



NOTICE OF PROPOSED AMENDMENT (NPA) 2012-16

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY

amending 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)

'Systematic review and transposition of existing FAA TSO standards for parts and appliances into EASA ETSOs'

EXECUTIVE SUMMARY

This Notice of Proposed Amendment (NPA) proposes to:

- (a) amend CS-ETSO, Subpart A, in relation to software (SW) development;
- (b) delete obsolete ETSOs no longer used by industry;
- (c) modify a number of ETSOs remaining harmonised with corresponding FAA TSOs; and
- (d) introduce new ETSO specifications that are always technically identical to existing Federal Aviation Administration (FAA) TSO (i.e. no ETSO proposed in Index 2 of CS-ETSO).

In general terms, the approach proposed in the present NPA includes three major aspects:

- improvement of specifications, driven by the advancement of the state of the art, for a number of aircraft equipment;
- modernisation of provisions on avionics to facilitate initial evolution towards SESAR (e.g. VDL Mode 2 and Mode S ATC transponder);
- more stringent or new specifications for safety equipment (e.g. Underwater Locating Devices) in some cases requested by Safety Recommendations issued by the safety investigation authorities.

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A. Explanatory Note

I. General

1. The purpose of this NPA is to amend Decision 2003/10/RM of the Executive Director of 24 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for European Technical Standard Orders (CS-ETSO)¹.
2. This NPA proposes to:
 - (a) amend CS-ETSO, Subpart A, in relation to software (SW) development;
 - (b) delete obsolete ETSOs no longer used by industry;
 - (c) modify a number of ETSOs remaining harmonised with corresponding FAA TSOs; and
 - (d) introduce new ETSO specifications that are always technically identical to existing Federal Aviation Administration (FAA) TSO² (i.e. no ETSO proposed in Index 2 of CS-ETSO).
3. The scope of this rulemaking activity is outlined in the Terms of Reference (ToR) for RMT.0186 (ETSO.008) 'Systematic review and transposition of existing FAA TSO standards for parts and appliances into EASA ETSOs' and is described in more detail below.
4. The European Aviation Safety Agency (hereafter referred to as the 'Agency') is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation³ which are adopted as 'Opinions' (Article 19(1)). It also adopts Certification Specifications, including Acceptable Means of Compliance and Guidance Material, to be used in the certification process (Article 19(2)).
5. European Technical Standard Orders (ETSOs) are defined by Article 1.2(g) of EASA 'Part-21'⁴ as detailed airworthiness specifications, issued by the Agency to ensure compliance with the requirements of the said 'Part-21' as minimum performance standards for specified articles.
6. When developing rules, the Agency is bound to follow a structured process as required by Article 52(1) of the Basic Regulation. Such process has been adopted

¹ Decision 2003/10/RM of the Executive Director of the Agency of 24 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for European Technical Standard Orders (CS-ETSO). Decision as last amended by Decision 2012/.../R of the Executive Director of the Agency of 28 June 2012 (Amendment 7 to CS-ETSO).

² FAA TSOs are available at:
http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rqTSO.nsf/Frameset?OpenPage.

³ Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.03.2008, p. 1). Regulation as last amended by Regulation 1108/2009 of the European Parliament and of the Council of 21 October 2009 (OJ L 309, 24.11.2009, p. 51).

⁴ Regulation (EC) No 1194/2009 of the European Parliament and of the Council of 30 November 2009 (OJ L 321, 8.12.2009, p. 5) amending Regulation (EC) No 1702/2003 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances as well as for certification of design and production organisations (OJ L 243, 27.9.2003, p. 6).

by the Agency's Management Board and is referred to as the 'Rulemaking Procedure'⁵.

7. This rulemaking activity is included in the Agency's Rulemaking Programme 2011–14. It implements the rulemaking task RMT.0186 (ETSO.008), i.e. a second NPA.
8. The text of this NPA has been developed by the Agency. It is submitted for consultation of all interested parties in accordance with Article 52 of the Basic Regulation and Articles 5(3) and 6 of the Rulemaking Procedure.

II. Consultation

9. To achieve optimal consultation, the Agency is publishing the draft Decision of the Executive Director on its website. Comments should be provided within **3 months** in accordance with Article 6.4 of the Rulemaking Procedure.
10. Please submit your comments using the **automated Comment-Response Tool (CRT)** available at <http://hub.easa.europa.eu/crt/>.⁶
11. The deadline for the submission of comments is **11 January 2013**.

III. Comment-Response Document (CRD)

12. All comments received in time will be responded to and incorporated in a Comment-Response Document (CRD). The CRD will be available on the Agency's website simultaneously with the Decision (i.e. no reactions possible), as allowed by the above-mentioned new rulemaking procedure and to respond more quickly to industry demands for updated/new ETSOs.

⁵ EASA MB Decision No 01-2012 of 13 March 2012 amending and replacing MB Decision No 08-2007 concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ('Rulemaking Procedure') (<http://easa.europa.eu/management-board/docs/management-board-meetings/2012/01/EASA%20MB%20Decision%2001-2012%20Revised%20MB%20Decision%20RM%20Process%20.pdf>).

⁶ In case the use of the Comment-Response Tool is prevented by technical problems please report them to the CRT webmaster (crt@easa.europa.eu).

IV. Content of the draft Decision

Need to act

13. Article 2.1 of the Basic Regulation mandates the Agency to establish and maintain a high uniform level of civil aviation safety in Europe. This NPA responds to this legal provision by proposing updates to emergency equipment such as recorders and Underwater Locating Devices (ULDs) as explained in more detail below.
14. Article 2.2(e) of the same Regulation mandates the Agency to promote Community views regarding civil aviation safety standards and rules, not only to achieve and maintain high safety, but also to promote EU industry. It is hence necessary to constantly align CS-ETSO with the evolution of the state of the art worldwide.

CS-ETSO

15. The reasons for the revision of CS-ETSO, Subpart A, on software matters and for the deletion, introduction or revision of a number of ETSOs (including explanation of the main differences with the current ETSOs) are described in the following paragraphs.

CS-ETSO – Subpart A

16. EUROCAE Document ED-12 and RTCA Document DO-178 on software consideration in airborne systems and equipment certification have been updated from edition 'b' to 'c'. This gave the Agency the opportunity to amend AMC 20-115 on the same subject, which is underway through rulemaking task RMT.0462.
17. It is the intention of the Agency to publish all the appropriate guidelines for airborne software, both at equipment and at aircraft level, in said AMC 20-115. Therefore, editorial amendments will be introduced to other relevant AMCs, as well as to a number of Certification Specifications (CSs) where software aspects are included. These would facilitate consultation with stakeholders for provisions on software in a single document, as well as future updates by the Agency. It would also prevent possible inconsistencies among published Agency regulatory materials.
18. ED-12 and DO-178 are in particular also mentioned in the current text of Subpart A of CS-ETSO. This NPA therefore proposes to amend paragraph 2.2 of Subpart A of CS-ETSO to refer only to the last edition of AMC 20-115 and not directly to EUROCAE or RTCA documents.
19. In the future, when amending individual ETSOs, the Agency will progressively refer again only to AMC 20-115 for software matters and not directly to industry standards.

CS-ETSO – Subparts B and C**Index 1 – ETSO to be deleted****ETSOs C9c (Automatic Pilot) and C52b (Flight Directors)**

20. The new ETSO C198 proposed below, can replace ETSOs C9c (Automatic Pilot) and C52b (Flight Directors). The deletion will not invalidate existing authorisations, but new applications would only be accepted on the basis of the new ETSO-C198.

ETSOs C60b Airborne Area Navigation Equipment Using Loran-C Inputs

21. The FAA has cancelled TSO-C60b already. As Loran-C service is stopped in the US, Canada and Russia, worldwide service is no longer available. Although the European Loran-C network is currently maintained⁷, it is proposed to cancel the ETSO as well. In fact there are currently no approvals listed for ETSO-C60b. The deletion will in any case not invalidate existing authorisations.

ETSO-C74d: Airborne ATC Transponder Equipment

22. This NPA proposes an updated standard for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) airborne equipment (i.e. ETSO-C112d).
23. However, the subject is also covered by ETSO-C74d on pure Mode A/C ATC transponders, published in the initial issue of CS-ETSO in 2003. These pure Mode A/C transponders are now obsolete. In fact, the Agency issued the last pure Mode A/C transponder approvals in 2004. Since then there were no more applications received on the basis of said ETSO-C74d.
24. Control units can be authorised against both standards (i.e. Mode S and Mode A/C), but in principle if a control unit is able to provide all the inputs to a Mode S transponder, the same is also able to feed a Mode A/C one. Furthermore, the Mode S control and display function is more demanding, but it includes the Mode A/C functionality as well. There are currently 36 ETSO authorisations issued by the Agency for control units compliant with functionalities required by both ETSOs.
25. Finally, the antenna specification is not related to the modulation characteristics but only to the centre frequency, which is the same for either Mode A/C or Mode S.
26. The Agency, which is still receiving applications based on ETSO-C112, but not on C74d, would therefore like to know if stakeholders concur that this obsolete ETSO-C74d can be deleted from Index 1 of CS-ETSO.
27. In conclusion the following ETSOs in Index 1 are proposed for deletion:

ETSOs proposed for deletion from Index 1 of CS-ETSO	
ETSO-C9c	Automatic Pilot
ETSO-C52b	Flight Directors
ETSO-C60b	Airborne Area Navigation Equipment Using Loran-C Inputs
ETSO-C74d	Airborne ATC Transponder Equipment

28. The Agency would like to know if stakeholders agree with such deletions.

⁷ For details see <http://www.loran-europe.eu/news.php>

Index 1 ETSO technical content revised

29. According to Issue 3 of the ToR RMT.0186 (ETSO.008) a number of ETSOs is proposed to be updated to remain harmonised with the FAA, aligned with the state of the art or to respond to safety recommendations addressed to the Agency by safety investigation authorities⁸. The technical changes to the revised ETSOs are described below.

ETSO-C87a: Airborne Low-Range Radio Altimeter

30. This update of ETSO-C87 is based on FAA TSO-C87a⁹ issued on 31 May 2012.
31. Standards set forth in EUROCAE ED-30 'Minimum Performance Standards for Airborne Low-Range Radar Altimeter Equipment', dated March 1980, are now proposed to be modified by Appendix 1 to this ETSO.
32. Furthermore, in addition to Chapter 5 of EUROCAE document ED-30, all materials used except small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire, must be self-extinguishing when tested in accordance with the applicable requirements of CS-25, Appendix F.
33. The applicable Chapter 2 and Chapter 3 requirements or the appropriate functional class from the EUROCAE document are identified in Table 1 of the ETSO.
34. Finally it is clarified that there is no standard minimum failure condition classification for this ETSO. The failure condition classification appropriate to the equipment will depend on the intended use of the equipment in a specific aircraft.
35. Edition C87a of this ETSO replaces edition 2C87 adopted by Decision 2003/10/RM of 24 October 2003, which means that the differences with respect to the corresponding FAA TSO have been removed and this ETSO is hence proposed to be moved from Index 2 to Index 1.

ETSO-C112d Air Traffic Control Radar Beacon System/Mode Select (ATCRSB/Mode S) Airborne Equipment

36. This update of ETSO-C112 is based on FAA C112d issued on 6 June 2011.
37. This ETSO now makes reference to the Minimum Operational Performance Standards set forth in EUROCAE ED-73E, dated May 2011, instead of previous version C. Since edition 'e' of the EUROCAE document improves the industry standards, it is deemed no longer necessary to introduce corrections through the ETSO.
38. Edition 'd' of this ETSO replaces edition C112c adopted by Decision 2010/010/R of 21 December 2010.

⁸ Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (OJ L 295, 12.11.2010, p. 35).

⁹ [http://rgl.faa.gov/Regulatory_and_Guidance_Library/rqTSO.nsf/0/3e13da064e29a5f586257a1b005889a8/\\$FILE/TSO-C87a.pdf](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rqTSO.nsf/0/3e13da064e29a5f586257a1b005889a8/$FILE/TSO-C87a.pdf)

ETSO-C115c Flight Management Systems (FMS) using Multi-Sensor Inputs

39. This update of ETSO-C115c is based on FAA C115c issued on 9 January 2012.
40. The Agency proposes to change the title of this ETSO no longer referring to Area Navigation (RNAV) but more in general to Flight Management Systems (FMS) using Multi-Sensor Inputs. This change of title allows to cover not only RNAV but any other type of Performance-Based Navigation (PBN) including Required Navigation Performance (RNP).
41. Furthermore the technical conditions published in edition 'b' are proposed to be replaced by a reference to the standards set forth in EUROCAE document ED-58 (June 1988)/RTCA DO-187 (1984) and RTCA DO-283A, Minimum Operational Performance Standards for Required Navigation Performance for Area Navigation, dated 28.10.2003; however, complemented by some specific requirements.
42. Finally a reference is added to CS-ETSO, Subpart A, paragraph 2.3, on electronic hardware qualification.
43. Edition 'c' of this ETSO replaces edition C115b adopted by Decision 2007/017/R of 18 December 2007.

