must be addressed in installation manual.

Recommend revising this to:

"a. Type A and Type B instruments shall provide a flashing caution or warning indication whenever any of the criteria described in Table 1 are met."

Also recommend moving Figure 1 to an appendix on installation guidance, if such an appendix must be provided and including the following in that appendix:

"The installation manual must include guidance that requires the caution or warning indication to be installed such that it is visible within the angle shown in Figure 1."

response *Partially accepted*

The use of warning together with amber indication is inconsistent; consequently, all warning is reworded to be alarm. An amber light is considered a caution indication and an adequate classification for the situation.

comment 64 comment by: *Garmin International*

ETSO-2C48a Appendix 1 Figure 1 shows a 100 degree range to the left and right of normal to the face of the display screen. At most, there are 180 degrees in the entire viewing plane.

Recommend revising Figure 1 so that the viewing angle is consistent with other MPS which are less stringent and are able to be met with existing display technology. Specifically, recommend 35 degrees to the left and right of normal to the face of the display screen. This will make the ETSO-2C48a Appendix 1 requirement consistent with the draft ETSO-C146c MPS requirement via RTCA/DO-229D 2.2.1.1.4.3, which states:

"All displays shall be fully readable up to a horizontal viewing angle of 35 degrees from normal to the face of the display screen."

The 35 degrees viewing angle is more stringent than the 30 degree viewing angle that several other ETSOs require; specifically:

ETSO-C2d via SAE AS 8019A paragraph 3.2.5
ETSO-C3d via SAE AS 8004 paragraph 3.7
draft ETSO-C6e via SAE AS 8013A paragraph 3.10.2
draft ETSO-C8e via SAE AS 8016A paragraph 3.2.4

Also, what does the term "NB!" mean in the box at the lower right of the figure? Recommend removing "NB!" or replacing with text that is not an abbreviation.

response *Accepted*

2 times 100 degree would lead to 200 degree viewing angle which is behind the instrument and quite difficult to reach.

comment *66* comment by: *Garmin International*

ETSO-2C48a Appendix 1 paragraph 3 includes the following:
"
a. Self test:

Both types of unit should have a function indicator which illuminates showing that a self test of the instrument has been successfully completed. The test should confirm as many of the functions as possible.

b. Battery Power test. TYPE A only

The TYPE A unit shall provide the pilot with a steady visual indication that there is 5 hours or less of useful battery power remaining. If there is less than 2 hours left, the visual indication should be made to flash.
"
In some aircraft, the CO monitoring instrument is connected to an integrated cockpit that provides the actual visual indications. Recommend revising these requirements so that they do not assume the equipment includes the visual indication capability.

response *Not accepted*

The incomplete system approach may be used in this case. In the described case, the display system is from a Type B as it is not powered by the internal battery. A pure Type A system is working independently from aircraft power and would be able to identify a risk even if the aircraft is not operational.

B. DRAFT DECISION - II Draft Decision AMC and GM to Part-21 p. 108-110

comment	*71* comment by: *Garmin International* AMC 21A.608 Standard Form header uses the terms for DDP identification: " DDP No. ..... ISSUE No. ..... " Suggest not being prescriptive about identification terms as companies do not use the same terms. For example, many companies will use a "Drawing Number" and "Revision" in lieu of the terms used in AMC 21A.608.
response	*Not accepted* AMC 21.608 has been understood by industry in the past to be an example and no issues regarding the DDP numbering have been brought up in the past.

comment	*72* comment by: *Garmin International* AMC 21A.608 item 2 includes "Modification Standard" as part of the Description and identification of the article". Is this equivalent to the "Modification Status" used by many companies? If so, an article typically uses this modification status to include multiple modifications that are better described in the Installation Manual. Suggest removing "Modification Status" and/or allowing a reference to the Installation Manual. Additionally, item 2 includes "Master drawing record". While an installation may typically include a Master Drawing number and revision, a Master Drawing is not typical for an appliance. It would be helpful to be less prescriptive about the content of item 2 to allow for the differences between company methods and types of products and appliances.
response	*Not accepted* Historically Modification Standard is interpreted as the description of foreseen variants, especially how minor and major changes in the context of 21A.611 are identified. As such, changes in the part number and introductions of new part numbers within the open bracket are expected to update the DDP. The master drawing record is used by industry to identify all drawing forming the definition of the approved system to allow tracing from that part to each subcomponent. In the TSO system the list of all drawings and processes (including revision level) that define the article's design is requested instead while we request only a reference to that document.

comment	*73* comment by: *Garmin International* AMC 21A.608 item 3 should also allow for Installation Manual as the "Specification reference".
response	*Not accepted* The Installation manual is not a requirement document but a function description.

comment	*74* comment by: *Garmin International* AMC 21A.608 item 9 should allow for a reference to the Environmental Qualification Form (EQF) rather than having to copy all of the EQF information into the DDP.
response	*Not accepted* We allow providing a reference to the Equipment Qualification Form as demanded in several TSOs but would like to remind applicants of which kind of information is expected as not only avionics manufacturer are requested to provide a DDP.

comment	*75* comment by: *Garmin International* AMC 21A.608 item 9 example b states: "b. For radio transmitters the transmitting frequency band, maximum transmitting power, and modulation identifier." The term "modulation identifier" is typically called an "Emission Designator".
response	*Accepted*

comment	*76* comment by: *Garmin International* AMC 21A.608 item 10 is followed by a note that states: (NOTE: Software levels are those defined in the current issue of EUROCAE ED–12B.) Recommend changing "ED-12B" to "ED-12" to as the note indicates the "Software levels are those defined in the ***current issue***" (***emphasis*** added). Making this change will also make the AMC 21A.608 item 10 NOTE consistent with the AMC 21A.608 item 11 NOTE.
response	*Partially accepted* Wording modified to mention the applicable issue of ED-12, respectively ED-80.

comment	*80* comment by: *THALES Avionics* Item 9 - Thales agrees with the proposed modification of the DDP template regarding the environmental qualification section. The NOTE to §8.a should be modified as follows : the "sections and categories" referred to are listed ... , instead of "the categories referred to are listed..." Item 10 : Software criticality. The word "criticality" is not appropriate for software. The proper wording is "software level"

	Item 11 : Complex hardware criticality. Replace "criticality of complex hardware" by "design assurance level of complex hardware" Even if compliance to ED-80 is not required by the corresponding standard, if this compliance has been assessed by a competent authority, the statement of Design Assurance Level can be put on the certificate. The sentence should be modified as follows : *A statement of Design Assurance level of complex hardware if required by the corresponding ETSO standard.* *If Design Assurance for complex hardware is not required by the corresponding ETSO, a statement indicating whether complex hardware is embedded or not in the product, or, optionally, a statement of Design Assurance Level if compliance has been assessed by a competent authority.*
response	*Partially accepted*

comment	*93* comment by: *Cobham Avionics (Communications)* The NOTE beneath the new section a. needs to be re-worded. There are no '"categories" referred to' in this AMC. Suggested re-wording: NOTE: The manufacturer should list environmental categories for each of the sections of the issue of EUROCAE ED-14 that was used to qualify the article. The NOTE beneath section 10 refers to "current issue", but then specifies a specific issue of EUROCAE ED-12**B**. Suggested re-wording: NOTE: The manufacturer should state the software level to which the software contained in the article was developed as defined in the current issue of EUROCAE ED-14.
response	*Accepted*

Appendix A – Resulting text

I Draft Decision CS-ETSO

SUBPART A – GENERAL

2.1 Environmental standards:

Unless otherwise stated in the paragraph 3.1.2 of the specific ETSO, the applicable environmental standards are contained in EUROCAE/RTCA document ED-14D change 3/DO-160D change 3 "Environmental Conditions and Test Procedures for Airborne Equipment", ~~change 3~~ dated December 2002, or ED-14E/DO-160E dated March 2005 or ED-14F/DO-160F dated March 2008.

It is not permissible to mix versions within a given qualification programme.

2.2 Software standards:

….

2.3 Electronic Hardware

If the article contains a complex Application-Specific Integrated Circuit (ASIC) or complex programmable logic (e.g. Programmable Array Logic components (PAL), Field-Programmable Gate Array components (FPGA), General Array Logic components (GAL), or Erasable Programmable Logic Devices) summarised as Complex Hardware to accomplish the function, develop the component according to EUROCAE/RTCA document ED-80/DO-254 "Design Assurance Guidance for Airborne Electronic Hardware", dated April 2000. All Complex Hardware included in the article definition must be developed in accordance with EUROCAE/RTCA document ED-80/DO-254.

2.4 Failure condition classification

When applicable, any failure condition should be classified according to the severity of its effect. For further guidance see AMC 25.1309.

To develop system design assurance guidance for failure condition classifications, the applicant may use EUROCAE/SAE document ED-79/ARP 4754 "Certification Considerations for Highly-Integrated or Complex Aircraft Systems" dated November 1996.

Develop the system to, at least, the design assurance level equal to the failure condition classifications provided in the ETSO. Development to a lower Design Assurance Level may be justified for certain cases and accepted during the ETSO process but will lead to installation restrictions.

3. Additional Information

EUROCAE documents may be purchased from:

European Organisation for Civil Aviation Equipment
102 rue Etienne Dolet – 92240 Malakoff - France.
Telephone: +33 1 40 92 79 30; FAX +33 1 46 55 62 65;
(e-mail: eurocae@eurocae.net - web site: www.eurocae.~~eu~~net).

