NOTICE OF PROPOSED AMENDMENT (NPA) NO 2011-12

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

Amending Decision No. 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 ETSO

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A. Explanatory Note

I. General

1. The purpose of this Notice of Proposed Amendment (NPA) is to envisage amending 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 (currently published as CS-ETSO)[1].

2. This NPA proposes to:

   a) introduce new ETSO specifications that are, where possible, technically similar to existing Federal Aviation Administration (FAA) TSO[2];

   b) publish the set of ETSOs proposed herein on the web, as individual documents, ordered according to their number (not as part of a large document titled "CS-ETSO" and covering several very diversified subjects) as currently used by the FAA in the USA.

3. The scope of this rulemaking activity is outlined in Terms of Reference (ToR) ETSO.008 (Update of EASA ETSO and Systematic review and transposition of existing FAA TSO for parts and appliances into EASA ETSO) and is described in more detail below.

4. The European Aviation Safety Agency (hereinafter 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 Regulation[3] which are adopted as "Opinions" (Article 19(1)). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 19(2)).

5. European Technical Standard Orders (ETSO) 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 by the Agency's Management Board and is referred to as "The Rulemaking Procedure"[5].

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[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 2010/010/R of the Executive Director of the Agency of 21 December 2010.

[2] FAA TSOs are available at http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgTSO.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) 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).

[5] Management Board Decision concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material (Rulemaking Procedure), EASA MB 08-2007, 13.6.2007.

7. This rulemaking activity is included in the Agency's Rulemaking Programme 2011-14. It implements the rulemaking task ETSO.008, first NPA. The second NPA under the same task ETSO.008 is planned for 2012 to transpose FAA TSO C87a and C160a.

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 Internet site. Comments should be provided within 3 months in accordance with Article 6(4) of the Rulemaking Procedure. Comments on this proposal should be submitted by one of the following methods:

CRT: Send your comments using the Comment-Response Tool (CRT) available at **http://hub.easa.europa.eu/crt/**.

E-mail: **Only** in case the use of CRT is prevented by technical problems, these should be reported to the CRT webmaster and comments sent by e-mail to NPA@easa.europa.eu.

Correspondence: If you do not have access to the Internet or e-mail, you can send your comment by mail to:

Process Support
Rulemaking Directorate
EASA
Postfach 10 12 53
D-50452 Cologne
Germany

Comments should be submitted **by 18 October 2011**. If received after this deadline, they might not be taken into account.

III. Comment response document

10. 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 and in the Comment-Response Tool (CRT).

IV. Content of the draft decision

11. The basis for the introduction and revision of each ETSO and main differences with the current ETSO are specified below:

CS-ETSO

Subpart A

Paragraph 2.1 Environmental standards has been updated to define the applicable "Environmental Conditions and Test Procedures for Airborne Equipment" requirements.

Subpart B

Index 1

ETSO-C55a: Fuel and Oil Quantity Instruments

This update of ETSO-C55 is based on FAA TSO-C55a issued on 08/06/2007.

Minimum Performance Specifications (MPS) are defined according to SAE AS405C "Fuel and Oil Quantity Instruments", as amended by Appendix 1 of the ETSO.

Edition C55a of this ETSO replaces edition C55 adopted by Decision 2003/10/RM of 24 October 2003.

ETSO-C62e: Aircraft Tyres

This update of ETSO-C62d is based on FAA TSO-C62e issued on 29/09/2006.

Newly designed aircraft tyres must meet the Minimum Performance Specifications (MPS) of Appendix 1, FAA Standard for Aircraft Tires of the ETSO.

Edition C62e of this ETSO replaces edition C62d adopted by Decision 2003/10/RM of 24 October 2003.

ETSO-C90d: Cargo Pallets, Nets and Containers

This update of ETSO-C90c is based on FAA Draft TSO-C90d.

The standards of this ETSO apply to Unit Load Devices (ULDs) used to load luggage, freight, and mail on aircraft.

Newly designed models of Type I ULDs that are to be identified and manufactured on or after the effective date of this ETSO must meet the MPS qualification and documentation requirements in NAS 3610 Rev. 10.