ETSO-C121b Underwater Locating Device

44. This update of ETSO-C121 is based on FAA C121b issued on 28 February 2012.
45. The main purpose of updating ETSO-C121 from 'a' to 'b' is to extend the life of the Underwater Locating Device (ULD) or Underwater Locating Beacon (ULB) to 90 days, following the accident of AF 447 on 1 June 2009. In particular this extension responds to safety recommendation FRAN-2009-016 received by the Agency on 17 December 2009.
46. The proposed modification would furthermore align the EASA Specifications with Amendment 36¹⁰ to ICAO Annex 6 Part I, whose extract is reproduced in Appendix C.I to this NPA, as well as with the updated SAE Aerospace Standard AS8045A of August 2011.
47. The possible rule on mandatory carriage of this ULD with battery life extended to 90 days is of course outside the scope of the ETSO and of this NPA, both related to equipment and not to aircraft. EASA will take into account mentioned amendment 36 to ICAO Annex 6, in order to assess possible mandatory carriage of 90 days ULD on large aeroplanes through an appropriate rulemaking task on air operations.
48. Edition 'b' of this ETSO replaces edition C121a adopted by Decision 2008/012/R of 28 November 2008.

¹⁰ Notified by ICAO Type II State Letter AN 11/1.3.25-12/10 of 4 April 2012, and applicable from 15 November 2012.

ETSO-C155a Recorder Independent Power Supply

49. This update of ETSO-C155 is based on FAA C155a issued on 9 June 2010.
50. Appendix 1 to this ETSO is deleted and replaced by reference to Section 5 of EUROCAE ED-112, Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems, dated March 2003, although with some exceptions.
51. Edition 'a' of this ETSO replaces edition C155 adopted by Decision 2010/010/R of 21 December 2010.
52. In summary, five ETSOs in Index 1 are proposed for update:

ETSOs in Index 1 of CS-ETSO proposed for update	
ETSO-C87a	Airborne Low-Range Radio Altimeter
ETSO-C112d	Air Traffic Control Radar Beacon System/ Mode Select (ATCRSB/Mode S) Airborne Equipment
ETSO-C115c	Flight Management Systems (FMS) using Multi-Sensor Inputs
ETSO-C121b	Underwater Locating Device
ETSO-C155a	Recorder Independent Power Supply

Index 1 – new ETSO

53. For the same reasons mentioned in relation to the need to update some ETSOs, a number of new ETSOs is proposed by this NPA for inclusion in Index 1 as described in the following paragraphs.

ETSO-C160a VDL Mode 2 Communications equipment

54. This newly introduced ETSO-C160a is based on FAA TSO-C160a issued on 27 March 2012.
55. This ETSO makes reference to the standards set forth in EUROCAE ED-92B, Minimum Operational Performance Standards for Aircraft VDL Mode 2 Physical, Link, and Network Layer, dated 21.3.2012. ED-92B is identical to RTCA DO-281B.
56. It facilitates the coordinated introduction of data link services based on air-ground point-to-point data communications mandated by Article 3 of the relevant 'single European sky' interoperability Regulation¹¹.

¹¹ Commission Regulation (EC) No 29/2009 of 16 January 2009 laying down requirements on data link services for the single European sky (OJ L 13, 17.1.2009, p. 3).

ETSO-C164 Night Vision Goggles (NVG)

57. This newly introduced ETSO-C164 is based on FAA TSO-C164 issued on 30 September 2004.
58. It makes reference to standards set forth in RTCA DO-275, Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment, dated 12.10.2001.

ETSO-C178 Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers

59. This newly introduced ETSO-C178 is based on FAA TSO-C178 issued on 3 March 2006.
60. It makes reference to standards set forth in SAE AS 5692, Arc Fault Circuit Breaker (AFCB), Aircraft, Trip-Free Single Phase 115 Vac, 400 Hz—Constant Frequency, dated October 2004. AFCBs may have separate indication of thermal and arcing faults to assist in fault isolation and performing proper repairs.

ETSO-C198 Automatic Flight Guidance and Control System (AFGCS) equipment

61. This newly introduced ETSO-C198 is based on FAA TSO-C198 issued on 2 June 2011 and replaces previous ETSO standards C9c and C52b which are proposed for deletion.
62. It makes reference to standards set forth in RTCA DO-325, Automatic Flight Guidance and Control Systems and Equipment, dated 8.12.2010.

ETSO-C200 Low-frequency Underwater Locating Device (ULD)

63. This newly introduced ETSO-C200 is based on FAA TSO-C200 issued on 26 June 2012.
64. The main purpose of introducing ETSO-C200 is to enhance the possibility of rapidly locating a wreckage after an accident at sea through a newly introduced second Underwater Locating Device (ULD) or Underwater Locating Beacon (ULB) operating at the low frequency of 8.8 kHz and transmitting for at least 30 days. A ULD operating at a lower frequency provides in fact for an extended detection range which facilitates general position identification of a submerged aircraft. The low-frequency ULD is intended to be mounted directly to the aircraft as a supplement to the existing ULDs which are attached directly to the crash protected recorders.
65. This follows the AF 447 accident on 1 June 2009 and in particular this new ULD responds to safety recommendation FRAN-2009-017 received by the Agency on 17 December 2009.
66. The proposed modification would furthermore align the EASA Specifications with the already mentioned Amendment 36 to ICAO Annex 6, Part I (extract reproduced in Appendix C.I to this NPA), as well as with the SAE Aerospace Standard AS6254 of February 2012.
67. The possible rule on mandatory carriage of this low-frequency ULD is of course outside the scope of the ETSO and of this NPA, both related to equipment and not to aircraft. EASA will take into account mentioned Amendment 36 to ICAO Annex 6 in order to assess possible mandatory carriage of low-frequency ULD on large aeroplanes through an appropriate rulemaking task on air operations.

68. In summary, five new ETSOs are proposed for inclusion in Index 1:

New ETSOs proposed for inclusion in Index 1 of CS-ETSO	
ETSO-C160a	VDL Mode 2 Communications equipment
ETSO-C164	Night Vision Goggles (NVG)
ETSO-C178	Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers
ETSO-C198	Automatic Flight Guidance and Control System (AFGCS) equipment
ETSO-C200	Low-frequency Underwater Locating Device (ULD)

Index 1 – Editorial changes to ETSO

69. The publication of this NPA gives also the opportunity to propose editorial changes to a number of ETSOs. The existing revision letter is however kept to ensure synchronisation with the FAA TSOs' identical revision letter. This is possible since there are no changes in the technical content. However, an amendment number is added to highlight the change.
70. The seven ETSOs in Index 1 for which few changes, mainly editorial, are proposed are:

Proposed editorial changes to ETSOs in Index 1 of CS-ETSO	
ETSO-C44c A1	Fuel Flowmeters
ETSO-C45b A1	Manifold Pressure Instruments
ETSO-C47a A1	Pressure Instruments — Fuel, Oil, and Hydraulic (Reciprocating Engine-Powered Aircraft)
ETSO-C56b A1	Engine-driven Direct Current Generators/Starter generators
ETSO-C106 A1	Air Data Computer
ETSO-C114 A1	Torso Restraint Systems
ETSO-C161a A1	Ground-Based Augmentation System Positioning and Navigation Equipment
ETSO-C166b A1	Extended Squitter ADS-B and TIS-B Equipment Operating on the RF of 1090 Megahertz (MHz)
ETSO-C174 A1	Battery-Based Emergency Power Unit (BEPU)

Index 2 – ETSO to be deleted

ETSO-2C87: Airborne Low-range Radio Altimeter

71. As already explained above, the proposed edition C87a of this ETSO replaces edition 2C87 adopted by Decision 2003/10/RM of 24 October 2003, which means that the differences with respect to the corresponding FAA TSO have been removed.
72. This ETSO is hence proposed to be moved to Index 1 and hence to be deleted from Index 2.

ETSOs 2C91a Emergency Locator Transmitter (ELT) equipment

73. On 1st February 2009 Cospas-Sarsat satellite system stopped processing signals from 121.5 MHz ELTs and now only processes signals from 406 MHz ELTs. The decision to discontinue processing of the 121.5 MHz signal was made by the International Cospas-Sarsat programme with guidance from the United Nations. This was made due to the problems within the 121.5 MHz frequency band which inundated SAR authorities with reports of poor accuracy and numerous false alerts, thus impacting the effectiveness of the life saving services.
74. The 406 MHz ELT technology is an advance over the older 121.5 MHz ELT technology. ETSO-C126a ELT equipment is more accurate and reliable than the 121.5 MHz ELT equipment. Examples of these improvements are:
- global satellite coverage;
 - a unique beacon identification which is required to be registered so that if an alert is activated the rescue coordination centre can confirm whether the distress is real, who they are looking for, and where the search should begin;
 - 406 MHz ELTs can be received by geostationary satellites which are always visible and provide instantaneous alerting; and
 - increased position accuracy which reduces the search area to less than two nautical miles in radius. Additionally, 406 MHz ELTs can optionally include a GPS position which can potentially reduce the search area to within 100 meters of the accident site.
75. The performance and benefits of ETSO-C126a equipment surpasses ETSO-2C91a equipment. The 406 MHz technology is mature and prevalent in the ELT market today. New ETSO authorisations for ELTs should be accomplished to ETSO-C126a, or subsequent, thus EASA is proposing to cancel ETSO-2C91a.
76. The requirement in ETSO-C126a asking for the 121.5 MHz homing function with a reduced output power of 50 mW in accordance with ICAO Annex 10 provisions will be maintained and is not affected by this cancellation.
77. The FAA has cancelled TSO-C91a already. The deletion will in any case not invalidate existing authorisations.
78. The following ETSO should be deleted from Index 2 of CS-ETSO since the differences in respect of the corresponding FAA TSOs have been removed:

ETSOs proposed for deletion from Index 2 of CS-ETSO	
ETSO-2C87	Airborne Low-range Radio Altimeter
ETSO-2C91a	Emergency Locator Transmitter (ELT) equipment

79. The Agency would like to know if stakeholders agree with such deletions.

Summary of new, revised or deleted ETSOs

80. The following tables summarise new, revised or deleted ETSOs proposed by this NPA:

ETSO reference	ETSO title	Based on and similar to FAA TSO
Subpart A – General		
Subpart A, par. 2.2	Software standards	n/a
Subpart A, par. 2.4	Failure condition classification	n/a

ETSO reference	ETSO title	Based on and similar to FAA TSO
Index 1		
ETSO-C9e	Automatic Pilot	DELETED
ETSO-C44c A1 (editorials)	Fuel Flowmeters	TSO-C44c (from 22/08/2006)
ETSO-C45b A1 (editorials)	Manifold Pressure Instruments	TSO-C45b (from 22/08/2006)
ETSO-C47a A1 (editorials)	Pressure Instruments – Fuel, Oil, and Hydraulic (Reciprocating Engine Powered Aircraft)	TSO-C47a (from 08/08/2006)
ETSO-C52b	Flight Directors	DELETED
ETSO-C56b A1 (editorials)	Engine-driven Direct Current Generators/Starter generators	TSO-C56b (from 01/06/2006)
ETSO-C60b	Airborne Area Navigation Equipment Using Loran C Inputs	DELETED
ETSO-C74d	Airborne ATC Transponder Equipment	TSO-C74d (from 12/17/2008) still current
ETSO-C87a (update)	Airborne Low-range Radio Altimeter	TSO-C87a (from 31/05/2012)
ETSO-C106 A1 (editorials)	Air Data Computer	TSO-C106 (from 15/01/1988)
ETSO-C112d (update)	Air Traffic Control Radar Beacon System/Mode Select (ATCRSB/Mode S) Airborne Equipment	TSO-C112d (from 06/06/2011)
ETSO-C114 A1 (editorials)	Torso Restraint Systems	TSO-C114 (from 27/03/1987)
ETSO-C115c (update)	Flight Management Systems (FMS) using Multi-Sensor Inputs	TSO-C115c (from 09/01/2012)
ETSO-C121b (update)	Underwater Locating Device	TSO-C121b (from 28/02/2012)
ETSO-C155a (update)	Recorder Independent Power Supply	TSO-C155a (from 09/06/2010)
ETSO-C160a (new)	VDL Mode 2 Communications equipment	TSO-C160a (from 27/03/2012)
ETSO-C161a A1 (editorials)	Ground-Based Augmentation System Positioning and Navigation Equipment	TSO-C161a (from 17/12/2009)
ETSO-C164 (new)	Night Vision Goggles (NVG)	TSO-C164 (from 30/09/2004)
ETSO-C166b	Extended Squitter ADS-B and TIS-B	TSO-C166b

A1(editorials)	Equipment Operating on the RF of 1090 Megahertz (MHz)	(from 02/12/2009)
ETSO-C174 A1 (editorials)	Battery-Based Emergency Power Unit (BEPU)	TSO-C174 (from 25/07/2005)
ETSO-C178 (new)	Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers	TSO-C178 (from 03/03/2006)
ETSO-C198 (new)	Automatic Flight Guidance and Control System (AFGCS) Equipment	TSO-C198 (from 02/06/2011)
ETSO-C200 (new)	Low-frequency Underwater Locating Device (ULD)	TSO-C200 (from 26/06/2012)

ETSO Reference	ETSO title	Based on and similar to FAA TSO
Index 2		
ETSO-2C87	Airborne Low-range Radio Altimeter	DELETED (moved to Index 1)
ETSO-2C91a	Emergency Locator Transmitter (ELT) Equipment	DELETED

V. Regulatory Impact Assessment

Issue analysis and risk assessment

What is the issue and the current regulatory framework?

81. Technology and related requirements are continuously changing, and thus new standards have been developed or existing standards (on which the already published ETSO had been based) have been updated and improved. As a result of this continuing update, new ETSOs and revised ETSOs need to be introduced. This will ensure that parts and appliances to be used on aircraft correspond to the latest standards. It should also be noted that the approval of parts and appliances which meet the requirements of a TSO, but for which there is no equivalent ETSO, can only be obtained when they are part of an (S)TC. This results in a disadvantage for European parts and appliances producers and installers of these parts and appliances.