SUBPART B – LIST OF ETSO (INDEX 1 AND INDEX 2)

INDEX 1

ETSO-C6~~d~~e	Direction Instrument, Magnetic (Gyroscopically Stabilized)	
ETSO-C8~~d~~e	Vertical Velocity Instrument (Rate-of-Climb)	
ETSO-C39~~b~~c	Aircraft Seats and Berths Certified by Static Testing only	
~~ETSO-C48~~	~~Carbon Monoxide Detector Instruments~~	
~~ETSO – C50c~~	~~Audio Selector Panels and Amplifiers~~	Cancelled
~~ETSO – C57a~~	~~Headsets and Speakers~~	Cancelled
~~ETSO – C58a~~	~~Aircraft Microphones~~	Cancelled
ETSO-C112c	Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/ MODE S) Airborne Equipment	
ETSO-C123~~a~~b	Cockpit Voice Recorders Systems	
ETSO-C124~~a~~b	Flight Data Recorder Systems	
ETSO-C135a	~~Transport~~ Large Aeroplane Wheels and Wheel and Brake Assemblies	
ETSO-C139	Aircraft Audio Systems and Equipment	
ETSO-C144a	Passive Airborne Global Navigation Satellite System (GNSS) Antenna	
ETSO-C145c	Airborne Navigation Sensors Using the Global Positioning System ~~(GPS)~~ Augmented by the ~~Wide Area~~ Satellite Based Augmentation System ~~(WAAS)~~	
ETSO-C146c	Stand Alone Airborne Navigation Equipment Using the Global Positioning System ~~(GPS)~~ Augmented by the ~~Wide Area~~ Satellite Based Augmentation System ~~(WAAS)~~	
ETSO-C155	Recorder Independent Power Supply	
ETSO-C165	Electronic Map Display Equipment for Graphical Depiction of Aircraft Position	
ETSO-C176	Crash Protected Airborne Recorder Systems Image Recorder	
ETSO-C177	Crash Protected Airborne Recorder Systems CNS/ATM Recorder	
ETSO-C190	Active Airborne Global Navigation Satellite System (GNSS) Antenna	

INDEX 2

~~ETSO-2C37e~~	~~VHF Communication Transmitting Equipment Operating within Radio Frequency Range 117.975 to 137 MHz~~	Cancelled
~~ETSO-2C38e~~	~~VHF Communication Receiving Equipment Operating within Radio Frequency Range 117.975 to 137 MHz~~	Cancelled
ETSO-2C48a	Carbon Monoxide Detector Instruments	
~~ETSO-2C112b~~	~~Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/MODE S) Airborne Equipment~~	
ETSO-2C169a	VHF Radio Communications Transceiver Equipment Operating Within the Radio Frequency Range 117.975 to 137.000 Megahertz	

ETSO-C6~~d~~e

~~**Date: 24.10.03**~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: DIRECTION INSTRUMENT, MAGNETIC (GYROSCOPICALLY STABILIZED)

1 – Applicability

This ETSO gives the requirements which new models of direction instruments, magnetic (gyroscopically stabilized) that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1. – General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - General

3.1.1 - Minimum Performance Standard

Standards set forth in the SAE Aerospace Standard (AS) document: AS-8013A, "Direction Instrument, Magnetic (Gyroscopically Stabilized)", dated ~~June 1983~~ September 1996, as modified by **Appendix 1** of this ETSO.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 – Specific

~~None~~

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition.

ETSO-C6e

4 - Marking

4.1 – General

Marking is detailed in CS-ETSO Subpart A, paragraph 1.2

4.2 - Specific

None. Clarification: SAE AS 8013A paragraph 3.15 is not applicable.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

ETSO-C6e
Appendix 1

APPENDIX 1

MODIFICATION TO MPS FOR DIRECTION INSTRUMENT, MAGNETIC (GYROSCOPICALLY STABILISED)

Modify AS8013A as follows:

SAE AS8013A reference:	***Replace with:***
Section 3.4: Except for small parts (such as knobs, fasteners, seals, grommets, and small electrical parts) that would not contribute significantly to the propagation of a fire, all materials must be self-extinguishing when tested in accordance with the requirements of Federal Aviation Regulation 25.1359 (d) and Appendix F thereto, with paragraph (b) of Appendix F or may be configured as used.	Except for small parts (knobs, fasteners, seals, grommets, and small electrical parts) that do not contribute significantly to the propagation of a fire, all materials must be self-extinguishing when tested according to EASA CS 25.869(a). See further to Appendix F, Part I (b)(2), *Specimen configuration,* for current requirements.

ETSO-C8~~d~~e

~~Date: 24.10.03~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

SUBJECT: VERTICAL VELOCITY INSTRUMENT (RATE-OF-CLIMB)

1 – Applicability

This ETSO gives the requirements which new models of vertical velocity instruments that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in the SAE Aerospace Standard (AS) document: AS 8016A "Vertical Velocity Instrument (Rate-of-Climb)" ~~reaffirmed October 1984~~ dated September 1996.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 – Specific

~~None~~

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition.

ETSO-C8e

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2.

4.2 – Specific

See SAE AS 8016 paragraph 1.2

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

There are no changes from comments to the proposed ETSO-C39c or Appendix 1.
Refer to NPA 2009-11.

ETSO-~~2~~C112~~b~~c

~~Date: 18.07.06~~
Date: xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order

Subject: AIR TRAFFIC CONTROL RADAR BEACON SYSTEM/MODE SELECT (ATCRBS/MODE S) AIRBORNE EQUIPMENT

1 - Applicability

This ETSO gives the requirements which airborne Mode S air traffic control (ATC) transponder equipment that is manufactured on or after the date of this ETSO, must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart ~~O~~A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - General

3.1.1 - Minimum Performance Standard

Standards set forth in EUROCAE document ED-73~~B~~C, ~~'MOPS for Mode S Transponders' dated January 2003~~ "Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders" dated September 2008.

The following correction applies to: EUROCAE ED-73C. The paragraph 3.29 c. is extended as follows: "In case the optional ACAS interface is not provided, the transponder must set Bit 16 of the Data Link Capability Report (BDS 1,0) to zero (0) indicating that no ACAS interface is available."

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3.

3.2 – Specific

~~None~~

3.2.1 - Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 - Specific

~~None~~ See EUROCAE ED-73C paragraph 1.4.2.2.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C123~~a~~b

~~**Date: 24.10.03**~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: COCKPIT VOICE RECORDER SYSTEMS

1 – Applicability

This ETSO gives the requirements that new models of cockpit voice recorder systems that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in ~~EUROCAE document ED-56A chapter 2, 3, 4, 5, and 6, dated October 1993, with amendment 1 dated 25 November 1997, as amended and supplemented by this ETSO.~~the applicable sections of EUROCAE document ED-112, dated March 2003 that pertain to the CVR type, as modified by **Appendix 1** of this ETSO, except:

a) *Recorder start and stop times, Section 2-1.5:* Start and stop times must comply with applicable operational regulations.

b) Recorder location, Section 2-5.4.1: Recorder location must comply with applicable EASA Certification Specifications.

c) Equipment Installation and Installed Performance (Deployable recorders) Section 3-4.

d) Equipment Installation and Installed Performance, Part I-6.

e) Other ED-112 requirements for installation, flight testing, aircraft maintenance, and others that do not pertain to MPS specific criteria.

The first two exceptions above to ED-112 are related to compliance with the operational regulations and certification specifications. The last three items are exceptions to requirements for installation, flight testing, aircraft maintenance, and others that do not pertain to MPS criteria specific to the ETSO equipment.

Table 1 below lists recorder types and the ED-112 Section and Part containing the MPS for each type:

Table 1. Recorder MPS Requirements

Recorder Type	ED-112 Reference
Single CVR	Section 2 and Part I
CVR function in a deployable recorder	Section 2, Section 3 and Part I
CVR function in a combined recorder	Section 2, Section 4, and Part I

See Appendix 1 for size, shape, and identification standards for crash protected enclosures.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3.

3.2 – Specific

~~None~~

3.2.1 - Failure Condition Classification

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to be at least the design assurance level commensurate with this failure condition.

Note: The failure classification is driven by the accident investigation need.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

~~None~~

4.2.1 - Lettering

EUROCAE ED112-Section 2-1 paragraph 2-1.16.3 requires the lettering on the recorder to be at least 25 mm in height. Where it is considered impractical to incorporate lettering of this height due to the size of the recorder case, the applicant may propose an alternative height provided that the size is adequate in relation to the size of the unit and allows easy readability.

4.2.2 - Marking recommendation

Marking in French: "ENREGISTREUR DE VOL NE PAS OUVRIR" is optional.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C123b
Appendix 1

APPENDIX 1

STANDARDS FOR CRASH PROTECTED ENCLOSURE

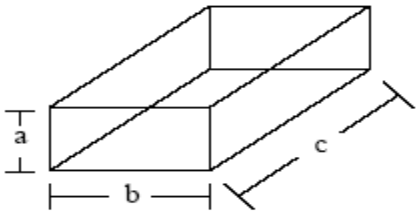
1 - Physical Size.

As technology allows for increased miniaturisation, manufacturers continue to shrink the crash enclosure. Now, the enclosure can be very difficult to find in wreckage. The sum of the height (a), width (b), and depth (c) of the crash enclosure must be 23 cm (9 inches) or greater. Each of these major dimensions must be 5 cm (2 inches) or greater. Here are five examples of a crash enclosure and the minimum required dimensions:

NOTE: The dimensions of the crash protected enclosure shall not include the underwater locator beacon (ULB) or its attachment hardware.

2 - Identification.

Paint the crash enclosure according to CS 23.1457(g), 25.1457(g), 27.1457(g), or 29.1457(g) and mark in accordance with paragraph 4 of this ETSO.