Newly designed models of Type II ULDs that are to be identified and manufactured on or after the date of this TSO must meet the MPS qualification and documentation requirements in SAE AS 36100a.

Edition C90d of this ETSO replaces edition C90c adopted by Decision 2003/10/RM of 24 October 2003.

ETSO-C95a: Mach Meters

This update of ETSO-C95 is based on FAA TSO-C95a issued on 31/08/2007.

Newly designed mach meters must meet the Minimum Performance Specifications (MPS) of SAE AS 8018A.

The standards of this ETSO apply to equipment intended to indicate the Mach number, when connected to sources of static (Ps), and total (Pt), or impact (Pt-Ps) pressure. This ETSO also includes MPS for equipment intended to perform the same function when connected to electrical outputs of the same sources.

Edition C95a of this ETSO replaces edition C95 adopted by Decision 2003/10/RM of 24 October 2003.

ETSO-C126a: 406MHz Emergency Locator Transmitter

This new ETSO is based on FAA TSO-C126a issued on 17/12/2008.

Newly designed 406 MHz Emergency Locator Transmitter must meet the MPS requirements of EUROCAE ED-62A.

The standards of this ETSO apply to equipment intended to locate aircraft that terminate flight as result of an accident.

This new ETSO-C126a replaces ETSO-2C126 "406 MHz Emergency Locator Transmitter (ELT)" which had been adopted by Decision 2003/10/RM of 24 October 2003.

ETSO-C154c: Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz

This new ETSO is based on FAA TSO-C154c issued on 02/12/2009.

The standards of this ETSO apply to equipment intended to transmit and receive broadcast messages about an aircraft's position (latitude and longitude), velocity, integrity, and other parameters. Similarly-equipped operators will share these messages with one another and with ground-based facilities such as air traffic services. These message parameters form the basis for various ADS-B, ADS-R and TIS-B reports.

Although UATs operating on the frequency of 978 MHz are not envisaged to be used in the European Union, nothing prevents eligible organisations to voluntarily apply for an ETSO authorisation in order to market their products world-wide.

ETSO-C157: Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment

This new ETSO is based on FAA TSO-C157 issued on 20/09/2004.

The standards of this ETSO apply to equipment intended to display weather and airspace/aerodrome status information by promoting pilot awareness of reported weather and airspace/aerodrome status. The operational goal of FIS-B equipment is to enhance pilot decision-making for strategic planning during flight. FIS-B products are considered to be advisory information only. As such, FIS-B is non-binding advice and information provided to provide pilots more situational awareness.

In other words, this service can be seen as an in-flight update of the pre-flight information bulletin (PIB), advantageous in particular on flights lasting several hours.

ETSO-C158: Aeronautical Mobile High Frequency Data Link (HFDL) Equipment

This new ETSO is based on FAA TSO-C158 issued on 19/08/2004.

The standards of this ETSO apply to equipment intended to provide worldwide data communications directly between aircraft sub networks and ground sub networks via High Frequency (HF) radio and HF ground stations. HFDL equipment will support data communication between aircraft users and ground-based users, such as Air Route Traffic Control Centres (ARTCCs) and aircraft operators. HFDL communication services include three categories: Air Traffic Services (ATS), Aircraft Operational Control (AOC), and Aeronautical Administrative Communications (AAC).

Currently HFDL is neither envisaged for use over the European Union nor over North Atlantic. However and again, nothing prevents eligible organisations to voluntarily apply for an ETSO authorisation in order to market their products world-wide.

ETSO-C159a: Avionics Supporting Next Generation Satellite Systems (NGSS) = Iridium Phone

This new ETSO is based on FAA TSO-C159a issued on 30/06/2010.

The standards of this ETSO apply to avionics equipment intended to provide long range communication services (LRCS) via aeronautical mobile satellite (route) services (AMS(R)S) by means of satellite communications between aircraft earth stations (AES), corresponding satellites, and ground earth stations (GES). Iridium will support both data and voice communications between aircraft users and ground-based users, such as air traffic service providers (ATSP) and aircraft operators.