Scale of the issue

82. A substantial number of manufacturers is facing a problem with validation if the ETSO and TSO are not equivalent. If manufacturers need to validate a part or appliance in the FAA system, they have to show compliance to the applicable FAA TSO(s). Therefore, any difference between ETSO(s) and TSO(s) has to be assessed. Equivalent levels of safety have to be demonstrated and related deviations from ETSO(s) or TSO(s) have to be substantiated. This creates additional burden and delays the approval process. On the contrary, when FAA TSO and ETSO coincide, the validation process on either side of the Atlantic is much simpler.
83. EASA has already published a large number of deviations for the ETSO(s) that have not been updated. These deviations are published on the EASA website¹².

Who is affected?

84. The following sectors of stakeholders are affected by the proposed changes to CS-ETSO:
- designers and manufacturers of equipment intended to be used in aeronautical products;
 - designers and manufacturers of aeronautical products.
85. The proposals contained in the present NPA have been developed by the Agency, and they are based on industry progress for software development, which affected Subpart A of CS-ETSO, and on regulatory material published by the FAA for the individual ETSOs (i.e. Subparts B and C).
86. The list of ETSOs to be updated or introduced has been published, after consultation with authorities and industry of Issue 3 of the ToR.
87. Furthermore, the list and principles were discussed in a public workshop on 28 June 2012. Therefore, drafting groups were not deemed necessary.
88. All citizens are consulted, for a period of three months, through the publication of this NPA on the Agency's website. They can raise comments on any part of this document (Explanatory Note, RIA, or proposed specifications).

What are the safety risks

89. In the absence of updated and harmonised FAA TSOs and ETSOs, the equipment may require additional verification in the design phase, at the end of production

¹² <http://easa.europa.eu/certification/docs/etso-authorisations/ETSO.Dev.pdf>.

(i.e. at factory level), or when installed in an aeronautical product, under the responsibility of the Type certificate (TC) or Supplemental TC holder.

90. The minimum performance requirements and any additional functionality are therefore always verified and as a consequence the risk of generating catastrophic or hazardous safety consequences is considered extremely remote.
91. Nevertheless, the proposal facilitates the introduction of more modern (and safer) technological solutions.

Objectives

92. The general objectives of this proposal, in compliance with Article 2 of the EASA Basic Regulation, are to:
 - facilitate the free movement of goods within the EU and worldwide;
 - promote cost-efficiency of the certification processes for equipment;
 - harmonise EASA specifications with the ones published by the FAA.
93. The specific objective of this NPA is to introduce new ETSO(s) or revise existing ETSO(s) specifications as a result of the continuing update of the industry's standards that reflect the latest technological developments and to harmonise with existing FAA TSO standards where possible.

Options

94. Three options have been identified:

No	Identification	Description
0	Do nothing	Do not publish new versions of EASA ETSOs aligned with latest FAA versions.
1	Amend CS-ETSO (with references)	Introduction of new ETSO(s) and transposition of selected TSO specifications into technically similar ETSO(s), published as amendment to CS-ETSO and wherever possible referring to applicable standards developed by industry (e.g. EUROCAE, RTCA, SAE, etc.).
2	Amend CS-ETSO (copy and paste)	As 1, but copying and pasting the entire content of the referred industry standards.

Analysis of the impacts

95. All identified impacts are qualitatively assessed (RIA light) and expressed in terms of a score = a numerical single digit from -3 (highly negative) to +3 (highly positive).
96. Safety scores, since safety is the primary objective of the Agency as per Article 2 of the Basic Regulation, are assigned a weight of 3. Environmental scores, based on the same article, have a weight of 2. Other scores have a weight of 1.

Safety

97. In general, adoption of the proposed ETSOs will have a positive impact on safety as a result of the introduction of new and improved technology ensuring compliance with the Agency's safety objectives. It should also be noted that some of these revised standards have already been integrated as approved deviations in ETSO parts or appliances (i.e. assessed in practice).

98. The three options can therefore be compared from the safety perspective in the table below:

Options	0	1	2
	Do nothing	Transpose by reference	Copy and paste
Assessment	More difficult to implement the latest industry developments to improve the standards.	Clear and short reference material available to facilitate implementation in aeronautical products of the latest (safest) technology	As 1
Score (unweighted)	-2	2	2
Weight	Multiply the unweighted score by: 3		
Score (weighted)	-6	6	6

Social impact

99. ETSOs provide the certification basis to issue 'Form 1', which is a declaration of conformity with the EASA regulatory material which is in turn worldwide recognised, legally based on Part-21, and widely accepted by manufacturers of aeronautical products, maintenance organisations and aircraft operators (i.e. the 'buyers' of aircraft parts for initial assembly of the aircraft or as replacements).
100. The absence of this 'Form 1' would make it more difficult for EU manufacturers to market their most advanced products, not only inside the Union, but worldwide too.
101. This more difficult marketing could in turn lead to fewer possibilities to create and maintain high-quality jobs in the EU.
102. The three options can therefore be compared from the social perspective in the table below:

Options	0	1	2
	Do nothing	Transpose by reference	Copy and paste
Assessment	Less probability of creating and maintaining high-quality jobs in the EU	High-quality jobs created and maintained in the EU	As 1
Score (unweighted)	-2	2	2
Weight	Multiply the unweighted score by: 1		
Score (weighted)	-2	2	2

Environmental impact

103. All three identified options are neutral from the environmental perspective.

Economic impact

104. No additional compulsory costs accrue in any case from options 1 and 2, in particular:
- for manufacturers of articles covered by ETSOs, since the application for an ETSO authorisation is not mandatory, but voluntary;
 - for aircraft operators registered in the EU, since the existence of an ETSO does neither constitute an obligation for mandatory carriage (e.g. for the new ULD mandated by Amendment 36 to ICAO Annex 6, Part I) nor for retrofit;
 - for users of the single European sky, since the existence of an ETSO does not in itself imply that the related equipment shall be fitted and used in the airspace where Air Navigation Services (ANSs) are provided by European ANS providers. This obligation is in fact based on possible SES implementing rules (e.g. mentioned Commission Regulation (EC) No 29/2009).
105. On the other hand the establishment and application of harmonised standards between the Agency and the FAA on subjects of common interest provide the basis for equipment approvals independent of aircraft approvals. This has a positive effect on the market value and applicability of equipment. The harmonisation of the ETSO and TSO standards will hence have a positive economic effect by contributing to the smooth validation of ETSO parts or appliances.
106. Furthermore, the proposed ETSOs benefit European aircraft designers and operators wishing to install equipment produced outside the EU, which means more competition in the market from the buyers' perspective.
107. On the other hand, the proposed ETSOs enhance the possibility for holders of ETSO authorisations to produce parts and appliances, including for use outside the EU. In other words they enhance the possibilities for export of high-technology articles.
108. The three options can therefore be compared from the economic perspective in the table below:

Options	0	1	2
	Do nothing	Transpose by reference	Copy and paste
Assessment	No additional compulsory cost for forward fit or retrofit, but less competition in the market and fewer possibilities for export.	No additional compulsory costs as in 0, but in addition more competition in the market and more possibilities for export.	As 1
Score (unweighted)	-3	3	3
Weight	Multiply the unweighted score by: 1		
Score (weighted)	-3	3	3

Proportionality issues

109. All applicants for ETSO authorisations are equally affected. However, in the absence of ETSO (and related authorisation and subsequent 'Form 1') the demonstration of functionality and performance has to be carried out under the responsibility of the TC/STC applicant/holder, who may be located at a significant distance from the manufacturer of the article, while more interaction (involving time and travel) between the two manufacturers could be required.
110. This additional coordination (and travel) may be a burden on small and medium-sized enterprises (SMEs).
111. The three options can therefore be compared from the proportionality perspective in the table below:

Options	0	1	2
	Do nothing	Transpose by reference	Copy and paste
Assessment	Burden on SMEs for more interaction (travel and time) with S/TC applicant/holder	Minimum interaction (travel and time) between the article manufacturer and the S/TC applicant/holder	As 1
Score (unweighted)	-1	1	1
Weight	Multiply the unweighted score by: 1		
Score (weighted)	-1	1	1

Regulatory coordination and harmonisation

112. 'Do nothing' would lead to loss of harmonisation with the FAA.
113. On the other hand copying and pasting material which is property of other organisations (e.g. EUROCAE), commercially available and whose intellectual property rights (IPRs) are protected, may render the Agency infringing copyright law.
114. The three options can therefore be compared from the proportionality perspective in the table below:

Options	0	1	2
	Do nothing	Transpose by reference	Copy and paste
Assessment	Loss of harmonisation with the FAA.	Harmonisation with the FAA maintained. No legal risks for the Agency.	Harmonisation with the FAA maintained, but potential legal risks for the Agency (i.e. copyright infringement).
Score (unweighted)	-2	3	-3
Weight	Multiply the unweighted score by: 1		
Score (weighted)	-2	3	-3

Comparison of the positive and negative impacts for each option evaluated

115. Harmonisation of EASA ETSOs with FAA TSOs would save costs by minimising any duplication of certification and maintenance activities in relation to parts and appliances. Such parts and appliances that meet the requirements of a TSO, but for which there is no similar ETSO, can only be approved when they are part of an (S)TC. This results in a disadvantage for installers of these parts and appliances.
116. European equipment manufacturers seeking TSO approval in the US cannot swiftly obtain such approval in the absence of an ETSO authorisation based on an ETSO standard.
117. European equipment purchasers may benefit from global competition among vendors when EASA ETSOs are harmonised with FAA TSOs.
118. Adoption of the proposed ETSO(s) has also a positive impact on safety though the introduction of new or improved technology. The systematic introduction of new standards enables the Agency to match new technology with adequate safety objectives.
119. However, option 3 would expose the Agency to legal risks.

Final assessment and recommendation of a preferred option

120. The above can be presented also using the multi-criteria analysis (MCA) methodology, the weighted scores assigned above are algebraically summed:

Options	0	1	2
	Do nothing	Transpose by reference	Copy and paste
	Weighted score		
Safety	-6	6	6
Social impact	-2	2	2
Environment	0	0	0
Economic impact	-3	3	3
Proportionality	-1	1	1
Regulatory harmonisation	-2	3	-3
TOTAL	-14	15	9

121. From the table above one can observe that option 0 ('do nothing') shows a significantly negative score, from any perspective (including safety, but except environment for which it is, like all the others, neutral) including safety, as well as for the negative economic and social implications.
122. Option 2 ('copy and paste') is significantly positive in safety terms (like 1) and also from the social and economic point of view, but it poses a significant legal risk for the Agency.
123. Option 1 is the only one positive, or even highly positive, from any perspective (except from the environmental point of view for which it is neutral).
124. **Therefore, option 1 (i.e. update the ETSOs, but refer to industry standards by reference) is the preferred one.**

B. Draft Decision

The text of the amendment is arranged to show deleted text, new text or new paragraph as shown below:

1. deleted or amended text is shown with a strike through: ~~deleted~~
2. new text is highlighted with grey shading: **new**
3. ... indicates that remaining text is unchanged in front of or following the reflected amendment.

I. Draft Decision ETSO

SUBPART A CS-ETSO

SUBPART A – GENERAL

1. APPLICABILITY

1.1 Requirements for the issue of European Technical Standard Order (ETSO) Authorisations are found in Part-21, Section A, Subpart O.

1.2. Marking requirements for the issue of European Technical Standard Order Authorisations are found in Part-21, Section A, Subpart Q.

2. ENVIRONMENTAL AND SOFTWARE STANDARDS TO MEET TECHNICAL CONDITIONS

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 '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 or ED-14G/RTCA-160G dated December 2010.

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

2.2 Software standards

If the equipment design implementation includes a digital computer, the computer software must be verified and validated in an acceptable manner.

Unless otherwise stated otherwise in paragraph 3.1.3 of the specific ETSO, one acceptable means of compliance for the verification and validation of the computer software is outlined in the latest revision of AMC 20-115 EUROCAE/RTCA document ED-12B/DO-178B, "S on software considerations in Airborne Systems and Equipment Certification", dated December 1992.

For those applicants who elect to use EUROCAE/RTCA document ED-12B/DO-178B to demonstrate compliance for the verification and validation of the computer software, the following requirements must be met:

(i) This document defines five levels of software:

Level A, Level B, Level C, Level D, and Level E. The applicant must declare the level (or levels) to which the computer software has been verified and validated.

(ii) If the equipment incorporates more than one software level, appropriate partitioning of different software level is required.

2.3 Airborne Electronic hardware (AEH)

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 Airborne Electronic hardware (AEH) 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 Airborne Electronic 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

Develop the system to, at least, the design development assurance level equal to the failure condition classifications provided in the ETSO. A lower 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.

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

~~To~~ For system development system design assurance, including guidance for failure condition classifications, the applicant may use EUROCAE/SAE document ED-79A/ARP 4754A 'Certification Considerations Guidelines for development of Highly Integrated or Complex civil Aircraft and Systems' dated November 1996 December 2010.

3. ADDITIONAL INFORMATION

3.1 In some ETSO's, reference is made to an associated FAA standard and in these cases the FAA standard is attached to the ETSO. Where in the associated 'FAA' standard, reference is made to 'FAA' of 'FAR', it should be replaced substituted by the equivalent reference, 'Agency' or 'Part/CS'.