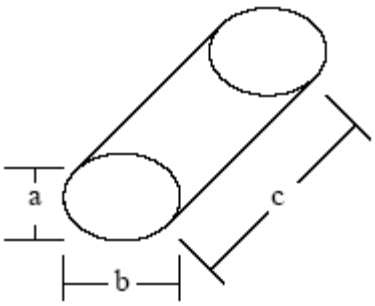


a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 1. Crash enclosure shaped like a rectangular prism.

Apply minimum dimensions to the major axis (a), minor axis (b), and length (c) of the enclosure.

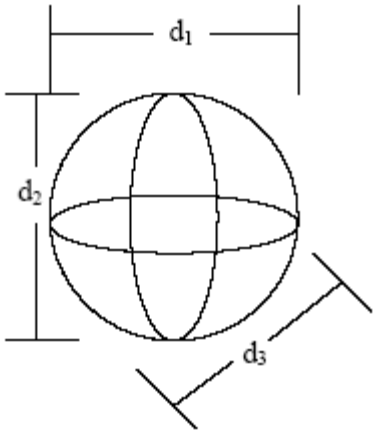


a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 2. Crash enclosure shaped like an elliptical cylinder.

Height, width, and depth are all equal to the diameter of the sphere which must be equal to or greater than 7.7 cm (3.0 inches) because of the, a + b + c >= 23 cm (9 inches), requirement.

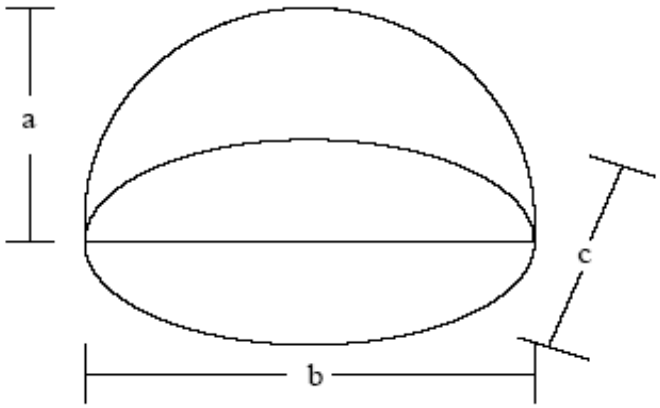


di >= 7.7 cm (3 inches)

$d_1+d_2+d_3$>= 23 cm (9 inches)

Figure 3. Crash enclosure shaped like a sphere.

Dimensions a, b, and c are not necessarily equal

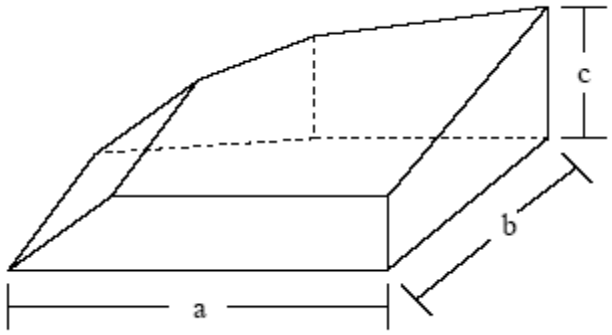


a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 4. Crash enclosure shaped like an ellipsoid hemisphere.

Width (a) is the largest width of the enclosure, depth (b) is the largest depth of the enclosure and height (c) is the largest height of the enclosure. Take each of these major dimensions from the outer surface of the enclosure. Do not include any protrusions such as mounting flanges or plates.



a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 5. Crash enclosure is generically shaped.

ETSO-C124~~a~~b

~~**Date: 24.10.03**~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: FLIGHT DATA RECORDER SYSTEMS

1 – Applicability

This ETSO gives the requirements that new models of flight data recorder systems that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

~~Standards set forth in EUROCAE document ED-55 dated May 1990 with amendment 1 dated 23 September 1998, as amended and supplemented by this ETSO.~~

Standards set forth in the applicable sections of EUROCAE document ED-112, dated March 2003 that pertain to the FDR type, as modified by **Appendix 1** of this ETSO, except:

The ED-112 exceptions below are due to conflicts with operational regulations and EASA Certification specifications. The following are exceptions to the ED-112 part and to the sections in table 1 below.

As part of this ETSO, compliance is not required for:

a) *Recorder start and stop times, Section 2-1.5.* Start and stop times must comply with applicable operational regulations.

b) *Recorder location, Section 2-5.4.1.* Recorder location must comply with applicable EASA Certification Specifications.

c) *Recorder parameters, Annex II-A.* Recorder parameters must comply with applicable operational regulations.

d) *All ED-112 requirements* for aircraft level equipment installation, test, and maintenance.

Table 1 below lists recorder types and the ED-112 Section and Part containing the MPS for each type:

ETSO-C124b

Table 1. Recorder MPS Requirements

Recorder Type	ED-112 Reference
Single FDR	Section 2 and Part II
FDR function in a deployable recorder	Section 2, Section 3 and Part II
FDR function in a combined recorder	Section 2, Section 4, and Part II

See Appendix 1 for size, shape, and identification standards for crash protected enclosures.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 – Specific

~~None~~

3.2.1 Failure Condition Classification

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to be at least the design assurance level commensurate with this failure condition.

Note: The failure classification is driven by the accident investigation need.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

~~None~~

4.2.1 - Lettering

EUROCAE ED112-Section 2-1 paragraph 2-1.16.3 requires the lettering on the recorder to be at least 25 mm in height. Where it is considered impractical to incorporate lettering of this height due to the size of the recorder case, the applicant may propose an alternative height provided that the size is adequate in relation to the size of the unit and allows easy readability.

4.2.2 - Marking recommendation

Marking in French: "ENREGISTREUR DE VOL NE PAS OUVRIR" is optional.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C124b
Appendix 1

APPENDIX 1

STANDARDS FOR CRASH PROTECTED ENCLOSURE

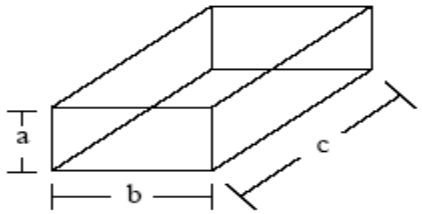
1 - Physical Size.

As technology allows for increased miniaturisation, manufacturers continue to shrink the crash enclosure. Now, the enclosure can be very difficult to find in wreckage. The sum of the height (a), width (b), and depth (c) of the crash enclosure must be 23 cm (9 inches) or greater. Each of these major dimensions must be 5 cm (2 inches) or greater. Here are five examples of a crash enclosure and the minimum required dimensions:

NOTE: The dimensions of the crash protected enclosure shall not include the underwater locator beacon (ULB) or its attachment hardware.

2 - Identification.

Paint the crash enclosure according to CS 23.1459(g), 25.1459(g), 27.1459(g), or 29.1459(g) and mark in accordance with paragraph 4 of this ETSO.

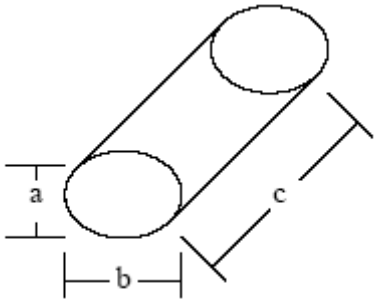


a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 1. Crash enclosure shaped like a rectangular prism.

Apply minimum dimensions to the major axis (a), minor axis (b), and length (c) of the enclosure.

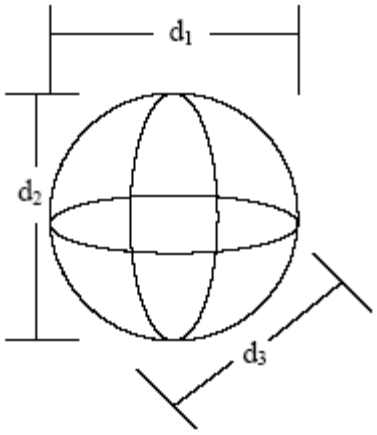


a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 2. Crash enclosure shaped like an elliptical cylinder.

Height, width, and depth are all equal to the diameter of the sphere which must be equal to or greater than 7.7 cm (3.0 inches) because of the, a + b + c >= 23 cm (9 inches), requirement.

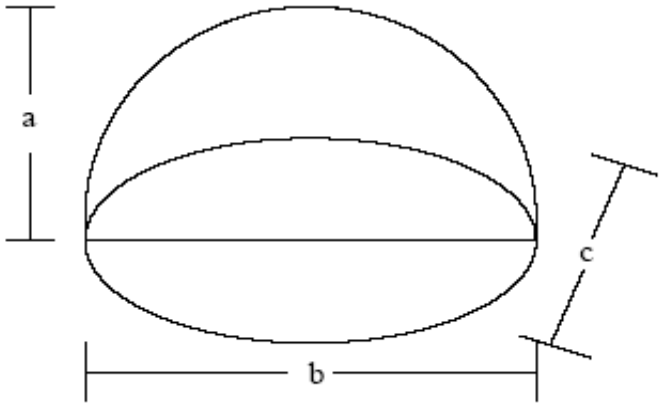


di >= 7.7 cm (3 inches)

$d_1+d_2+d_3$>= 23 cm (9 inches)

Figure 3. Crash enclosure shaped like a sphere.

Dimensions a, b, and c are not necessarily equal

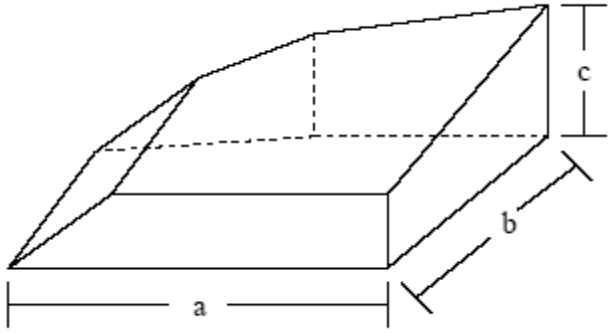


a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 4. Crash enclosure shaped like an ellipsoid hemisphere.