ETSO C-161a Ground Based Augmentation System Positioning and Navigation Equipment

This new ETSO is based on FAA TSO-C159a issued on 17/12/2009.

The standards of this ETSO apply to airborne navigation equipment intended to output deviations relative to a precision approach path using GBAS (Global Positioning System

(GPS) augmented by the Ground Based Augmentation System) and to provide position information to a navigation management unit that outputs deviation commands referenced to a desired flight path. It supports Category I precision approach using GBAS and/or optional GBAS positioning service. These standards do not address integration issues with other avionics except for automatic dependent surveillance (ADS).

ETSO-C162a: Ground Based Augmentation System Very High Frequency Data Broadcast Equipment

This new ETSO is based on FAA TSO-C162a issued on 17/12/2009.

The standards of this ETSO apply to equipment designed to receive the GBAS VDB and output the VDB messages to GBAS Positioning and Navigation equipment.

ETSO-C166b: Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS – B) and Traffic Information Services (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)

This update of ETSO-C166a is based on FAA TSO-C166b issued on 02/12/2009.

The standards of this ETSO apply to equipment intended to transmit and receive broadcast messages about an aircraft's position (latitude and longitude), velocity, integrity, and other parameters. Similarly-equipped operators will share these messages with one another and with ground-based facilities, such as air traffic services. These message parameters form the basis for various ADS-B, ADS-R, and TIS-B reports.

Edition C166b of this ETSO replaces edition C166a adopted by Decision 2003/10/RM of 24 October 2003.

ETSO-C170: High Frequency (HF) Radio Communications Transceiver Equipment Operating Within the Radio Frequency 1.5 to 30 Megahertz

This new ETSO is based on FAA TSO-C170 issued on 20/12/2004.

The standards of this ETSO apply to equipment intended for aircraft HF communications operating in the radio frequency range of 1.5 MHz to 30 MHz, for Air Traffic Services (ATS) safety communications by playing an integral role with other aircraft equipment used to communicate tactical and strategic information.

This ETSO cancels ETSO-C31d "HF Transmitting Equipment" and ETSO-C32d "HF Receiving Equipment" as they are combined in the new ETSO-C170.

ETSO-C172: Cargo Restraint Strap Assemblies

This new ETSO is based on FAA Draft TSO-C172.

The standards of this ETSO apply to equipment intended to be used to restrain cargo on board civil transport aircraft during flight.

ETSO-C179: Rechargeable Lithium Cells and Lithium Batteries

This new ETSO is based on FAA TSO-C179 issued on 22/08/2006.

The standards of this ETSO apply to rechargeable lithium cells and lithium batteries intended to provide power for aircraft equipment, including emergency systems.

ETSO-C184: Galley Equipment

This new ETSO is based on FAA Draft TSO-C184.

The standards of this ETSO apply to equipment intended to be used as airplane galley insert equipment.

ETSO-C194: Helicopter Terrain Awareness and Warning System (HTAWS)

This new ETSO is based on FAA TSO-C194 issued on 17/12/2008.

The standards of this ETSO apply to equipment intended to provide terrain and obstacle aural and visual alerts to reduce the risk of controlled flight into terrain (CFIT) helicopter accidents.

ETSO-C195: Avionics Supporting Automatic Dependent Surveillance – Broadcast (ADS-B) Aircraft Surveillance

This new ETSO is based on FAA TSO-C195 issued on 27/09/2010.

The standards of this ETSO apply to equipment intended to be used in aircraft to display traffic using ADS-B message data from other aircraft. Applications 1 through 4 support a pilot's "*see and avoid*" responsibility. The legal responsibility of the pilot is not changed by virtue of installation of this equipment on board.

Equipment authorised under this ETSO must also comply with ETSO-C165 when implementing Surface Applications. This ETSO shall take precedence where it differs from ETSO-C165. For example, databases must meet medium quality as defined in DO-272A to be considered compliant with this ETSO.

Equipment authorised under this ETSO must contain or interface with equipment complying with ETSO-C154c or ETSO-C166b and ETSO-C119b (if TCAS installed).