3.2 The following addresses are provided below:

— 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, website: www.eurocae.net)

— RTCA documents may be purchased from:
Radio Technical Commission for Aeronautics, Inc.
1828 L Street NW, Suite 805, Washington DC 20036, USA
(Website: www.rtca.org)

— SAE documents may be purchased from:
Society of Automotive Engineers, Inc.
400 Commonwealth Drive, WARRENDALE, PA 15096-001, USA
(Website: www.sae.org)

— NAS specifications may be obtained from:
Aerospace Industries Association (AIA)
1327 Jones Drive, Ann Arbor, MI 48105, USA
(Website: www.techstreet.com)

— FAA Standards may be purchased from:
Superintendent of Documents, Government Printing Office
732N Capitol Street NW, Washington DC 20401, USA
(Website: www.gpoaccess.gov)

— MIL Specifications may be obtained from:
DODSSP, Standardization Documents Order Desk
Building 4D, 700 Robbins Avenue, PHILADELPHIA, PA 19111-5094, USA
(Website: <http://dodssp.daps.mil/>)

— ASTM documents may be purchased from:
American Society for Testing and Materials, ASTM International,
100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania 19428-2959,
USA
(Website: www.astm.org)

SUBPART B – LIST OF ETSOs (INDEX 1 AND INDEX 2)**INDEX 1**

ETSO-C1c	Cargo Compartment Fire Detection Instruments
ETSO-C2d	Airspeed Instruments
ETSO-C3d	Turn and Slip Instruments
ETSO-C4c	Bank and Pitch Instruments
ETSO-C5e	Direction Instrument, Non-magnetic (Gyroscopically Stabilized)
ETSO-C6e	Direction Instrument, Magnetic (Gyroscopically Stabilized)
ETSO-C7d	Direction Instrument, Magnetic Non-stabilized Type (Magnetic Compass)
ETSO-C8e	Vertical Velocity Instrument (Rate-of-Climb)
ETSO-C9e	Automatic Pilot
ETSO-C10b	Aircraft Altimeter, Pressure Actuated, Sensitive Type
ETSO-C13f	Life preservers
ETSO-C14b	Aircraft Fabric, Intermediate Grade; External Covering Material
ETSO-C15d	Aircraft Fabric, Grade A; External Covering Material
ETSO-C16a	Electrically Heated Pitot and Pitot-Static Tubes
ETSO-C20	Combustion Heaters
ETSO-C21b	Aircraft turnbuckle Assemblies and/or Turnbuckle Safetying Devices
ETSO-C22g	Safety Belts
ETSO-C23d	Personal Parachute Assemblies
ETSO-C25a	Aircraft Seats and Berths (Type I Transport 6g Forward Load)
ETSO-C26c	Aircraft Wheels and Wheel-Brake Assemblies (CS-23, 27 and 29 aircraft)
ETSO-C27	Twin Seaplane Floats
ETSO-C28	Aircraft Skis
ETSO-C30c	Aircraft Position Lights
ETSO-C39c	Aircraft Seats and Berths Certified by Static Testing only
ETSO-C42	Propeller Feathering Hose Assemblies
ETSO-C43c	Temperature Instruments
ETSO-C44c A1	Fuel Flowmeters

ETSO-C45b A1	Manifold Pressure Instruments
ETSO-C46a	Maximum Allowable Airspeed Indicator System
ETSO-C47a A1	Pressure Instruments — Fuel, Oil, and Hydraulic (Reciprocating Engine Powered Aircraft)
ETSO-C49b	Electric tachometer: Magnetic Drag (Indicator and generator)
ETSO-C52b	Flight Directors
ETSO-C53a	Fuel and Engine Oil System Hose Assemblies
ETSO-C54	Stall Warning Instruments
ETSO-C55a	Fuel and Oil Quantity Instruments
ETSO-C56b A1	Engine-driven Direct Current Generators/Starter generators
ETSO-C59	Airborne Selective Calling Equipment
ETSO-C60b	Airborne Area Navigation Equipment Using Loran-C Inputs
ETSO-C62e	Aircraft Tyres
ETSO-C64a	Oxygen Mask Assembly, Continuous Flow, Passenger
ETSO-C65a	Airborne Doppler Radar Ground Speed and/or Drift Angle Measuring Equipment (for Air Carrier Aircraft)
ETSO-C68a	Airborne Automatic Dead Reckoning Computer Equipment Utilizing Aircraft heading and Doppler Ground Speed and Drift Angle Data (for Air Carrier Aircraft)
ETSO-C69c	Emergency Evacuation Slides, Ramps and Slide/Rafts Combinations
ETSO-C71	Airborne Static ('DC to DC') Electrical Power Converter (for Air Carrier Aircraft)
ETSO-C72c	Individual Flotation Devices
ETSO-C73	Static Electrical Power Inverter
ETSO-C74d	Airborne ATC Transponder Equipment
ETSO-C76	Fuel Drain Valves
ETSO-C79	Fire Detectors (Radiation Sensing Types)
ETSO-C80	Flexible Fuel and Oil Cell Material
ETSO-C85a	Survivor Locator Lights
ETSO-C87a	Airborne Low-range Radio Altimeter
ETSO-C88a	Automatic Pressure Altitude Reporting Code Generating Equipment
ETSO-C89	Oxygen Regulators, Demand
ETSO-C90d	Cargo Pallets, Nets and Containers

ETSO-C92c	Ground Proximity Warning, Glide Slope Deviation Alerting Equipment
ETSO-C95a	Mach Meters
ETSO-C96a	Anticollision Light Systems
ETSO-C97	Lithium Sulphur Dioxide Batteries
ETSO-C99	Protective Breathing Equipment
ETSO-C100b	Child restraint system
ETSO-C101	Overspeed Warning Instruments
ETSO-C102	Airborne Radar Approach and Beacon Systems for Helicopters
ETSO-C103	Continuous Flow Oxygen Mask Assembly (for Non-transport Category Aircraft)
ETSO-C105	Optional Display Equipment for Weather and Ground Mapping Radar Indicators
ETSO-C106 A1	Air Data Computer
ETSO-C109	Airborne navigation Data Storage System
ETSO-C110a	Airborne Passive Thunderstorm Detection Systems
ETSO-C112ed	Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment
ETSO-C113	Airborne Multi-purpose Electronic Displays
ETSO-C114 A1	Torso Restraint Systems
ETSO-C115bc	Flight Management Systems (FMS) using Multi-Sensor Inputs
ETSO-C116	Crew member PBE
ETSO-C117a	Airborne Windshear Warning and Escape Guidance Systems (Reactive Type) for Transport Aeroplanes
ETSO-C118	TCAS I
ETSO-C119c	TCAS II
ETSO-C121ab	Underwater Locating Device
ETSO-C123b	Cockpit Voice Recorders Systems
ETSO-C124b	Flight Data Recorder Systems
ETSO-C126a	406 MHz Emergency Locator Transmitter
ETSO-C127a	Rotorcraft, Transport Aeroplane, and Normal and Utility Aeroplane Seating Systems
ETSO-C132	Geosynchronous Orbit Aeronautical Mobile Satellite Services Aircraft Earth Station Equipment

ETSO-C135a	Large Aeroplane Wheels and Wheels and Brake Assemblies
ETSO-C139	Aircraft Audio Systems and Equipment
ETSO-C141	Aircraft Fluorescent Lighting Ballast/Fixture Equipment
ETSO-C142a	Non-Rechargeable Lithium Cells and Batteries
ETSO-C144a	Passive Airborne Global Positioning System (GNSS) Antenna
ETSO-C145c	Airborne Navigation Sensors Using the Global Positioning System Augmented by the Satellite Based Augmentation System
ETSO-C146c	Stand-Alone Airborne navigation Equipment Using the Global Positioning System Augmented by the Satellite Based Augmentation System
ETSO-C147	Traffic Advisory System (TAS) Airborne Equipment
ETSO-C151b	Terrain Awareness and Warning System (TAWS)
ETSO-C154c	Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment
ETSO-C155a	Recorder Independent Power Supply
ETSO-C157a	Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment
ETSO-C158	Aeronautical Mobile High Frequency Data Link (HF DL) Equipment
ETSO-C159a	Avionics Supporting Next generation Satellite Systems (NGSS) = Iridium Phone
ETSO-C160a	VDL Mode 2 Communications equipment
ETSO-C161a A1	Ground-Based Augmentation System Positioning and Navigation Equipment
ETSO-C162a	Ground-Based Augmentation System Very High Frequency Data Broadcast Equipment
ETSO-C164	Night Vision Goggles (NVG)
ETSO-C165	Electronic Map Display Equipment for Graphical Depiction of Aircraft Position
ETSO-C166b A1	Extended Squitter ADS-B and TIS-B Equipment Operating on the RF of 1090 Megahertz (MHz)
ETSO-C170	High Frequency (HF) Radio Communication Transceiver Equipment Operating Within the Radio Frequency 1.5 to 30 Megahertz
ETSO-C172	Cargo Restraint Strap Assemblies
ETSO-C173	Nickel-Cadmium and Lead-Acid Batteries
ETSO-C174 A1	Battery Based Emergency Power Unit (BEPU)
ETSO-C175	Galley Cart, Containers and Associated Components

ETSO-C176	Crash Protected Airborne Recorder Systems Image Recorder
ETSO-C177	Crash Protected Airborne Recorder Systems CNS/ATM Recorder
ETSO-C178	Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers
ETSO-C179a	Rechargeable Lithium Cells and Lithium Batteries
ETSO-C184	Galley Equipment
ETSO-C190	Active Airborne Global navigation Satellite System (GNSS) Antenna
ETSO-C194	Helicopter Terrain Awareness and Warning System (HTAWS)
ETSO-C195a	Avionics Supporting Automatic Dependent Surveillance-Broadcast (ADS-B) Aircraft Surveillance
ETSO-C196a	Airborne Supplemental navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation
ETSO-C198	Automatic Flight Guidance and Control System (AFGCS) Equipment
ETSO-C200	Low-frequency Underwater Locating Device (ULD)

INDEX 2

ETSO-2C11e	Powerplant Fire Detection Instruments (Thermal and Flame Contact Types)
ETSO-2C19b	Fire Extinguishers, Portable Water Type
ETSo-2C34f	Glide Slope Receiving Equipment Operating within the Radio Frequency Range of 328.6-335.4 Megahertz (MHz)
ETSO-2C35d	Radar Marker Receiving Equipment
ETSO-2C36f	Airborne ILS Localizer Receiving Equipment Operating within the Radio Frequency Range 108-112 Megahertz
ETSO-2C40c	VOR Receiving Equipment Operating within the Radio Frequency Range of 108-117.95 Megahertz
ETSO-2C41d	Airborne Automatic Direction Finding (ADF) Equipment
ETSO-2C48a	Carbon Monoxide Detector Instruments
ETSO-2C63c	Airborne Weather and Ground Mapping Pulsed Radars
ETSO-2C66b	Distance measuring Equipment (DME) Operating within the Radio Frequency Range 960-1215 Megahertz
ETSO-2C70b	Liferafts (Reversible and Non-reversible)
ETSO-2C75	Hydraulic Hose Assembly
ETSO-2C78	Crewmember Oxygen Mask
ETSO-2C87	Airborne Low range Radio Altimeter
ETSO-2C91a	Emergency Locator Transmitter (ELT) Equipment
ETSO-2C93b	Airborne Interim Standard Microwave Landing System Converter Equipment
ETSO-2C104a	Microwave Landing System (MLS) Airborne Receiving Equipment
ETSO-2C122	Devices That Prevent Blocked Channels Used in Two-Way Radio Communications Due to Simultaneous Transmissions
ETSO-2C128	Devices That Prevent Blocked Channels Used in Two-Way Radio Communications Due to Unintentional Transmissions
ETSO-2C169a	VHF Radio Communications Transceiver Equipment Operating within the Radio Frequency Range 117.975 to 137 Megahertz
ETSO-2C197	Information Collection and Monitoring Systems
ETSO-2C500a	Combined ILS/MLS Airborne Receiving Equipment
ETSO-2C501	Mode S Aircraft Data Link Processor
ETSO-2C502	Helicopter Crew and Passenger Integrated Immersion Suits

ETSO-2C503	Helicopter Crew and Passenger Immersion Suits for Operations to or from Helidecks Located in a Hostile Sea Area
ETSO-2C504	Helicopter Constant-Wear Lifejackets for Operations to or from Helidecks Located in a Hostile Sea Area
ETSO-2C505	Helicopter Liferafts for Operations to or from Helidecks Located in a Hostile Sea Area
ETSO-2C509	Light Aviation Secondary Surveillance Transponders (LAST)
ETSO-2C512	Portable Gaseous Oxygen Supply (PGOS)
ETSO-2C513	Tow Release
ETSO-2C514	Airborne Systems for Non-Required Telecommunication Services (in Non-Aeronautical Frequency Bands) (ASNRT)

ETSO-C44c A1

European Aviation Safety Agency

Date: XX/XX/20XX

European Technical Standard Order (ETSO)

Subject: FUEL FLOWMETERS

1 – Applicability

This ETSO gives the requirements which fuel flowmeters 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 **Appendix 1**.

3.1.2 – Environmental Standard

The Fuel Flowmeter must be tested in accordance with SAE AS407C 'Fuel Flowmeters' from July 1, 2001, unless otherwise specified by Appendix 1 of this ETSO, SAE AS1055D 'Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components' (sections 4 and 5) from June 1997, and EUROCAE ED-14E (RTCA DO-160E) 'Environmental Conditions and Test Procedures for Airborne Equipment' from March 2005 the applicable environmental test procedure as specified by paragraph 2.1 of CS-ETSO, Subpart A, unless otherwise specified by Appendix 1 of this ETSO.