Width (a) is the largest width of the enclosure, depth (b) is the largest depth of the enclosure and height (c) is the largest height of the enclosure. Take each of these major dimensions from the outer surface of the enclosure. Do not include any protrusions such as mounting flanges or plates.



a, b, c >= 5 cm (2 inches)

a+b+c>= 23 cm (9 inches)

Figure 5. Crash enclosure is generically shaped.

ETSO-C135a

There are no changes from comments to the proposed ETSO-C135a and Appendices from NPA 2009-11 except for the following paragraphs to Appendix 2

APPENDIX 2.

MPS FOR LARGE AEROPLANE WHEEL AND BRAKE ASSEMBLIES FOR ELECTRICALLY ACTUATED BRAKES

….

1.4.30 V_{RT} – wheel/brake accelerate-stop speed

V_{RT} is the initial brakes-on speed used to demonstrate KE_{RT} in paragraph 3.3.3 of this Appendix 2.

1.4.31 V_{SS} - wheel/brake most severe landing stop speed

V_{SS} is the initial brakes-on speed used to demonstrate KE_{SS} in paragraph 3.3.4 of this Appendix 2.

….

ETSO-C139

Date: xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AIRCRAFT AUDIO SYSTEMS AND EQUIPMENT

1 – Applicability

This ETSO gives the requirements which new models of aircraft audio systems and associated equipment that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

This ETSO cancels ETSO-C50c "Audio Selector Panels and Amplifiers", ETSO-C57a "Headsets and Speakers" and ETSO-C58a "Aircraft Microphones".

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in section 2 of the RTCA document DO-214 "Audio Systems Characteristics and Minimum Performance Standards for Aircraft Audio Systems and Equipment" dated March 2, 1993, with the following clarifications:

In sub-paragraph 2.8.2.7.1 Input-to-Output Crosstalk and Bleed-Through Levels: V_{ref} will be defined as the rated output level of the monitored output in lieu of the rated input.

In sub-paragraph 2.8.2.7.2 Input-to-Input Crosstalk: V_{ref} will be defined as the rated input level of the monitored input.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

None

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C144a

~~**Date: 24.10.03**~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: PASSIVE AIRBORNE GLOBAL ~~POSITIONING~~ NAVIGATION SATELLITE SYSTEM (GNSS) ANTENNA

1 – Applicability

This ETSO gives the requirements ~~that new models of~~ which new models of passive airborne ~~global positioning system antenna~~ Global Navigation Satellite System (GNSS) Antenna that are manufactured on or after the date of this ETSO must meet in order to be identified with applicable ETSO marking.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in ~~Section 2 of~~ RTCA document ~~RTCA/~~DO-228, "Minimum Operational Performance Standards for ~~Airborne~~ Global Navigation Satellite Systems (GNSS) Airborne Antenna Equipment" dated October 20, 1995, Section 2 (excluding Sections 2.2.2 and 2.4.3) and Change 1 to DO-228.

Note 1: For Active Airborne Global Navigation Satellite System (GNSS) Antenna, see ETSO-C190

Note 2: The ETSO standards herein apply to equipment intended to receive and provide signals to a global positioning system (GPS)/satellite based augmentation system (SBAS) operational Class 1, or GPS, sensor or system that will provide flight path deviation commands to the pilot or autopilot. These standards do not address the use of the signals received through this antenna for other applications. GPS/SBAS operational classes are defined in RTCA document DO-229D "Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment", dated December 13, 2006, Section 1.4.2.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

ETSO-C144a

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 – Specific

~~None~~

3.2.1 - Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2.

4.2 – Specific

None

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

ETSO- C145c

~~**Date: 24.10.03**~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AIRBORNE NAVIGATION SENSORS USING THE GLOBAL POSITIONING SYSTEM ~~(GPS)~~ AUGMENTED BY THE SATELLITE BASED ~~WIDE AREA~~ AUGMENTATION SYSTEM ~~(WAAS)~~

1 – Applicability

This ETSO gives the requirements ~~that~~ which new models of airborne navigation sensors using the Global Positioning System (GPS) augmented by the ~~Wide Area~~ Satellite Based Augmentation System ~~(WAAS)~~(SBAS) that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

The standards of this ETSO apply to equipment intended to provide position information to a navigation management unit that outputs deviation commands referenced to a desired flight path~~.~~, ~~These deviations will be used by the~~ Pilots or autopilots will use these deviations to guide the aircraft. ~~These standards do not address integration issues with other avionics, such as the potential for the sensor to inadvertently command an autopilot hardover. These standards also do not address the use of position information for other applications such as automatic dependent surveillance.~~

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 – Basic

3.1.1 - Minimum Performance Standard

~~Airborne navigation sensors using GPS augmented by WAAS that are to be so identified must meet the minimum performance standards for Class Beta equipment set forth in Section 2 of RTCA/DO-229A, "Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Equipment", dated June 8, 1998, as amended and supplemented by this ETSO.~~

~~Class Beta equipment is defined in Section 1 of RTCA/DO-229A.~~

Standards set forth for functional equipment Class Beta in RTCA document DO-229D, Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment dated December 13, 2006, Section 2, except as modified in **Appendix 1** of this ETSO.

Class Beta equipment is defined in DO-229D, Section 1.4.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 – Specific ~~Failure Condition Classification~~

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph ~~1~~ 3.1.1 of this ETSO ~~has been determined to be~~ is a:

· ~~a~~ *Major* failure condition for loss of function and malfunction of en route, terminal, ~~or nonprecision approach position data~~ approach lateral navigation (LNAV), and approach LNAV/vertical navigation (VNAV) position data,

· ~~a~~ *Major* failure condition for loss of function of ~~precision~~ approach ~~position data~~ localiser performance without vertical guidance (LP), and approach localiser performance with vertical guidance (LPV) position data, and

· ~~and a~~ *Hazardous* failure condition for ~~the~~ malfunction of ~~precision~~ approach (LP and LPV) position data.

~~The applicant must develop the system to, at least, the design assurance level commensurate with this hazard classification these failure conditions~~

3.3. - Functional qualifications.

~~The required performance shall be demonstrated under the test conditions specified in RTCA/DO-229A, Section 2.5. The use of test procedures other than those specified in Sections 2.5.2 through 2.5.9 of RTCA/DO-229A constitutes a deviation to this ETSO.~~None

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

~~In addition, the following requirements apply to all separate components of equipment that are~~

~~manufactured under this ETSO :~~

~~- The operational equipment class as defined in Section 1.4.2 of RTCA/DO-229A (e.g., Class 2).~~

~~- When applicable, identification that the article is an incomplete system or that the article accomplishes additional functions beyond that described in paragraph 1 of this ETSO.~~

At least one major component must be permanently and legibly marked with the operational equipment class as defined in Section 1.4.2 of RTCA document DO-229D (e.g., Class 2). A marking of Class 4 indicates compliance to Delta-4 requirements. The functional equipment class defined in Section 1.4.1 of RTCA document DO-229D (e.g. Gamma, Delta) is not required to be marked.

It is sufficient to declare the proper functional equipment class in the DDP.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C145c
Appendix 1

APPENDIX 1

MPS for airborne navigation sensors using GPS augmented by SBAS

1. This appendix prescribes EASA modifications to the MPS for functional equipment Class Beta in RTCA document DO-229D, Section 2. Operational Class 3 equipment already complies with the MPS changes below. These MPS changes apply for operational Class 1 or Class 2 equipment only.

a Section 2.5

Section 2.5.6.1, Scenario #1, Step 3)

Change step 3) to read: "Broadband external interference noise ($I_{Ext, Test}$) of spectral density equal to -170.5 dBm/Hz at the antenna port."

Section 2.5.6.1, Scenario #2, Step 4)

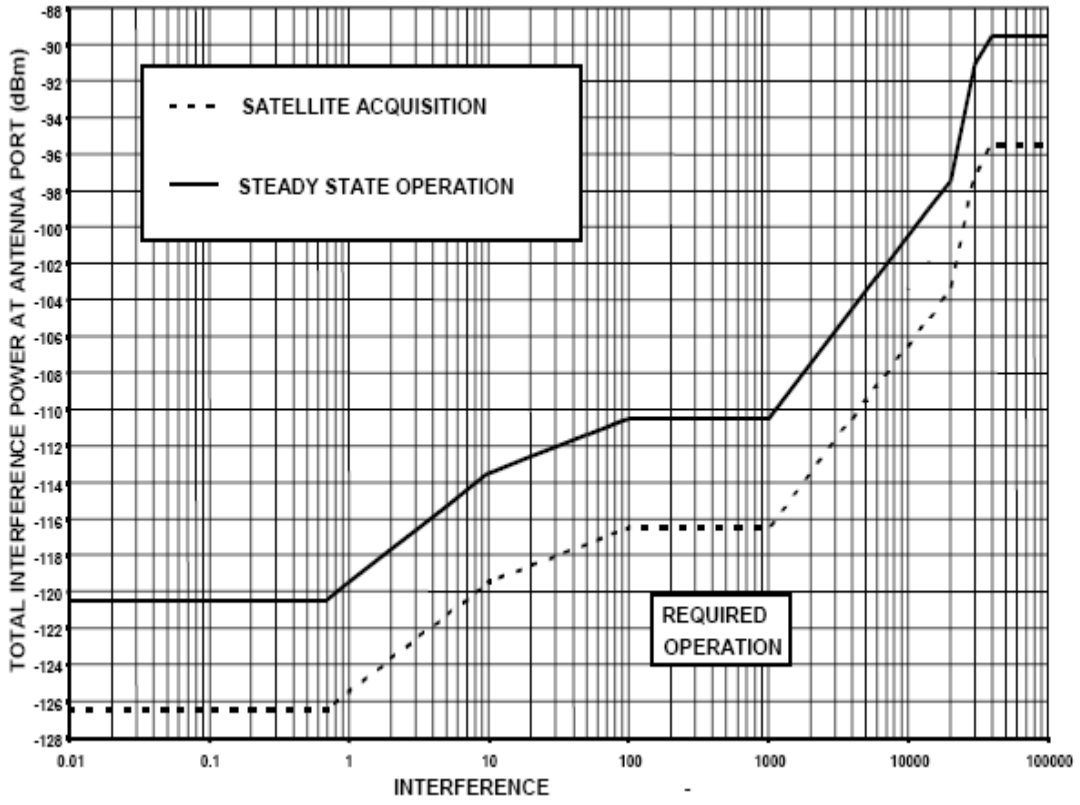
Change step 4) to read: "Broadband external interference noise ($I_{Ext, Test}$) of spectral density equal to -170.5 dBm/Hz at the antenna port."