ETSO-C196: Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation

This new ETSO is based on FAA TSO-C196 issued on 21/09/2009.

The standards of this ETSO apply to equipment intended to provide position information to a navigation management unit that outputs deviation commands keyed to a desired flight path. Pilots and autopilots will use the deviation output by the navigation management unit to guide the aircraft. Except for automatic dependent surveillance, these ETSO standards do not address integration issues with other avionics, such as how to preclude an inadvertent autopilot hardover.

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ETSO-2C197: Information Collection and Monitoring Systems

This new ETSO is based on FAA TSO-C197 issued on 15/11/2010.

The standards of this ETSO apply to a system that records cockpit audio, aircraft data, airborne images, or data link communications. In order to facilitate the work of the accident investigators, a requirement on the minimum physical dimensions of the crash enclosure has been added, while all other technical conditions are identical to those proposed by the FAA, EASA is interested in knowing whether stakeholders agree with this minimal additional requirement, which even if triggering insertion of the proposed ETSO in index 2, will not introduce significant differences with the FAA equivalent for any of the functional requirements.

12. The following table summarises proposed selected FAA TSOs to be transposed into updated/new ETSOs:

ETSO Reference	ETSO title	Based on and similar to FAA TSO
Subpart A, par. 2.1	Environmental standard	Subpart A, par. 2.1
ETSO-C55a	Fuel and Oil Quantity Instruments	TSO-C55a (from 08/06/2007)
ETSO-C62e	Aircraft Tyres	TSO-C62e (from 29/09/2006)
ETSO-C90d	Cargo Pallets, Nets and Containers	Draft TSO-C90d
ETSO-C95a	Mach Meters	TSO-C95a (from 31/08/2007)
ETSO-C126a	406MHz Emergency Locator Transmitter	TSO-C126a (from 17/12/2008)
ETSO-C154c	Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz	TSO-C154c (from 02/12/2009)
ETSO-C157	Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment	TSO-C157 (from 20/09/2004)
ETSO-C158	Aeronautical Mobile High Frequency Data Link (HFDL) Equipment	TSO-C158 (from 19/08/2004)
ETSO-C159a	Avionics Supporting Next Generation Satellite Systems (NGSS) = Iridium Phone	TSO-C159a (from 30/06/2010)
ETSO-C161a	Ground Based Augmentation System Positioning and Navigation Equipment	TSO-C161a (from 17/12/2009)
ETSO-C162a	Ground Based Augmentation System Very High Frequency Data Broadcast Equipment	TSO-C162a (from 17/12/2009)
ETSO-C166b	Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS – B) and Traffic Information Services (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)	TSO-C166b (from 02/12/2009)
ETSO-C170	High Frequency (HF) Radio Communications Transceiver Equipment Operating Within the Radio Frequency 1.5 to 30 Megahertz	TSO-C170 (from 20/12/2004)
ETSO-C172	Cargo Restraint Strap Assemblies	Draft TSO-C172
ETSO-C179	Rechargeable Lithium Cells and Lithium Batteries	TSO-C179 (from 22/08/2006)
ETSO-C184	Galley Equipment	Draft TSO-C184
ETSO-C194	Helicopter Terrain Awareness and Warning System (HTAWS)	TSO-C194 (from 17/12/2008)
ETSO-C195	Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance	TSO-C195 (from 27/09/2010)
ETSO-C196	Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation	TSO-C196 (from 21/09/2009)
ETSO-2C197	Information Collection and Monitoring Systems	TSO-C197 (from 15/11/2010)

V. Regulatory Impact Assessment

13. Process and consultation

The proposals contained in present NPA have been developed by the Agency, since based on regulatory material published by the FAA. Therefore neither drafting groups nor workshops or similar were deemed necessary.

All citizens are consulted, for a period of three months, through the publication of this NPA on the web. They can raise comments on any part of this document (explanatory note, RIA or proposed specifications).