3.1.3 – Computer Software

If the equipment design includes a digital computer, the software must be developed in accordance with EUROCAE ED-12B (RTCA DO-178B) 'Software Considerations in Airborne Systems and Equipment Certification' from 1992. see CS-ETSO, Subpart A, paragraph 2.2, for software development.

3.1.4 – Airborne 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.

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

5 – Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

APPENDIX 1

MINIMUM PERFORMANCE STANDARD FOR FUEL FLOWMETERS

1. General requirements

The applicable standard is SAE AS407C, *Fuel Flowmeters*, dated July 1, 2001.

Paragraphs 3.1, 3.1.1, 3.1.2, 3.2.b, and 4.2.1 of the SAE AS407C do not apply to this ETSO.

SAE AS407C must be applied as follows (changed text shown boxed):

a. Temperature On page 2 of SAE AS407C, replace Table 1 with the following table.

TABLE 1		
INSTRUMENT LOCATION	<u>A</u>	<u>B</u>
Heated Areas (Temp. Controlled)	-30 to 50 °C	-65 to 70 °C
Unheated Areas (Temp. Controlled)	-55 to 70 °C	-65 to 100 °C
Power Plant Compartment	-55 to 70 °C	-65 to 100 °C
Power Plant Accessory Compartment	-55 to 70 °C	-65 to 100 °C

b. Altitude In the first sentence of paragraph 3.3.4, Altitude, (page 3), replace '40.000 feet (12.192 m) standard altitude' with '51.000 ft (15.545 m) standard altitude'.

c. Leak test In the second sentence of paragraph 6.3, Leak Test, (page 6), replace 'to an air pressure of 40 psi (275.8 kPa)' with 'to an air pressure in accordance with the manufacturer's recommendations'.

2. Testing your fuel flowmeter

In addition to the qualification test requirements described in SAE AS407C, perform the following tests:

a. Thermal shock test This test applies to any hermetically sealed components. Subject the components to four cycles of exposure to water 85 °C ± 2 °C and 5 °C ± 2 °C. There should be no evidence of moisture damage to coating or enclosure. During each cycle of the test, immerse the component in water at 85 °C ± 2 °C for 30 minutes. Within 5 seconds of removal from the bath, immerse the component for 30 minutes in the other bath maintained at 5 °C ± 2 °C. Repeat this cycle continuously, one cycle following the other until four cycles are completed. After this test, subject the component to the sealing test in paragraph 2b(2) of this appendix. The component must have no leakage resulting from the test.

b. Sealing test Apply this performance test to any hermetically sealed components. Immerse the component in a suitable liquid such as water. Then reduce the absolute pressure of the air above the liquid to about 1 inch of mercury (Hg) (3.4 kPa). Maintain this absolute pressure for 1 minute, or until the liquid stops giving off air bubbles, whichever is longer. Increase the absolute

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APPENDIX 1

pressure by 2½ inches Hg (8.5 kPa). If any bubbles come from the component case, consider it leakage and reject the component.

Do not consider bubbles, resulting from entrapped air in the exterior parts of the case, as leakage. If other test methods provide evidence equal to the immersion test, they can be used to test the integrity of the instrument's seals. If the component includes non-hermetically sealed appurtenances such as a case extension, these appurtenances can be removed before the sealing test.

c. Other tests The following table lists where other tests and conditions can be found:

For:	Use the test conditions in:
Fire-resistant or fireproof test	SAE AS 1055, Rev. D, dated June 1997, Sections 4 and 5
	The following sections of the environmental standards mentioned in paragraph 3.1.2 above.
Explosion proofness test	EUROCAE ED 14E /RTCA/DO 160E Section 9
Power input test	EUROCAE ED 14E /RTCA/DO 160E Section 16
Voltage spike test	EUROCAE ED 14E /RTCA/DO 160E Section 17
Audio frequency conducted susceptibility test	EUROCAE ED 14E /RTCA/DO 160E Section 18
Induced signal susceptibility test	EUROCAE ED 14E /RTCA/DO 160E Section 19
Radio frequency susceptibility test	EUROCAE ED 14E /RTCA/DO 160E Section 20

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European Aviation Safety Agency

Date: xx/xx/2008

European Technical Standard Order (ETSO)

Subject: MANIFOLD PRESSURE INSTRUMENTS

1 – Applicability

This ETSO gives the requirements which manifold pressure 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

Standard set forth in the SAE Aerospace Standard (AS) document: SAE AS 8042 from December 1, 1985, unless otherwise specified by Appendix 1 of this ETSO.

3.1.2 – Environmental Standard

The Manifold Pressure Instruments must be tested according to Section 7 of SAE AS 8042 and EUROCAE ED 14E (RTCA DO 160E) *'Environmental Conditions and Test Procedures for Airborne Equipment'* from March 2005. the environmental test procedures as defined in CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 – Computer Software

If the Manifold Pressure Instruments includes a digital computer, the software must be developed according to EUROCAE ED 12B (RTCA DO 178B), *'Software Considerations in Airborne Systems and Equipment Certification'*, dated December 1992. see CS-ETSO, Subpart A, paragraph 2.2, for software development.

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.

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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.

APPENDIX 1**MINIMUM PERFORMANCE STANDARD
FOR MANIFOLD PRESSURE INSTRUMENTS**

This appendix lists EASA modifications to the MPS for Manifold Pressure Instruments.

The applicable standard is SAE AS 8042, Manifold Pressure Instruments, dated December 1, 1985.

1. Manifold Pressure Instruments are not required to meet the requirements in SAE AS 8042, paragraphs 3.1, 3.2, and 3.3.

2. Replacement of SAE AS 8042, paragraph 3.24.2 (Fire Hazards), by:

'Except for small parts (such as fasteners, grommets, knobs, seals, and small electrical parts) that would not contribute significantly to the propagation of a fire, all material used must be self-extinguishing when tested in accordance with the requirements of CS 25.869(a)(4) and the applicable portions of Part I, Appendix F.'

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European Aviation Safety Agency

Date: xx/xx/2008

European Technical Standard Order (ETSO)

Subject: PRESSURE INSTRUMENTS — FUEL, OIL, AND HYDRAULIC

1 — Applicability

This ETSO gives the requirements which fuel, oil, and hydraulic pressure 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: SAE AS 408C 'Pressure Instruments — Fuel, Oil, and Hydraulic' from July 1, 2001, unless otherwise specified by Appendix 1 of this ETSO.

3.1.2 — Environmental Standard

Testing fuel, oil, and hydraulic pressure instruments must be in accordance with SAE AS408C section 7 and EUROCAE ED-14E (RTCA DO-160E) 'Environmental Conditions and Test Procedures for Airborne Equipment' from March 2005. See CS-ETSO, Subpart A, paragraph 2.1, for environmental test procedures.

3.1.3 — Computer Software

If fuel, oil, and hydraulic pressure instrument includes a digital computer, the software must be developed according to EUROCAE ED-12B (RTCA DO-178B) 'Software Considerations in Airborne Systems and Equipment Certification' from 1992. See CS-ETSO, Subpart A, paragraph 2.2, for software development.

3.1.4 Electronic Hardware Qualification

If the fuel, oil, and hydraulic pressure instrument includes a complex custom micro-coded component, this must be developed according to EUROCAE ED-80 (RTCA DO-254), 'Design Assurance Guidance for Airborne Electronic Hardware' from April 2000. See CS-ETSO, Subpart A, paragraph 2.4.

3.2 — Specific

None.

3.2.1 — Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

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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 1.27.

4.2 – Specific

a) At least one major component of the fuel, oil, and hydraulic pressure instrument shall be marked permanently and legibly with all the information as provided for in SAE AS408C, Section 3.2 (except paragraph 3.2.b).

b) Mark 'Fire-resistant' or 'Fireproof' information legibly and permanently.

5 – Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

APPENDIX 1-

MINIMUM PERFORMANCE STANDARDS (MPSs) FOR PRESSURE INSTRUMENTS — FUEL, OIL, AND HYDRAULIC

1. The MPSs applying to this ETSO are provided in SAE AS408C, Pressure Instruments — Fuel, Oil, and Hydraulic, dated July 1, 2001, except for paragraphs 3.1, 3.1.1, 3.1.2, and 3.2.b.

Here are provided the modifications to be applied to the referenced SAE document:

AS408C

modification:

Title	Replace 'Pressure Instruments — Fuel, Oil, and Hydraulic (Reciprocating Engine Powered Aircraft)' Substitute: 'Pressure Instruments — Fuel, Oil, and Hydraulic'.
Section 1.1	Replace '... primarily for use with reciprocating engine powered transport aircraft, ...' Substitute: '... for use with civil aircraft, ...'

AS408C section 7

modification:

Para 7.13	Use test conditions in SAE AS1055 Rev D, 'Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components', dated June 1, 1997, Sections 4 and 5. The following test conditions from the environmental standards mentioned in paragraph 3.1.2 above are added.
Para 7.14	Add test conditions in EUROCAE ED-14E / RTCA DO-160E, Section 16, Power Input.
Para 7.15	Add test conditions in EUROCAE ED-14E / RTCA DO-160E Section 17, Voltage Spike.
Para 7.16	Add test conditions in EUROCAE ED-14E / RTCA DO-160E Section 18, Audio Frequency Conducted Susceptibility — Power Inputs.
Para 7.17	Add test conditions in EUROCAE ED-14E / RTCA DO-160E Section 19, Induced Signal Susceptibility
Para 7.18	Add test conditions in EUROCAE ED-14E / RTCA DO-160E Section 20, Radio Frequency Susceptibility.

2. The performance of fuel, oil, and hydraulic pressure instruments can be enhanced or made superior to this specification, depending on intended application and configuration.

European Aviation Safety Agency

Date: xx/xx/2008

European Technical Standard Order (ETSO)

Subject: ENGINE-DRIVEN DIRECT CURRENT GENERATORS/STARTER GENERATORS

1 – Applicability

This ETSO gives the requirements which eEngine-dDriven dDirect cCurrent generators/starter generators 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 cConditions

3.1 – Basic

3.1.1 – Minimum pPerformance sStandard

Standards set forth in the SAE Aerospace Standard (AS) document: AS8020, '*Engine-Driven D.C. Generators/Starter Generators and Associated Voltage Regulators*', dated January 1980 (and reaffirmed by SAE in August 1991).

3.1.2 – Environmental sStandard

~~EUROCAE ED-14E (RTCA DO160E) 'Environmental Conditions and Test Procedures for Airborne Equipment' from March 2005.~~

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 – Computer sSoftware

If the Engine-Driven Direct Current Generator/Starter Generator and the associated voltage regulators include a digital computer, ~~the software must be developed according to EUROCAE ED-12B (RTCA DO-178B) 'Software Considerations in Airborne Systems and Equipment Certification' from 1992~~ see CS-ETSO, Subpart A, paragraph 2.2, for software development.

3.1.4 – Airborne Electronic hardware qualification

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 – Specific

None.

4 – Marking

4.1 – General

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

4.2 – Specific

In addition to the information specified in §4.1, the following information is required:

- (1) Means of indicating if the article is a D.C. generator or a D.C. starter generator;
- (2) Nominal power output (electrical voltage and watts);
- (3) Mechanical power input requirements (pad requirements).

5 – Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AIRBORNE LOW-RANGE RADIO ALTIMETER

1 – Applicability

This ETSO gives the requirements which Airborne Low-range Radio Altimeter 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 EUROCAE ED-30, Minimum Performance Standards for Airborne Low-Range Radar Altimeter Equipment, dated March 1980 as modified by Appendix 1 to this ETSO.

In addition to Chapter 5 of EUROCAE document ED-30, all materials used except small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire, must be self-extinguishing when tested in accordance with applicable requirements of CS-25 Appendix F.

The applicable Chapter 2 and Chapter 3 requirements are defined in Table 1 for the appropriate functional class.

Table 1

Low-Range Radio Altimeter Functional Class	Low-Range Radio Altimeter Class Description	Applicable requirements in ED-30
A	Approach and landing	2.1-2.8, 3.1, 3.1.1, 3.2.1, 3.2.1.1, 3.2.1.2, 3.2.1.3, 3.2.1.4, 3.3.1
B	Terrain Avoidance (ground proximity warning systems)	2.1-2.8, 3.1, 3.1.2, 3.2.3, 3.2.3.1, 3.2.3.2, 3.2.3.3, 3.2.3.4, 3.3.2

Note: It is possible for a radio altimeter to meet both functional classes.

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 — Airborne Electronic hardware qualification

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

None.

3.2.1 Failure condition classification

There is no standard minimum failure condition classification for this TSO. The failure condition classification appropriate for the equipment will depend on the intended use of the equipment in a specific aircraft.

4 — Marking

4.1 — General

Marking as 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.

**APPENDIX 1
 MODIFICATIONS AND ADDITIONS TO EUROCAE ED-30
 FOR MINIMUM PERFORMANCE STANDARDS FOR LOW-RANGE RADIO ALTIMETERS**

1.0. ED-30 REQUIREMENT MODIFICATIONS

1.1. ED-30 Paragraph 1.3 (Radio Altimeters with Auto-Surveillance). ETSO-C87a does not include a separate category for monitoring. Design the radio altimeter to support the failure condition classification of the intended installation.

1.2. ED-30 Paragraph 2.2 (Transmitter Operating Frequency). Add the following requirement to ED-30, paragraph 2.2: The radio altimeter shall meet the International Telecommunication Union (ITU) regulations, if applicable.

1.3. ED-30 Paragraph 2.5 (Failure Warning). Add the following sentence to the beginning of ED-30, paragraph 2.5, to clarify that a failure detection system is required: 'A failure detection system must be incorporated in the equipment to indicate to the pilot, and to any systems utilizing the radio altimeter data, a failure of the radio altimeter to accomplish its intended function or an inability to meet the performance requirements in this document.'