Section 2.5.8.2, Requirement 1), Item a)

Change item a) to read: "The broadband external interference noise ($I_{Ext, Test}$) of spectral density equal to -170.5 dBm/Hz at the antenna port."

b Appendix C, Figure C-2, In-Band and Near-Band Interference Environments

Replace Figure C-2 with the following:



ETSO-C145c
Appendix 1

c Appendix C, Section C.2.2

Change the first paragraph to read:

The baseline in-band and near-band interference environments apply to steady-state operation. For initial acquisition of the GPS and SBAS signals prior to steady-state navigation, the in-band and near-band interference levels are 6 dB less than those for steady-state operation. The interference bandwidth is the 3 dB bandwidth.

Delete the last paragraph in the section (as shown below).

~~The in-band and near-band interference levels for the LNAV approach steady-state navigation operations are 3 dB less than those for LNAV/VNAV, LP, and LPV approach steady-state navigation operations. For terminal area and en route steady-state navigation operations, and for initial acquisition of the GPS and WAAS signals prior to steady-state navigation for all flight phase operations, the in-band and near-band interference levels are 6 dB less than those for LNAV, LNAV/VNAV, and LPV approach steady-state navigation operations.~~

ETSO-C146c

~~**Date: 24.10.03**~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: STAND ALONE AIRBORNE NAVIGATION EQUIPMENT USING THE GLOBAL POSITIONING SYSTEM ~~(GPS)~~ AUGMENTED BY THE ~~WIDE AREA~~ SATELLITE BASED AUGMENTATION SYSTEM ~~(WAAS)~~

1 – Applicability

This ETSO gives the requirements ~~that~~ which new models of stand alone airborne navigation equipment using the Global Positioning System (GPS) augmented by the ~~Wide Area~~ Satellite Based Augmentation System ~~(WAAS)~~(SBAS) that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

~~The standards of this ETSO apply to equipment intended to provide position information to a navigation management unit that outputs deviation commands referenced to a desired flight path. These deviations will be used by the pilot or autopilot to guide the aircraft. These standards do not address integration issues with other avionics, such as the potential for the sensor to inadvertently command an autopilot hardover. These standards also do not address the use of position information for other applications such as automatic dependent surveillance.~~

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

~~Airborne navigation sensors using GPS augmented by WAAS that are to be so identified must meet the minimum performance standards for Class Gamma or Class Delta equipment set forth in Section 2 of RTCA/DO-229B, "Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Equipment", dated October 5, 1999, as amended and supplemented by this ETSO. Class Gamma and Class Delta equipment are defined in Section 1.4 of RTCA/DO-229B.~~

Standards set forth for functional equipment Class Gamma or Delta in RTCA document DO-229D, *Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment*, dated December 13 2006, Section 2, except as modified by **Appendix 1** of this ETSO.

Classes Gamma and Delta equipment are defined in DO-229D, Section 1.4.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - ~~Failure Condition Classification~~. Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4.

Failure of the function defined in paragraph ~~1~~ 3.1.1 of this ETSO ~~has been determined to be~~ is a:

· ~~a~~ *Major* failure condition for loss of function and malfunction of en route, terminal, ~~or nonprecision approach position data~~ approach lateral navigation (LNAV), and approach LNAV/vertical navigation (VNAV) position data,

· ~~a~~ *Major* failure condition for loss of function of ~~precision~~ approach ~~position data~~ localiser performance without vertical guidance (LP), and approach localiser performance with vertical guidance (LPV) position data, and

· ~~and a~~ *Hazardous* failure condition for ~~the~~ malfunction of ~~precision~~ approach (LP and LPV) position data.

3.3. - Functional qualifications.

None ~~The required performance shall be demonstrated under the test conditions and procedures specified in RTCA/DO-229B, Section 2.5. The use of test procedures other than those specified in Sections 2.5.2 through 2.5.9 of RTCA/DO-229B constitutes a deviation to this ETSO.~~

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

~~In addition, the following requirements apply to all separate components of equipment that are manufactured under this ETSO :~~

~~- The operational equipment class as defined in Section 1.4.2 of RTCA/DO-229B (e.g., Class 2). A marking of Class 4 indicates compliance to Delta-4 requirements. The functional equipment class defined in Section 1.4.1 of RTCA/DO-229B (e.g. Gamma, Delta) is not required to be marked.~~

~~- When applicable, identification that the article is an incomplete system or that the article accomplishes additional functions beyond that described in paragraph 1 of this ETSO.~~

At least one major component must be permanently and legibly marked with the operational equipment class as defined in Section 1.4.2 of RTCA document DO-229D (e.g., Class 2). A marking of Class 4 indicates compliance to Delta-4 requirements. The functional equipment class defined in Section 1.4.1 of RTCA document DO-229D (e.g. Gamma, Delta) is not required to be marked.

It is sufficient to declare the proper functional equipment class in the DDP.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

ETSO-C146c
Appendix 1

APPENDIX 1

MPS for stand-alone airborne navigation equipment using GPS augmented by SBAS

1. This appendix prescribes modifications to the MPS for functional equipment class Gamma found in RTCA document DO-229D, Section 2. Gamma operational Class 3 and Delta operational Class 4 equipment already complies with the MPS changes below. These MPS changes apply for operational Class 1 or Class 2 equipment only.

a Section 2.5

Section 2.5.6.1, Scenario #1, Step 3)

Change step 3) to read: "Broadband external interference noise ($I_{Ext, Test}$) of spectral density equal to -170.5 dBm/Hz at the antenna port."

Section 2.5.6.1, Scenario #2, Step 4)

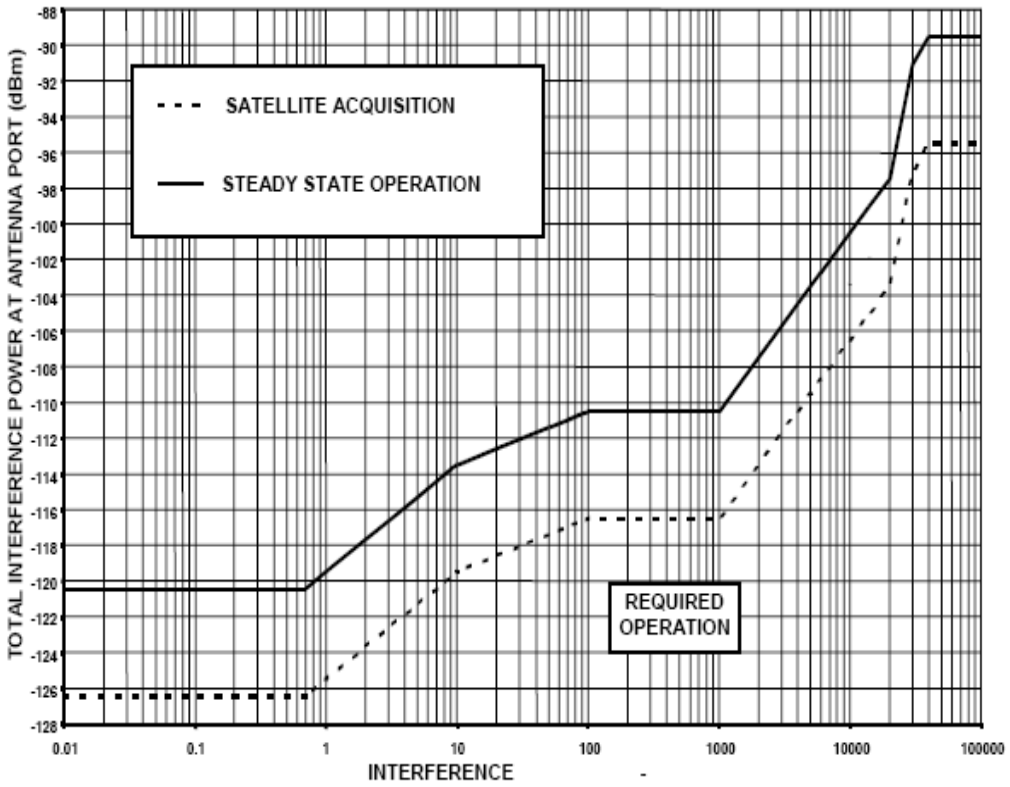
Change step 4) to read: "Broadband external interference noise ($I_{Ext, Test}$) of spectral density equal to -170.5 dBm/Hz at the antenna port."

Section 2.5.8.2, Requirement 1), Item a)

Change item a) to read: "The broadband external interference noise ($I_{Ext, Test}$) of spectral density equal to -170.5 dBm/Hz at the antenna port."

b Appendix C, Figure C-2, In-Band and Near-Band Interference Environments

Replace Figure C-2 with the following:



ETSO-C146c
Appendix 1

c Appendix C, Section C.2.2

Change the first paragraph to read:

The baseline in-band and near-band interference environments apply to steady-state operation. For initial acquisition of the GPS and SBAS signals prior to steady-state navigation, the in-band and near-band interference levels are 6 dB less than those for steady-state operation. The interference bandwidth is the 3 dB bandwidth.

Delete the last paragraph in the section (as shown below).

~~The in-band and near-band interference levels for the LNAV approach steady-state navigation operations are 3 dB less than those for LNAV/VNAV, LP, and LPV approach steady-state navigation operations. For terminal area and en route steady-state navigation operations, and for initial acquisition of the GPS and WAAS signals prior to steady-state navigation for all flight phase operations, the in-band and near-band interference levels are 6 dB less than those for LNAV, LNAV/VNAV, and LPV approach steady-state navigation operations.~~

ETSO-C155

Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: RECORDER INDEPENDENT POWER SUPPLY

1 – Applicability

This ETSO gives the requirements which new models of recorder independent power supply equipment, that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

This ETSO applies to equipment intended to provide back-up power to an installed cockpit crash protected recorder, whether it is:

- Voice
- Image
- Data
- Combination voice/data
- Combination voice/image, or
- Combination image/data.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in **Appendix 1** of this ETSO.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1 and **Appendix 2** to this ETSO.

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

None

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C155
Appendix 1

APPENDIX 1

MINIMUM PERFORMANCE STANDARD (MPS) FOR RECORDER INDEPENDENT POWER SUPPLY (RIPS)

RIPS supplies direct current (DC) voltage to an aircraft installed recorder for a specified time whenever the primary aircraft power is removed. RIPS ensures continued recording. RIPS supports recorders of cockpit voice, image, combination voice/data, combination voice/image, or combination image/data. RIPS does not distinguish between a normal shutdown and loss of electrical power from an emergency. It executes operational cycles regardless of the type of power loss.

In the tables below are standards for RIPS classified by performance requirements:

1. Power Requirements*:*	
Aircraft Voltage	Operate from either $115V_{AC}$ single phase 360-800Hz variable frequency, or from $27.5V_{DC}$ primary aircraft power, or both (depends on model).
Availability	Power the recorder any time the aircraft's electrical power is removed. Includes normal shutdown

2. RIPS Power output:	
Supplied Voltage	Power the recorder continuously or only after aircraft power is lost. Output voltage should be $27.5V_{DC}$ nominal but can vary from $18V_{DC}$ to $32.2V_{DC}$. Ripple voltage will not exceed limits at **Figure 1** (shown after this table). Output power should be prevented from causing damage when short-circuited. Output power should not be hazardous to personnel during handling.
Energy Requirements	Provide minimum 12 watts for the supply duration. Corresponds to stored energy of 6480 to 7920 watt-seconds (9 to 11 minutes times 60 seconds/minute= 12 watts)
Recharging	Be ready to function within 15 minutes from application or re-application of primary power. Since stored energy could be fully depleted, design the charging system to restore the stored energy source. Restoration should be from any initial charge state, back to the minimum energy level specified above. Unit can provide full 10 minutes of power no more than 15 minutes from aircraft power restoration. Recharge time required for unit to provide 6 minutes of power: not more than 10 minutes

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Appendix 1

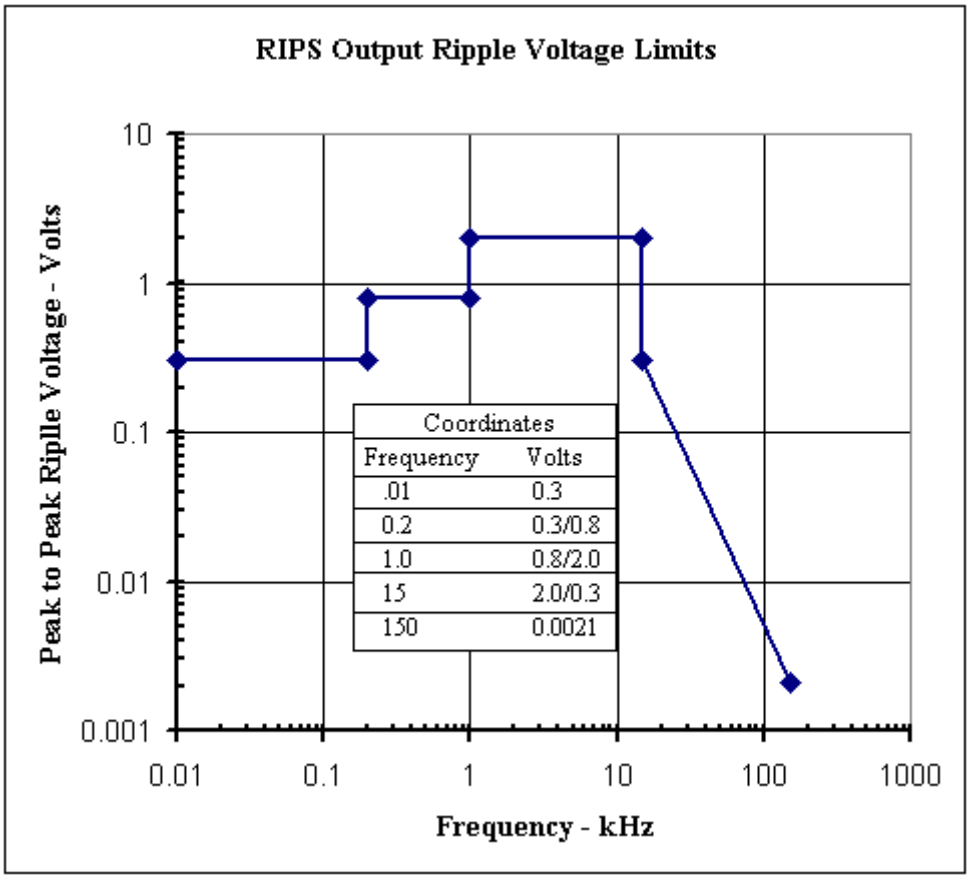
3. Built In Monitoring:	Be equipped with built-in test equipment (BITE) to detect internal failures and to monitor the unit's condition. If maintenance is required based on any combination of the following aspects, monitor and log the maintenance: - Energy source life expiration (number of hours operating time until battery replacement), - Other energy source failure, - - Absence of energy source in the device, and - - Number of energy source cycles Manufacturers may add other operational aspects

4. Maintenance Warning*:*	Issues a warning as discrete output, alerting of any inability to perform the intended function or that maintenance is required. To do this, RIPS provides an output that indicates: - A fail condition with an OPEN circuit. Resistance greater than 100,000 ohms or voltage greater than 18 V_{DC} (36V_{DC} Max), and - A normal operation by a standard GROUND. V_{OUT} less than 3.5 V_{DC}

5. Operational Timing*:*	Monitors the line voltage supplied to the recorder. When aircraft power is lost, the RIPS restores power to recorder from its stored energy no more than 50 milliseconds after the line voltage falls below the specified recorder minimum operating voltage (18 V_{DC} or 100 V_{AC})
Tolerance	Tolerance on the 10 minute output is ± 1 minute
Operational Reset	If input power to RIPS is restored before the 10 minute period ends, RIPS should reset the 10 minute timer to 0 and resume monitoring the recorder line voltage. The RIPS should recharge as required (see "Recharging," above)

ETSO-C155
Appendix 1

Figure 1 – DC Ripple Voltage Limits



ETSO-C155
Appendix 2

There are no changes to Appendix 2 as proposed in NPA 2009-11.

ETSO-C165

Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

SUBJECT: ELECTRONIC MAP DISPLAY EQUIPMENT FOR GRAPHICAL DEPICTION OF AIRCRAFT POSITION

1 – Applicability

This ETSO gives the requirements which new models of Electronic Map Display Equipment for Graphical Depiction of Aircraft Position, that are manufactured on or after the date of this ETSO, must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

New models of Electronic Map Displays that are to be so identified and that are manufactured on or after the effective date of this ETSO must meet the standards set forth for moving map equipment in Section 2 of RTCA document DO-257A, "Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps," dated June, 25, 2003.

Electronic Map Displays for use in flight must meet the MPS in Sections 2.1 and 2.2 of DO-257A.

Electronic Map Displays for use on the airport surface must meet the MPS in Sections 2.1, 2.2, and 2.3 of DO-257A, and Electronic Map Displays including Vertical Situation Displays (VSD) for use in facilitating pilot's awareness of the aircraft's vertical flight path must meet the MPS in Sections 2.1, 2.2, and 2.4 of DO-257A.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the functions defined in paragraph 3.1.1 of this ETSO for Electronic Map Displays used in flight and VSD equipment (airborne applications) have been determined to be a major failure condition for malfunctions causing the display of misleading information.

Loss of function for Electronic Map Displays used in flight and VSD equipment (airborne applications) have been determined to be a minor failure condition.

Failure of the function defined in paragraph 3.1.1 of this ETSO for Electronic Map Displays used on the airport surface (ground applications) have been determined to be a minor failure condition for malfunctions causing the display of misleading information.

Loss of function for Electronic Map Displays used on the airport surface (ground applications) is determined to be a no safety effect failure condition.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

None

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C176

Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

SUBJECT: AIRCRAFT COCKPIT IMAGE RECORDER SYSTEMS

1 – Applicability

This ETSO gives the requirements that new models of aircraft cockpit image recorder systems that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in the applicable sections of EUROCAE document ED-112, Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems, dated March 2003 including amendment 1 dated 25 July 2003 and amendment 2 dated 22 September 2003 that pertain to the Cockpit Image Recorder (CIR) type, except that compliance with ED-112 chapters 2-5, 3-4, 5-6, and all ED-112 requirements for installation, flight testing, aircraft maintenance, and others that do not pertain to MPS specific criteria are not required for this ETSO.