1.4. ED-30 Paragraph 3.2.2 (Category A2). ETSO-C87a does not include Category A2. If alternate accuracy requirements not meeting the requirements of paragraph 3.2.1 are desired, the applicant should apply for a deviation in accordance with paragraph 3.g. of this ETSO.

1.5. ED-30 Paragraph 3.2.4 (Category C). ETSO-C87a does not include Category C. If the radio altimeter has been designed and tested to tighter accuracy requirements, include the design information, test results, and limitations with the application for ETSO and document the performance in the installation manual.

1.6. ED-30 (Appendix). The ED-30 appendix references TSO-C87 and RTCA/DO-123 for external loop loss standards. As TSO-C87 and DO-123 are no longer current, reference RTCA/DO-155, *Minimum Performance Standards Airborne Low-Range Radar Altimeters*, Appendix B, for external loop loss standards instead.

2.0. REQUIREMENT ADDITIONS to ED-30: Rate Data. The equipment need not provide a rate data output as a condition of compliance with this minimum performance standard. Altimeters with rate outputs must meet the following accuracy requirements for at least 95 percent of all observations for heights from the terrain to the antenna:

RATE DATA

Height (ft)	Range (ft/sec)	Accuracy (ft/sec)
3-100	0-15	± (1.5 ft.+ 0.01 h + 0.1 /r/)
100-200	0-20	± (2.0 ft.+ 0.01 h + 0.1 /r/)

Where: h = altitude in feet; and /r/ = absolute value of rate (feet/sec.)

ETSO-C106 A1**Date: 24.10.2003****Date: xx.xx.201x**

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AIR DATA COMPUTER

1 — Applicability

This ETSO gives the requirements which air data computers 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 Standards set forth in the SAE Aerospace Standard (AS) AS 8002 'Air Data Computer', dated April 1, 1985, as amended by this ETSO:

— Paragraph 4.2 of document AS 8002 shall be deleted and replaced by the following:

— Static source Error Correction (if applicable)

Unless otherwise noted, outputs may be corrected for static source errors of the specific aircraft model in which the computer is intended to be used.

— The tolerance of correction value produced from the correction profile (correction curve) residing in the computer shall be the sum of the following:

A — ~~plus or minus~~ $\pm 15\%$ of theoretical value of correction or equivalent of ~~plus or minus~~ ± 8.44 Pa (.0025 inch Hg) static pressure, whichever is greater.

B — Value of correction curve slope times the tolerance of independent variable programming the correction curve.

When testing corrected parameters (altitude, airspeed or Mach) the nominal value of the parameter at each test point indicated in Tables 1, 3 or 4 shall be adjusted to include the correction value with tolerance limits set per (A) and (B) above.

— Exception TABLE 3, CALIBRATED AIRSPEED: A looser tolerance of ~~plus or minus~~ ± 6.5 km/h

(3.5 knots) may be used at the 148 km/h (80 knots) reference point.

3.1.2 — Environmental standard

See Subpart A, paragraph 2.1.

3.1.3 — Computer Software

See Subpart A, paragraph 2.2.

3.2 — Specific
None.

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-C112ed**Date: 21.12.2010****Date: xx.xx.2011**

European Aviation Safety Agency

European Technical Standard Order (ETSO)

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

1 – Applicability

This ETSO gives the requirements which airborne Mode S air traffic control (ATC) transponder Air Traffic Control Radar Beacon System/Mode Select (ATCRSB/Mode S) Airborne Equipment 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 EUROCAE ED-73C, 'Minimum Operational Performance Standards for Secondary Surveillance Radar Mode S Transponders' dated September 2008 Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment', dated May 2011.

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

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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 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 as detailed in CS-ETSO, Subpart A, paragraph 1.2.

4.2 – Specific

~~None.~~

The marking must also include the transponder's functional level, minimum peak output power, and optional additional features as provided for in ED-73E.

5 – Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: TORSO RESTRAINT SYSTEMS

1 – Applicability

This ETSO gives the requirements which torso restraint 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 SAE Aerospace Standard (AS) document: AS 8043 'Aircraft Torso Restraint System', dated March 1986.

3.1.2 – Environmental Standards

- (i) American Society for Testing Materials (ASTM) G23-81, Standard Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.
- (ii) ASTM D17-73, Standard Method of Salt Spray (Fog) Testing.
- (iii) ASTM D756-78, Standard Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions.

3.1.3 – Tests Methods

- (i) American Association of Textile Chemists and Colorists (AATCC) Standard Test Method 8-1981, Colorfastness to Crocking.
- (ii) AATCC Standard Test Method 107-I 981, Colorfastness to Water.
- (iii) Federal Test Method Standard 191 Method 5906.
- (iv) AATCC Chart for Measuring Transference of Color.

3.1.4 – Computer Software

None.

3.2 – Specific

None.

ETSO-C114 A1**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.
- AATCC Chart for Measuring Transference of Color and Standard Test Materials 8-1981 and 1071981 may be purchased from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.
- Federal Test Method Standard 191 Method 5906 may be purchased from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

ETSO-C115bc**Date: 24.10.03****Date: xx.xx.2011**

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AIRBORNE AREA NAVIGATION EQUIPMENT FLIGHT MANAGEMENT SYSTEMS
(FMS) USING MULTI-SENSOR INPUTS

1 – Applicability

This ETSO gives the requirements which Airborne Area Navigation Equipment Flight Management Systems (FMS) using Multi-Sensor Inputs 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-58 (June 1988) (RTCA DO-187 (1984)).~~

Standards set forth in the RTCA DO-283A, Minimum Operational Performance Standards for Required Navigation Performance for Area Navigation, dated 28/10/2003.

3.1.2 – Use of Global Positioning System Sensors

~~EUROCAE document ED-72A, „Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS),“ dated April 1997, and ETSO C129a, Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS), provide standards for the use of GPS sensors. These standards provide additional and, in some cases, contradictory requirements to the requirements of this ETSO. Additional operational capabilities have been authorized for aircraft equipped with ETSO C129a compliant equipment. If the ETSO applicant wishes to manufacture equipment that is eligible for these additional operational capabilities, then the applicant must certify that the GPS sensor is compliant with ETSO C129a. In this case the following criteria shall apply:~~

~~(i) All additional standards contained in ETSO C129a that apply to the appropriate class (B or C) of sensor being incorporated into the multi-sensor system must be complied with in addition to the requirements of this ETSO.~~

~~(ii) The performance requirements of ETSO C129a take precedence over this ETSO when the GPS sensor is being used for navigation. It is acceptable to revert to the criteria of this ETSO when the GPS sensor is not installed or is otherwise not available. Reversion from ETSO C129a~~

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~~requirements to ETSO C115b requirements must be continuously in the pilot's primary field of view.~~

~~(iii) If any conflict is encountered between the two ETSOs, ETSO C129a will always take precedence over ETSO C115b.~~

~~(iv) The requirements of ETSO C129a that are applicable to the multi-sensor system must be demonstrated as a part of demonstrating compliance with this ETSO. All testing which would require inputs from a GPS sensor must be conducted with a sensor that has been demonstrated to meet the criteria of ETSO C129a for the class of sensor required by the multi-sensor system being evaluated. It is acceptable to simultaneously demonstrate compliance with ETSO C129a for the sensor and ETSO C115b for the multi-sensor system.~~

3.1.32 – Environmental sStandard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.43 – Computer sSoftware

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 – Airborne Electronic hardware qualification

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 – Specific

None.

Add the following system performance requirement, consistent with the desired RNP capability, to DO-283A, paragraph 2.2.5.2:

When using GNSS, the aircraft navigation system shall provide an alert when the probability of signal-in-space errors causing a lateral position error greater than two times the desired RNP ($2 \times \text{RNP}$) exceeds 1×10^{-7} per hour.

Note: This exception supports international harmonisation of requirements for RNAV and RNP. The exception is comparable to the ETSO-C115b exception that invoked ETSO-C129a system performance requirements when integrating GNSS as part of a multi-sensor navigation solution.

3.2.1 Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

Design the system to the appropriate failure condition classification(s).

For RNP ≥ 0.3 : Malfunction is a major failure condition for misleading lateral or vertical guidance. Loss of the function defined in paragraph 3.1.1 of this ETSO is a major failure condition for lateral guidance and a minor failure condition for vertical guidance.

For RNP < 0.3 : Malfunction is a hazardous (severe-major) failure condition for misleading lateral or vertical guidance. Loss of the function defined in paragraph 3.1.1 of this ETSO is a hazardous (severe-major) failure condition for lateral guidance and a minor failure condition for vertical guidance.

4 – Marking**4.1 – General**

Marking as detailed in CS-ETSO, Subpart A, paragraph 1.2.

4.2 – Specific

None.

5 – Availability of rReferenced dDocument

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C121ab**Date: 28.11.2008****Date: xx.xx.2011**

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: UNDERWATER LOCATING DEVICE (ACOUSTIC) (SELF-POWERED)

1 – Applicability

This ETSO gives the requirements which Underwater Locating Device (Acoustic) (Self-Powered) 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: AS8045 'Minimum Performance Standard for Underwater Locating Devices (Acoustic) (Self-Powered)', dated May 16, 1988, and from the American Society Testing Materials (ASTM) document D.1141-98 'Standard Practice for the Preparation of Substitute Ocean Water', dated September 2003.~~

Standards set forth in the SAE AS 8045A, Minimum Performance Standard for Underwater Locating Devices (Acoustic) (Self-Powered), dated August 2011.

3.1.2 – Environmental Standard

~~The equipment must be tested according to EUROCAE ED 14E (RTCA DO 160E) 'Environmental Conditions and Test Procedures for Airborne Equipment' from March 2005.~~

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 – Computer Software

~~If the article includes a digital computer, the software must be developed according to EUROCAE ED 12B (RTCA DO 178B), 'Software Considerations in Airborne Systems and Equipment Certification', dated December 1, 1992.~~

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 – Electronic Hardware Qualification

~~If the article includes a complex custom micro-coded component, the component must be developed according to EUROCAE ED 80 (RTCA DO 254), 'Design Assurance Guidance for~~

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~~Airborne Electronic Hardware, from April 2000.~~

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 – Specific

The battery used in the underwater locating device authorised under this ETSO must be appropriate for the intended operational environment, not pose a hazard to the aircraft and meet the requirements of acceptable battery standards. If non-rechargeable lithium batteries are used to power the underwater locating device, ETSO-C142a 'Lithium Batteries' provides MPS for such lithium batteries.

Demonstrate the saltwater immersion tests in SAE Document AS 8045a, section 5.13, using a seawater solution meeting the requirements of ASTM D1141-98, Standard Practice for the Preparation of Substitute Ocean Water, dated 2008.

3.2.1 – Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

Failure or loss 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-C155a**Date: 21.12.2010****Date: xx.xx.2012**

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: RECORDER INDEPENDENT POWER SUPPLY

1 – Applicability

This ETSO gives the requirements which Recorder Independent Power Supply 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.~~

ETSOs that may be used in conjunction with this ETSO are those covering:

- rechargeable lithium cells and lithium batteries,
- digital flight data recorder,
- cockpit voice recorder,
- data link recorder,
- cockpit image recorder.

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~~ Section 5 of EUROCAE ED-112, Minimum

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Operational Performance Specification for Crash Protected Airborne Recorder Systems, dated March 2003.

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 — Airborne Electronic hardware qualification

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

None.

Exceptions to ED-112. We make the following first two exceptions to ED-112 to comply with EASA requirements. The third item is an exception to requirements for installation, flight testing, aircraft maintenance, and others that do not pertain to MPS criteria specific to the ETSO equipment.

- RIPS location, Chapter 2-5.3.10: We don't require Chapter 2-5.3.10 as part of this ETSO. RIPS location must comply with applicable EASA requirements.
- Equipment Installation and Installed Performance (RIPS) Chapter 5-6.
- Other ED-112 requirements for installation, flight testing, aircraft maintenance, and others that do not pertain to MPS specific criteria.

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 as 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.

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: VDL MODE 2 COMMUNICATIONS EQUIPMENT

1 – Applicability

This ETSO gives the requirements which VDL Mode 2 Communications equipment 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 EUROCAE ED-92B, Minimum Operational Performance Standards for Aircraft VDL Mode 2 Physical, Link, and Network Layer, dated 21/03/2012. ED-92B is identical to RTCA DO-281B.

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 – Airborne 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 as 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.

European Aviation Safety Agency

Date: xx/xx/2008

European Technical Standard Order (ETSO)

Subject: GROUND-BASED AUGMENTATION SYSTEM (GBAS) POSITIONING
AND NAVIGATION EQUIPMENT

1 – Applicability

This ETSO gives the requirements which 'Ground-Based Augmentation System (GBAS) Positioning and Navigation Equipment' manufactured on or after the effective date of this ETSO have to 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

Section 2 of RTCA/DO-253A, 'Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment,' dated November 28, 2001.

3.1.2 – Environmental Standard

~~The equipment must be tested according to EUROCAE ED-14E (RTCA DO-160E) 'Environmental Conditions and Test Procedures for Airborne Equipment' from March 2005. See CS-ETSO, Subpart A, paragraph 2.1.~~

3.1.3 – Computer Software

~~If the article includes a digital computer, the software must be developed according to EUROCAE ED-12B (RTCA DO-178B) 'Software Considerations in Airborne Systems and Equipment Certification' from 1992. See CS-ETSO, Subpart A, paragraph 2.2.~~

3.1.4 – Airborne Electronic hardware qualification

See CS-ETSO, Subpart A, paragraph 2.3.