The table below lists recorder types and the ED-112 Section and Part with the MPS for each:

Recorder MPS Requirements	
Recorder Type	**ED-112 Reference**
Single CIR	Section 2 and Part III
CIR function in deployable recorder	Section 2, Part III, and Section 3
CIR function in combined recorder	Section 2, Part III, and Section 4

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

Failure of the function defined in paragraph 3.1.1 of this ETSO depends on the aircraft installation. The applicant must develop the system to at least the design assurance level commensurate with the failure condition classification in the table below:

Classifications of Failure Conditions for Recorders	
Recorder type	**Failure Classification**
Single CIR	Minor
CIR function in deployable recorder	Major
CIR function in combined recorder function: • Aeroplane or rotorcraft with two recorders • Rotorcraft with one combined recorder	 Minor Major

Note: The failure classification is driven by the accident investigation need.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

4.2.1 - Lettering

ED112-Chapter 2-1 paragraph 2-1.16.3 requires the lettering on the recorder be at least 25 mm in height. Where it is considered impractical to incorporate lettering of this height due to the size of the recorder case, the applicant may propose an alternative height provided that the size is adequate in relation to the size of the unit and allows easy readability.

4.2.2 - Marking recommendation

Marking in French: "ENREGISTREUR DE VOL NE PAS OUVRIR" is optional.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C177

Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

SUBJECT: DATA LINK RECORDER SYSTEMS

1 – Applicability

This ETSO gives the requirements that new models of data link recorder systems that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in the applicable sections of EUROCAE document ED-112 "Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems" dated March 2003 that pertain to the data link recorder types, except that compliance with ED-112 chapters 2-5, 3-4, 5-6, and all ED-112 requirements for installation, flight testing, aircraft maintenance are not required for this ETSO.

The table below lists recorder types and the ED-112 Section and Part containing the Minimum Performance Specification for each:

Recorder MPS Requirements, Excluding Aircraft Level Requirements	
Recorder Type	ED-112 Reference
Single DLR	Section 2 and Part IV
DLR function in a deployable recorder	Section 2, Section 3 and Part IV
DLR function in a combined recorder	Section 2, Section 4 and Part IV

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition.

Note: The failure classification is driven by the accident investigation need.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

4.2.1 Lettering

ED112-Chapter 2-1 paragraph 2-1.16.3 requires the lettering on the recorder be at least 25 mm in height. Where it is considered impractical to incorporate lettering of this height due to the size of the recorder case, the applicant may propose an alternative height provided that the size is adequate in relation to the size of the unit and allows easy readability.

4.2.2 Marking recommendation

Marking in French: "ENREGISTREUR DE VOL NE PAS OUVRIR" is optional.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-C190

Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

SUBJECT: ACTIVE AIRBORNE GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) ANTENNA

1 – Applicability

This ETSO gives the requirements for new models of Active Airborne Global Navigation Satellite System (GNSS) Antenna that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

This ETSO apply to equipment intended to receive and provide signals to global positioning system (GPS)/satellite based augmentation system (SBAS) sensors or systems of all operational classes, and GPS/ground based augmentation system (GBAS) sensors or systems that will provide flight path deviation commands to the pilot or autopilot. These standards do not address the use of the signals received through this antenna for other applications. GPS/SBAS receiver operational classes are defined in RTCA document DO-229D "Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment" dated December 13, 2006, Section 1.4.2.

Note: For Passive Airborne Global Navigation Satellite System (GNSS) Antenna, see ETSO-C144a

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in the RTCA document DO-301 "Minimum Operational Performance Standards for Global Navigation Satellite System (GNSS) Airborne Active Antenna Equipment for the L1 Frequency Band" dated December 13, 2006, Section 2.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

ETSO-C190

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraphs 3.1.1 of this ETSO constitutes a loss of navigation which is a major failure condition.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

None

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-2C48a

~~**Date: 24.10.03**~~
Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

SUBJECT: CARBON MONOXIDE DETECTOR INSTRUMENTS

1 – Applicability

1.1. - General

This ETSO gives the requirements for new models of carbon monoxide detector instruments ~~that~~ , which are manufactured on or after the date of this ETSO, must meet in order to be identified with the applicable ETSO marking.

1.2 - Specific

This ETSO refers to two basic types of detector instruments:

- TYPE A instruments are completely self-contained and carry their own power source and alarm system.
- TYPE B instruments are powered by the aircraft power supplies including the alarm system.

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None

3 - Technical Conditions

3.1 – Basic

3.1.1 - Minimum Performance Standard

~~Standards set forth in the SAE Aerospace Standard AS-412A „Carbon Monoxide Detector Instruments", dated December 15, 1956.~~

See **Appendix 1**

3.1.2 - Environmental Standard

~~As indicated in AS-412A.~~

See CS-ETSO Subpart A paragraph 2.1 and **Appendix 2**

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

ETSO-2C48a

3.1.4 – Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

~~None~~

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition.

4. Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

~~None~~

The component must be permanently and legibly marked with the equipment class as defined in paragraph 1.2 of this ETSO.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

ETSO-2C48a

Appendix 1

APPENDIX 1

Minimum Performance Standard

The following requirements apply to both TYPE A & B unless otherwise stated.

1 - Performance Standard

a. The Instrument shall trigger visual and aural alarm when CO is detected.

b. The concentration against time characteristic of the alarm activation shall meet the requirements of Table 1 below:

c. The instrument may provide a readout of actual detected CO concentration level in parts per million (ppm) by volume.

d. The probability of false alarms should be shown by the manufacturer to be sufficiently remote so as not to encourage the flight crew to distrust the instrument.

e. The warm-up time of the instrument should not exceed 5 minutes.

CONCENTRATION (ppm by volume)	NO ALARM BEFORE (minutes)	ALARM BEFORE (minutes)
Less than or equal to 30	**DO NOT ALARM**	**DO NOT ALARM**
More than 30	120	180
More that 50	60	90
More than 100	10	40
More than 300	No delay	3

Table 1: Alarm Activation Concentration

2 - Alarm Operation

a. There shall be a flashing AMBER indication, visible within the angle shown in Figure 1 below, whenever any of the criteria, described in Table 1, are met.

ETSO-2C48a
Appendix 1

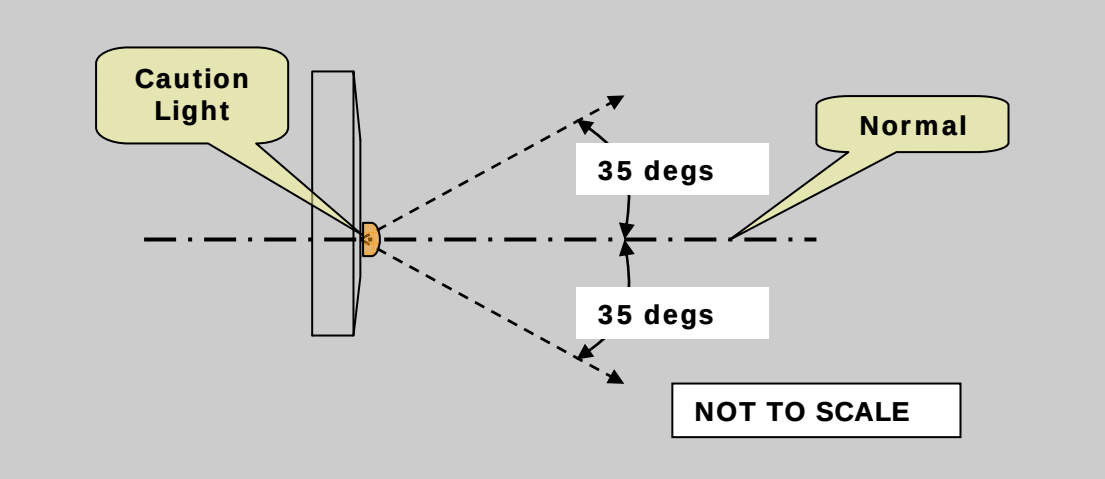


Figure 1 Plan View of Instrument showing Minimum Viewing Angle

b. The flashing visual caution light shall be accompanied by an intermittent aural alarm of a distinctive characteristic that cannot be confused with other aural alarms or indications that are typically found in the aircraft.

c. The aural alarm shall be of such a characteristic that the attenuation by an Automatic Noise Reduction Headset will be kept to a minimum.

d. In order to mitigate any distraction at critical stages of the flight, the aural alarm should initially alarm at a low intensity. At each cycle of the alarm the intensity should be increased until it is at least 85dBA at a range of 3 metres.

e. It shall be possible for the pilot to cancel the alarms. Once cancelled the instrument should re-set within 2 minutes. At this point, the instrument should continue to monitor the air and re-warn if the criteria of paragraph 1b are met.

3 - Function/Power Indications

a. Self test:

Both types of unit should have a function indicator which illuminates showing that a self test of the instrument has been successfully completed. The test should confirm as many of the functions as possible.

b. Battery Power test. TYPE A only

The TYPE A unit shall provide the pilot with a steady visual indication that there is 5 hours or less of useful battery power remaining. If there is less than 2 hours left, the visual indication should be made to flash.

4 - Standard Performance Test

The following is a detailed test requirement to be carried out when specified. During all tests the detector should be mounted in its normal operating orientation.

a. Test gases for Alarm Operation: the following concentrations should be used to check the alarm operation.

ETSO-2C48a
Appendix 1

REF	CO TEST GAS (ppm by volume)	NO ALARM BEFORE (minutes)	ALARM BEFORE (minutes)
A	20 25	240	-
B	31 37	120	180
C	51 61	60	90
D	101 121	10	40
E	301 361	-	3
F	5000 5500	-	3

b. The test conditions for the standard test are:

- Temperature: 15 to 25°C
- Humidity: Between 30% and 70% Relative humidity.
- Pressure: 980 to 1050 hPa

c. Standard Test procedure: the following is required:

- Switch on instrument and allow to warm up for 5 minutes
- Purge with clean air for 15 minutes
- Test Gas B and check alarm between 120 to 180 minutes
- Purge with clean air for 15 minutes
- Test Gas C and check alarm between 60 to 90 minutes
- Purge with clean air for 15 minutes
- Test Gas D and check alarm between 10 to 40 minutes
- Purge with clean air for 15 minutes
- Test Gas E and check alarm before 3 minutes

d. Digital Display

If a digital display is featured on the equipment, then it should be checked that it reads in the band ± 10% of the actual value for each of the conditions above.

5 - Low CO concentration test.

To ensure that nuisance warnings do not occur at low concentrations, carry out the following test exposing the instrument to the following gases:

- Clean air for 15 min
- Test gas A for 240 min or more
- Check that the alarm is not triggered
- Test gas B and ensure that alarm is triggered between 120 and 180 min

ETSO-2C48a
Appendix 1

6 - High CO concentration test.

To ensure that the instrument is capable of reacting to extremely high concentrations, carry out the following test exposing the instrument to the following gases:

- Pass clean air for 15 min
- Pass test gas F.
- Check that the alarm is triggered within 3 min.
- Pass clean air for 10 min
- Pass test gas B.
- Check that the alarm triggers between 120 and 180 min.

7 – Documentation

The supplier shall provide written guidance in the following areas:

7.1 - Operation

General description including the principle of operation including;

- Details of and interpretation of warnings.
- Details of and interpretation of test indications.
- Limitations.
- Battery changing procedure if applicable.

Action in the event of receiving a warning

Suggest generic actions helping the installer defining appropriate AFM procedures.

7.2 - Installation

The installation instruction must make it clear which categories of aircraft the instrument is suitable for and any restrictions in its use must also be clearly stated.

A general description of

- the optimum position for the instrument in different aircraft types and
- the positions to be avoided to ensure reliable air sampling and to avoid compass interference.

7.3 – Continued Airworthiness

Cleaning and other instructions as required.

ETSO-2C48a
Appendix 2

APPENDIX 2:

Additional Tests

The following additional tests are required.

a - Effect of Fuel contaminated air.

i Air contaminated with 1,000 ppm by volume of 100LL fuel is to be passed through the instrument for 2 hours

ii Verify that there are no false alarms during that period

iii Pass test sample D through the instrument and ensure that the alarm is triggered between 10 and 40 minutes

iv Repeat 2.2-a, 2.2-b and 2.2-c using JET A1 fuel.

v Repeat 2.2-a, 2.2-b and 2.2-c using MOGAS Leaded fuel to BS:4040:1988.

vi Repeat 2.2-a, 2.2-b and 2.2-c using MOGAS Unleaded fuel to BS:7070 or EN228:1995.

vii Repeat 2.2-a, 2.2-b and 2.2-c using diesel fuel

ETSO-2C169a

Date : xx.xx.20xx

European Aviation Safety Agency

European Technical Standard Order (ETSO)

SUBJECT: VHF RADIO COMMUNICATIONS TRANSCEIVER EQUIPMENT OPERATING WITHIN THE RADIO FREQUENCY RANGE 117.975 TO 137.000 MEGAHERTZ

1 – Applicability

This ETSO gives the requirements which new models of VHF Radio Communications Transceiver Equipment Operating within the Radio Frequency Range 117.975 to 137.000 Megahertz that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

This ETSO cancels ETSO-2C37e "VHF Radio Communication Transmitting Equipment Operating within the Radio Frequency Range 117.975-137.000 Megahertz" and ETSO-2C38e "VHF Radio communication Receiving Equipment Operating within the Radio Frequency Range 117.975-137.000 Megahertz".

2 - Procedures

2.1. - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

This ETSO applies to equipment intended for aircraft VHF amplitude modulated (AM) communications operating within 117.975 to 137.000 MHz. This includes 25 and 8.33 kHz channel spacing capabilities. VHF communication equipment covered by this ETSO is primarily intended for aeronautical operational control (AOC) and air traffic services (ATS) safety communications.

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in EUROCAE document ED-23C "Minimum Operational Performance Standards for Airborne VHF Receiver-Transmitter Operating within the Radio Frequency Range 117.975-137.000 MHz", dated June 2009 for the equipment classes defined in the following table.

ETSO-2C169a

Table of Equipment Classes for VHF Communication Equipment

Equipment Class	Description
C	Receiver used in a 25 kHz channel separation environment having off-set carrier operation
D	Receiver used in a 25 kHz channel separation environment not having off-set carrier operation
E	Receiver used in an 8.33 kHz channel separation environment not having off-set carrier operation
H1 and H2	Receivers which are to be used in a 8,33 kHz channel separation environment and intended for off-set carrier operation with only two carriers.
3	Transmitter used in a 25 kHz channel separation environment and intended to operate with a range of 200 nautical miles.
4	Transmitter used in a 25 kHz channel separation environment and intended to operate with a range of 100 nautical miles.
5	Transmitter used in an 8.33 kHz channel separation environment and intended to operate with a range of 200 nautical miles.
6	Transmitter used in an 8.33 kHz channel separation environment and intended to operate with a range of 100 nautical miles.

It is recommended that, when applying for ETSO-2C169a authorisation, the applicant also applies for ETSO-2C128 "Devices that Prevent Blocked Channels Used in Two-Way Radio Communications due to Unintentional Transmission" authorisation.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 - Computer Software

See CS-ETSO Subpart A paragraph 2.2

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition.

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2

4.2 – Specific

None

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

II Draft Decision AMC and GM to Part-21

AMC 21A.608

Declaration of Design and Performance

STANDARD FORM

DDP No. .....

ISSUE No. .....

1 Name and address of manufacturer.

2 Description and identification of article including:

Type No .....

Modification Standard

Master drawing record

Weight and overall dimensions

3 Specification reference, i.e., ETSO No. and Manufacturer's design specification.

4 The rated performance of the article directly or by reference to other documents.

5 Particulars of approvals held for the equipment.

6 Reference to qualification test report.

7 Service and Instruction Manual reference number.

8 Statement of compliance with appropriate ETSO and any deviations therefrom.

9 A statement of the level of compliance with the ETSO in respect of the ability of the article to withstand various ambient conditions or to exhibit various properties.

The following are examples of information to be given under this heading depending on the nature of the article and the requirements of the ETSO.

~~a. Working and ultimate pressure or loads.~~

~~b. Limitations of voltage and frequency.~~

~~c. Time rating (e.g., continuous, intermittent) or duty cycle.~~

~~d. Limits of accuracy of measuring instruments.~~

~~e. Whether the equipment is "flameproof" (explosion-proof).~~

~~f. Whether the equipment is "fire-resistant".~~

~~g. The compass safe distance.~~

~~h. Level of radio interference.~~

~~j. Radio and audio frequency susceptibility.~~

~~k. Degree of vibration which the equipment will withstand.~~

~~l. Degree of acceleration and shock which the equipment will withstand.~~

~~m. Degree of waterproofness or sealing of equipment.~~

~~n. Ability to withstand sand and dust.~~

~~o. Ability to resist salt spray and aircraft fluids.~~

~~p. Fungus resistance.~~

~~q. Temperature and altitude category.~~

~~r. Humidity category.~~

~~s. Any other known limitations which may limit the application in the aircraft e.g., restrictions in mounting attitude.~~

a. Environmental Qualification

i. Temperature and Altitude
ii. Temperature Variation
iii. Humidity
iv. Operational Shocks and Crash Safety
v. Vibration
vi. Explosionproofness
vii. Waterproofness
viii. Fluids Susceptibility
ix. Sand and Dust
x. Fungus Resistance
xi. Salt Spray
xii. Magnetic Effect
xiii. Power Input
xiv. Voltage Spike
xv. Audio Frequency Conducted Susceptibility - Power Inputs
xvi. Induced Signal Susceptibility
xvii. Radio Frequency Susceptibility (Radiated and Conducted)
xviii. Emission of Radio Frequency Energy
xix. Lightning Induced Transient Susceptibility
xx. Lightning Direct Effects
xxi. Icing
xxii. Electrostatic Discharge
xxiii. Fire, Flammability

(NOTE: The manufacturer should list environmental categories for each of the sections of the issue of EUROCAE ED-14/RTCA DO-160 that was used to qualify the article.)

b. For radio transmitters the transmitting frequency band, maximum transmitting power, and emission designator.
c. Working and ultimate pressure or loads.
d. Time rating (e.g., continuous, intermittent) or duty cycle.
e. Limits of accuracy of measuring instruments.

f. Any other known limitations which may limit the application in the aircraft, e.g., restrictions in mounting attitude.

10 A statement of the software level(s) used or "None" if not applicable.

(NOTE: Software levels are those defined in the applicable issue of EUROCAE ED–12/RTCA document DO–178.)

11 A statement of design assurance level for complex hardware or a statement indicating whether complex hardware is embedded or not in the product.

(NOTE: Complex hardware design assurance levels are those defined in the applicable issue of EUROCAE ED–80/RTCA DO-254.)

~~11~~12 The declaration in this document is made under the authority of

……(name of manufacturer)

(Manufacturer's name) cannot accept responsibility for equipment used outside the limiting conditions stated above without their agreement.

Date: ……Signed……..(Manufacturer's authorised representative)

Appendix B - Attachments

NATS EXT003 07.pdf
Attachment #1 to comment #90