ETSO-C161a A1**3.2 – Specific**

Regarding the installation procedures and limitations, adequate specification of the interface between the equipment and other systems are mandatory to ensure proper functioning of the integrated system.

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 for the position data and a hazardous failure condition for the precision approach navigation data. Loss of the function as defined in paragraph 3.1.1 of this ETSO is a minor failure condition for both position data and precision approach data. 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.

5 – Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: NIGHT VISION GOGGLES (NVG)

1 – Applicability

This ETSO gives the requirements which Night Vision Goggles (NVG) 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 RTCA DO-275, Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment, dated 12/10/2001.

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 – Airborne 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

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Marking as detailed in CS-ETSO, Subpart A, paragraph 1.2.

4.2 — Specific

If the night vision goggle includes airborne software, then the part number must include hardware and software identification. Or, you can use a separate part number for hardware and software. Either way, you must include a means for showing the modification status.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C166b A1**Date: 05/07/2012****xx.xx.201x**

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: EXTENDED SQUITTER AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) AND TRAFFIC INFORMATION SERVICES-BROADCAST (TIS-B) EQUIPMENT OPERATING ON THE RADIO FREQUENCY OF 1090 MEGAHERTZ (MHz)

1 — Applicability

This ETSO gives the requirements which Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz) 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 ~~RTCA DO-260B~~ EUROCAE ED-102A, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B), dated ~~02/12/~~ December 2009, section 2.

This ETSO supports two major classes of 1090 MHz ADS-B and TIS-B equipment:

- (a) Class A equipment, consisting of transmit and receive subsystems; and
- (b) Class B equipment, containing a transmit subsystem only.

Class A equipment includes Classes A0, A1, A1S, A2 and A3. This standard requires 1090 MHz airborne Class A equipment to include the capability of receiving both ADS-B and TIS-B messages and delivering both ADS-B and TIS-B reports, as well as transmitting ADS-B messages. A Receive-only Class of equipment is allowed.

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Class B equipment includes Classes B0, B1, and B1S. Classes B0, B1, and B1S are the same as A0, A1, and A1S, except they do not have receive subsystems. Note that Classes B2 and B3 are not for aircraft use.

3.1.2 — Environmental **s**Standard

See CS-ETSO, Subpart A, paragraph 2.1. The required performance under test conditions is defined in RTCA/DO-260B, section 2.4.

3.1.3 — Computer **s**Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Electronic **h**Hardware **q**Qualification

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 — Failure **c**Condition **c**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.

Note: The major failure condition for transmission of incorrect ADS-B messages is based on use of the data by other aircraft or Air Traffic Control for separation services.

4 — Marking

4.1 — General

Marking as detailed in CS-ETSO, Subpart A, paragraph 1.2.

4.2 — Specific

Transmitting and receiving components must be permanently and legibly marked.

The following table explains how to mark components.

RTCA/DO-260AB provides the equipment class in Section 2.1.11, and the receiving equipment type in Section 2.2.6.

<i>If component can:</i>	<i>Mark it with:</i>	<i>Sample marking pattern:</i>
Transmit and receive	Equipment class it supports, and Receiving equipment type	Class A0/Type 1
Transmit, but not receive	Equipment class it supports	Class B1, or Class A3-Transmitting only
Receive, but not transmit	Equipment class it supports, and Receiving equipment type	Class A2/Type 2-Receiving only

5 — Availability of **rReferenced **d**Document**

See CS-ETSO, Subpart A, paragraph 3.

European Aviation Safety Agency

Date: ~~28/11/2008~~ xx/xx/201x

European Technical Standard Order (ETSO)

Subject: BATTERY-BASED EMERGENCY POWER UNIT (BEPU)

1 – Applicability

This ETSO gives the requirements which Battery-based Emergency Power Units (BEPU) 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 are given in **Appendix 1**.

Note: The battery used in the BEPU must meet the requirements of ETSO-C173 'Nickel-Cadmium and Lead Acid Batteries' or any other battery standards acceptable to the Agency.

3.1.2 – Environmental Standard

As stated in **Appendix 1**, chapter 2, of this ETSO.

3.1.3 – Computer Software

~~If the article includes a digital computer, the software must be developed according to EUROCAE ED-12B (RTCA DO-178B) 'Software Considerations in Airborne Systems and Equipment Certification' from 1992. See CS-ETSO, Subpart A, paragraph 2.2.~~

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 hazardous 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

Product label shall indicate:

- Battery capacity (e.g. 20 Amp-Hour (Ah)),
- Nominal voltage,
- Battery chemistry.

5 – Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

APPENDIX 1**MINIMUM PERFORMANCE STANDARD
FOR BATTERY-BASED EMERGENCY POWER UNIT (BEPU)****CHAPTER 1: MINIMUM PERFORMANCE STANDARD UNDER STANDARD CONDITIONS**1 — PURPOSE

These are the requirements under standard conditions for a Battery-Based Emergency Power Units (BEPU) to meet the Minimum Performance Standard for this ETSO. The performance of specific equipment may be enhanced, depending on its intended application and configuration.

2 — GENERAL REQUIREMENTS

The BEPU must meet the power quality requirements of MIL-STD-704F, Aircraft Electrical Power Characteristics, dated March 12, 2004, and maintain the rated values and functionality according to its specification data sheet, unless otherwise specified in this ETSO.

- (a) Design the BEPU to minimize the risk of causing or spreading a fire.
- (b) Storage batteries must be designed and installed as follows: Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge):
 - At maximum regulated voltage or power,
 - During a flight of maximum duration, and
 - Under the most adverse cooling condition likely to occur in service.
- (c) Demonstrate the above conditions by test, unless your experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures do not present a problem.
- (d) Systems like electronic circuits installed in the BEPU must be compatible with the battery chemistry.
- (e) During a failure of the normal power source to the emergency electrical bus, the BEPU supplies emergency electrical bus loads without intervention by the flight crew. After re-establishment of the normal power source, the emergency bus loads revert automatically from the BEPU to the normal power source, and the BEPU automatically returns to charging mode. To prevent inadvertent recharging of the BEPU from the aircraft battery when a normal power source is not available, the BEPU shall not enter the recharge mode when the BEPU input (source) voltage is below 24VDC.
- (f) Specify the value of voltage spikes occurring when the BEPU is switched on and off and between modes (if applicable).
- (g) Any single component failure within the BEPU (either open or short) cannot result in an over voltage condition on the battery.
- (h) The BEPU will not have any protection/provision that results in automatic removal of power from the emergency load.

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- (i) The BEPU will not discharge through the input side of the BEPU.
- (j) If the BEPU provides backup power to multiple loads, equip the BEPU with protection provisions that allow for the isolation and removal of excess load on any of its output feeders that draw more than its pre-determined maximum current. This will protect remaining loads in case of a load short circuit.
- (k) The BEPU should not drain its battery power when the aircraft power is off.
- (l) Fully charge the battery before installation. Charge the battery every time the aircraft is powered up, independent of cockpit switch position.
- (m) The charging time from 20 % to 80 % capacity will be less than 3 hours.
- (n) Specify the nominal current and the short time maximum current.
- (o) Design the BEPU in such a way so that separation devices placed between input, output, and battery will enable the current flow from input to output, even when there is a malfunction with other BEPU components. The separation devices will prevent current flow in the direction from output (respectively the battery) to input, and from output to battery. See Figure A-2 at the end of this Appendix. The minimum current rating of the separation devices must be greater than three times the continuous rated output current of the BEPU. Unless provided in the aircraft, design the BEPU to prevent output current greater than 30 milliamperes (mA) from flowing back to battery. The loss (breakdown) of voltage of such separation devices will exceed three times the BEPU rated voltage.
- (p) The maximum output voltage ripple cannot exceed the limits stated in MIL-STD-704F. Note that this limit does not include the ripple already on the input line into the BEPU. (See Figure A-3 at the end of this Appendix.)
- (q) To preclude catastrophic effects of excess temperature, the BEPU will monitor battery temperature during battery-charging cycles, and remove power when over temperature limits are reached. Applications where excessive battery temperature cannot cause catastrophic events do not require monitoring.
- (r) If the BEPU contains a battery heater device, a single-fault failure redundancy protection is required to prevent heater runaway.

3 — CAPACITY AND RELATED PARAMETERS

The parameters listed in this section under environmentally benign and ground benign conditions at 25 °C must be provided. Considered nominal conditions follow.

- (a) BEPU capacity. Specify the value for the nominal capacity in Amp-Hours (Ah) based on a constant discharge current for 1.0 hour. During capacity testing, the output voltage cannot degrade below 20VDC.
- (b) BEPU output voltage excursions. Provide graphs of output voltage versus time for the following conditions:
 - Complete discharge to low voltage dropout point after being fully charged;
 - Complete discharge to low voltage dropout point after being charged to 72 % capacity. This (72 % capacity) represents a BEPU at the end of its life and 90 % state of charge.
- (c) BEPU life. Declare the expected battery life based on the number of 100 % discharge cycles on the battery nameplate. Battery life is expired when 80 % of the capacity stated on the nameplate stated capacity is reached.

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- (d) BEPU maximum current consumption. Specify the maximum current consumption (excluding external loads) of the BEPU. Maximum current includes charging, heating, and other functionalities performed by electronic circuits.
- (e) BEPU output current. Specify the nominal current that can be delivered by the BEPU related to the nominal Ah rating specified in paragraph 3.a of this Chapter 1 'CAPACITY AND RELATED PARAMETERS', and the short time maximum current, versus time, if necessary.

4 — MONITOR AND CONTROL

- (a) Instrumentation, data read-outs, and controls can be provided by support equipment instead of the BEPU.
- (b) Design all instrumentation and data read-outs for easy interpretation to avoid misunderstandings.
- (c) The BEPU can have (but is not limited to) the following optional controls:
- BEPU Off: Battery power is disconnected from all loads;
 - BEPU Arm: Ready to engage power to the loads if aircraft power is lost. The BEPU should be in 'Charging Mode' unless there is a failure of the emergency bus;
 - BEPU On/Engage: Causes the battery to be applied to the loads. The BEPU should be in 'Charging Mode' unless during failure of the emergency bus.
- (d) Provide a test function for pre-flight check, showing the system function and battery status. The battery is considered good with 80 % state of charge. We recommend an in-flight low battery warning indication. Perform a lamp test where the checked segments are lighted.

CHAPTER 2: MINIMUM PERFORMANCE STANDARD UNDER ENVIRONMENTAL TEST CONDITIONS**1 — GENERAL**

Unless otherwise specified, applicable test procedures are in ~~EUROCAE ED14E / RTCA DO 160E~~ defined in CS-ETSO, Subpart A paragraph 2.1.

2 — PERFORMANCE TESTS

The following environmental tests verify BEPU operations based on manufacturer specifications and requirements under extreme environmental conditions. If the manufacturer's specifications during these tests are different than those recorded under benign environmental conditions as specified in paragraph 3 of Chapter 1 of this Appendix~~1~~, the manufacturer will specify the modified rating and under what condition such ratings would occur. For the following tests determine compliance of the BEPU ~~with~~ the manufacturer's nominal ratings (unless otherwise specified) as referenced in paragraph 3 of Chapter 1 of this Appendix except when otherwise noted, charge the batteries to at least 80 % of manufacturer's rated capacity before conducting these tests:

- BEPU capacity using nominal current discharge;
- BEPU output voltage excursion;
- BEPU current consumption.

For the applicable environmental test requirements contained in ~~EUROCAE ED14E / RTCA DO 160E~~ are see ETSO, Subpart A, paragraph 2.1:

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- (a) ~~EUROCAE ED14E / RTCA DO 160E~~ Section 4, Temperature and Altitude.
- Operating Low Temperature Test. You may use an internal battery heater for this test.
 - Operating High Temperature Test.
 - Altitude Test.
 - Decompression Test.
 - Overpressure Test.
- (b) ~~EUROCAE ED14E / RTCA DO 160E~~ Section 5, Temperature Variation. Combine this test with ~~EUROCAE ED14 E / RTCA DO 160 E~~, Section 4 Testing Requirements.
- (c) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 6, Humidity.
- (d) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 7, Operational Shocks and Crash Safety. After this test, the equipment must remain in its mounting with no part of the equipment or its mounting becoming detached and free on the shock test table. Measure and record the BEPU capacity after completion.
- NOTE: These tests may damage the equipment. Therefore, these tests may be conducted last.*
- (e) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 8, Vibration. While the equipment is subjected to this test, ensure that all mechanical devices operate satisfactorily and that the mechanical construction remains undamaged.
- (f) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 9, Explosion Proofness. Required only if the BEPU contains components that are known to cause inductive arcing.
- (g) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 10, Water Proofness (if required).
- (h) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 11 Fluids Susceptibility (if required). Not mandatory for ETSO approval.
- (i) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 12, Sand and Dust (if required).
- (j) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 13, Fungus Resistance (if required). Compliance by analysis is acceptable.
- (k) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 15, Magnetic Effect.
- (l) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 16, Power Input.
- (m) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 17, Voltage Spike. During and after this test, no failed parts must exist, including any degradation on component voltage and current ratings. No parasitic or transient mode switching can result from this test.
- (n) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 18, Audio Frequency Conducted Susceptibility — Power Inputs. Conduct by charging the BEPU when its capacity is between 0 % and 75 %. No parasitic or transient mode switching can result from this test.
- (o) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 19, Induced Signal Susceptibility. No parasitic or transient mode switching can result from this test.
- (p) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 20, RF Susceptibility. No parasitic or transient mode switching can result from this test.
- (q) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 21, Emission of RF Energy. Conduct while BEPU is being charged. Charge must be between 0 % and 75 % of capacity during this test.

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(r) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 22, Lightning Induced Transient Susceptibility. No parasitic or transient mode switching can result from this test.

(s) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 23, Lightning Direct Effects. Not mandatory for this ETSO approval. If you conduct this test, no failed parts may exist during and after the test. Failed parts include any degradation on component voltage and current ratings. No parasitic or transient mode switching should result during this test.

(t) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 24, Icing. Not mandatory for this ETSO approval. If you conduct this test, no failed parts may exist during and after the test. Failed parts include any degradation on component voltage and current ratings.

(u) ~~EUROCAE ED14 E / RTCA DO 160 E~~ Section 25, Electrical Discharge.

CHAPTER 3: ELECTRICAL TEST PROCEDURES

1 – GENERAL

Electrical test procedures covered under environmental test conditions in Chapter 2 of this Appendix are conducted according to ~~EUROCAE ED14 E / RTCA DO 160 E~~. The test procedures that meet specific requirements for the BEPU are outlined below.

2 – GENERAL TEST CONDITIONS

Unless otherwise specified, the following test conditions apply:

(a) Conduct all tests under conditions of ambient room temperature (except ~~EUROCAE ED14 E / RTCA DO 160 E~~, sections 4, 5 and 6) and ambient pressure and humidity as outlined in ~~EUROCAE ED14 E / RTCA DO 160 E~~, Section 1, Paragraph 3.

(b) Unless otherwise specified, the input supply voltage will be within 10 % of the nominal value the BEPU is designed to operate.

(c) A reasonable warm-up period for stabilization is permissible. Battery nominal capacity is defined at 25 °C.

3 – SPECIFIC TEST CONDITIONS

(Per paragraph 4 'MONITOR and CONTROL' of Chapter 1 of this document)

(a) Lamp test: All segments lighted.

(b) Check load segment on when load is applied.

4 – ALIGNMENT, ADJUSTMENT AND CALIBRATION PRIOR TO TEST

If necessary, perform alignment, adjustment and calibration before testing.

5 – TEST EQUIPMENT

Calibrate the test equipment you use to verify final test results traceable to the National Bureau of Standards. Test equipment accuracy will be at least 2 %.

CHAPTER 4 : DESCRIPTION OF A BEPU1 – GENERAL

A BEPU supplies power for a specified time period to an emergency power bus (output) in case of main or emergency bus failure.

2 – PARTS OF A BEPU

The BEPU consists of a remote unit or panel-mounted device containing a rechargeable battery pack (accumulator) and means for providing charging, monitoring of battery temperature, battery state, current, as well as system testing and related functions. The batteries are kept fully charged during normal operation independent from ~~regardless of~~ surrounding temperature.

- (a) An indicator/test switch gives information on the battery status of the BEPU before commencing flight.
- (b) Figure A-1 block diagram illustrates the description of the BEPU functionality. It does not define a requirement.
- (c) Figure A-2 depicts an example BEPU current flow.
- (d) Figure A-3 depicts a recommended measurement of BEPU output voltage ripple.

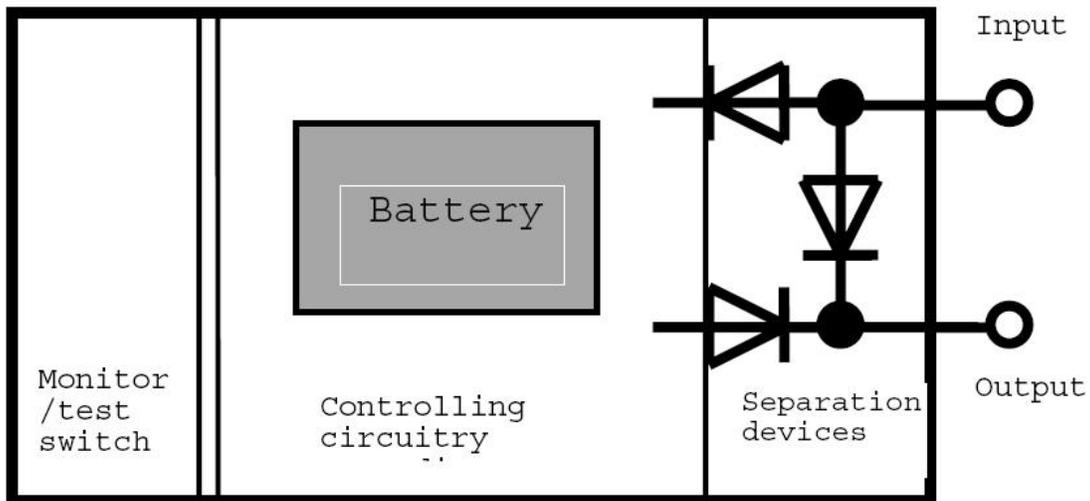


Figure A-1: BEPU Block Diagram

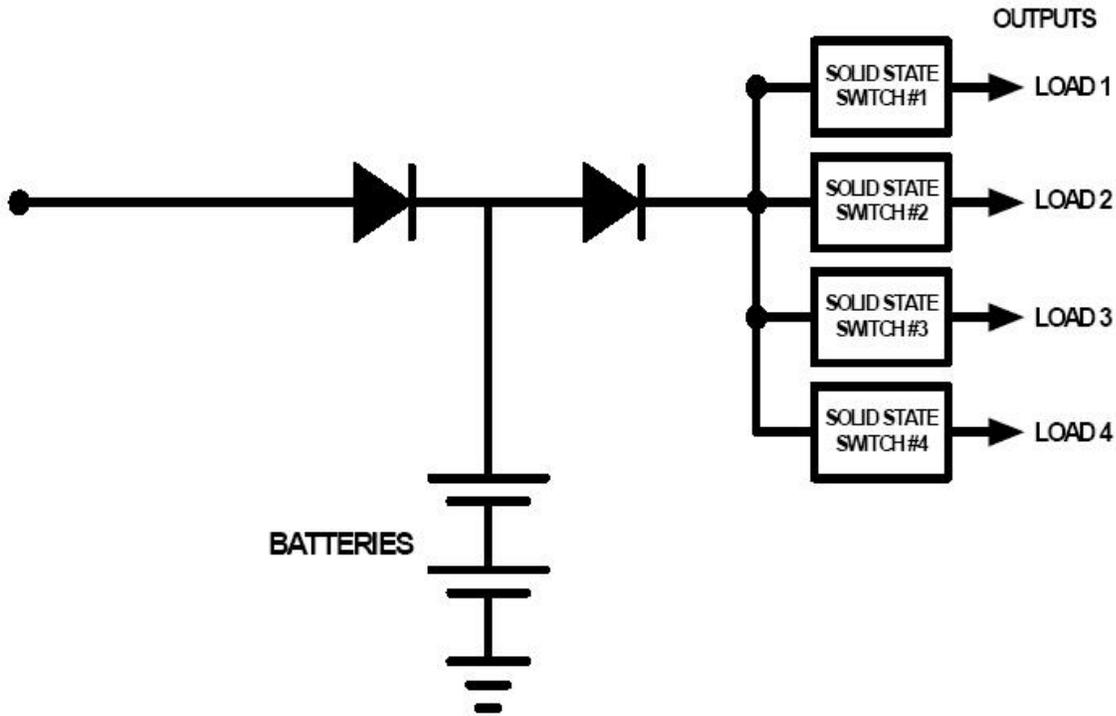


Figure A-2: An example BEPU Current Flow

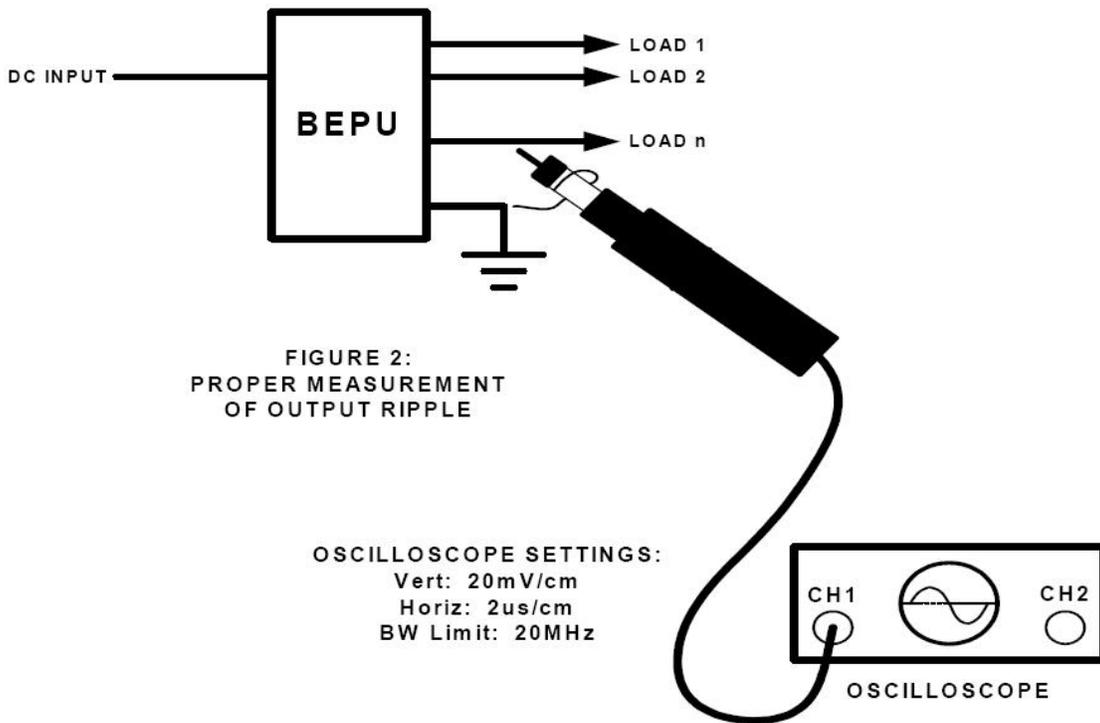


FIGURE 2:
PROPER MEASUREMENT
OF OUTPUT RIPPLE

Figure A-3: Recommended Measurement of BEPU Output Voltage Ripple

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: SINGLE PHASE 115 VAC, 400 HZ ARC FAULT CIRCUIT BREAKERS

1 – Applicability

This ETSO gives the requirements which Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers 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 AS 5692, Arc Fault Circuit Breaker (AFCB), Aircraft, Trip-Free Single Phase 115 Vac, 400 Hz – Constant Frequency, dated October 2004. AFCBs may have separate indication of thermal and arcing faults to assist in fault isolation and performing proper repairs.

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 – Airborne 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.

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AUTOMATIC FLIGHT GUIDANCE AND CONTROL SYSTEM (AFGCS) EQUIPMENT

1 – Applicability

This ETSO gives the requirements which Automatic Flight Guidance and Control System (AFGCS) Equipment 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 RTCA DO-325, Automatic Flight Guidance and Control Systems and Equipment, dated 08/12/2010.

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 – Airborne 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.

There is no standard minimum failure condition classification for this ETSO. The failure condition classification appropriate to the equipment will depend on the intended use of the equipment in a specific aircraft.

4 – Marking

4.1 – General

Marking as 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.

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: LOW-FREQUENCY UNDERWATER LOCATING DEVICES (ACOUSTIC) (SELF-POWERED)

1 – Applicability

This ETSO gives the requirements which Low-Frequency Underwater Locating Devices (Acoustic) (Self-Powered) 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 document AS6254 Minimum Performance Standard for Low-Frequency Underwater Locating Devices (Acoustic) (Self-Powered), dated February 2012.

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 – Airborne 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 or loss 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 as 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.

C. Appendices

I Extract from Amendment 36 to Annex 6 to the Chicago Convention — Part I

6.5.3 All aeroplanes on long-range over-water flights

6.5.3.1 In addition to the equipment prescribed in 6.5.1 or 6.5.2 ...

- a) life saving rafts...;
- b) equipment for making the pyrotechnical distress signals described in Annex 2; and
- c) at the earliest practicable date but not later than 1 January 2018, on all aeroplanes of a maximum certificated take-off mass of over 27 000 kg, a securely attached **underwater locating device operating at a frequency of 8.8 kHz**. This automatically activated underwater locating device shall operate for a minimum of 30 days and shall not be installed in wings or empennage.

Note.— *Underwater Locator Beacon (ULB) performance requirements are as contained in the SAE AS6254, Minimum Performance Standard for Underwater Locating Devices (Acoustic) (Self-Powered), or equivalent documents.*

APPENDIX 9. FLIGHT RECORDERS

(Note — See Chapter 6, 6.3)

The material in this Appendix concerns flight recorders intended for installation in aeroplanes engaged in international air navigation. Crash protected flight recorders comprise one or more of the following four systems: a flight data recorder (FDR), a cockpit voice recorder (CVR), an airborne image recorder (AIR) and/or a data link recorder (DLR). Lightweight flight recorders comprise one or more of the following four systems: an aircraft data recording system (ADRS), a cockpit audio recording system (CARS), an airborne image recording system (AIRS) and/or a data link recording system (DLRS).

1. General requirements

1.1 The flight recorder systems containers shall:

- a) be painted a distinctive orange or yellow colour;
- b) carry reflective material to facilitate their location; and
- c) have securely attached an automatically activated **underwater locating device operating at a frequency of 37.5 kHz. At the earliest practicable date but not later than 1 January 2018, this device shall operate for a minimum of 90 days.**

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