14. Issue analysis and risk assessment

a. Issue which the NPA is intended to address

Technology and related requirements are continually changing, and thus new standards have been developed or the existing standards on which the already published ETSO had been based have been updated and improved. As a result of this continuing updating, new ETSOs and revised ETSOs need to be introduced. This will ensure that the parts and appliances to be used on aircraft are up to the latest standards. It should also be noted that the approval of parts and appliances that 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.

b. Scale of the issue

A substantial number of manufacturers are facing a problem of 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 the ETSO(s) and TSO(s) has to be assessed. Equivalent levels of safety have to be demonstrated and related deviations to 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.

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 web site[6].

c. Sectors concerned

- Designers and manufacturers of equipment intended to be used on aeronautical products;
- Designers and manufacturers of aeronautical products.

d. Risk (probability and severity) assessment

In the absence of updated and harmonised FAA TSO and ETSO, the equipment may require additional verification in the design phase, at the end of production (i.e. at factory level) or when installed on an aeronautical product, under the responsibility of the Type certificate (TC) or Supplemental TC holder. The minimum performance requirements and any additional functionality are therefore always verified.

As a consequence the risk of generating catastrophic or hazardous safety consequences is considered extremely remote.

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6 http://easa.europa.eu/certification/docs/etso-authorisations/ETSO.Dev.pdf.

Nevertheless the proposal facilitates the introduction of more modern (and safer) technological solutions.

15. Objectives

The general objectives of this proposal, in compliance with Article 2 of EASA B.R., are to:

- Facilitate the free movement of goods inside the EU and beyond;
- Promote cost-efficiency of the certification processes for equipment;
- Harmonise EASA specifications with the ones published by the FAA.

The specific objective of this NPA is to introduce new ETSO(s) or revise existing ETSO(s) specifications as a result of the continued updating of the industry standards that reflect the latest technology and to harmonise with existing FAA TSO standards where possible.

16. Options identified

The following options have been identified:

a. Option 1: Do not publish new versions of EASA ETSOs aligned with latest FAA versions (i.e. "do nothing");

b. Option 2: Introduction of new ETSO(s) and transposition of selected TSO specifications into technically similar ETSO(s), published as amendment to CS-ETSO;

c. Option 3: Introduction of new ETSO(s) and transposition of selected TSO specifications into technically similar ETSO(s), published as individual documents directly accessible through a numerically ordered list on the EASA web site.

17. Methodology and data requirements

Only qualitative e assessments are contained in present "light" RIA.

18. Analysis of the impacts

a. Safety

Adoption of these ETSO(s) will have a positive impact on safety as a result of the introduction of new and improved technology ensuring compliance with the Agency 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.

Therefore, options 2 and 3 are positive in safety terms, while option 1 is not.

b. Social

No impact expected.

c. Economic

No additional compulsory costs accrue from options 2 and 3, 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 not constitute an obligation for mandatory carriage;

- For users of the single European sky, since the existence of an ETSO does not imply that the related equipment shall be fitted and used in the airspace where Air Navigation Services (ANS) are provided by European ANS providers.

The establishment and the application of harmonised standards between the Agency and the FAA on subjects of common interest provide the basis for equipment approvals independent from aircraft approvals. This has a positive effect on the market value and applicability of these equipments. 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.

On the one hand, this will benefit European aircraft designers and operators wishing to install equipment produced outside the European Union (EU). On the other hand, this will enhance the possibility for holders of ETSO authorisations to produce parts and appliances, including for use outside the EU.

These economic advantages will not materialise in case of option 1.

Furthermore, option 3 will facilitate web access to ETSOs, in comparison with option 2, so leading to a marginal reduction of the effort needed by stakeholders to consult the said ETSOs.

d. Environmental

No impact expected.

e. Proportionality issues

All applicants for ETSO authorisations are equally affected.

f. Impact on regulatory coordination and harmonisation

No negative impact is expected for options 2 and 3. On the contrary, this harmonisation has a positive effect since it implies compliance with FAA TSO requirements. In addition, option 3 will harmonise the way in which ETSOs will be made available on the web, compared with current FAA practice for TSOs.

19. Conclusion and preferred option

a. Comparison of the positive and negative impacts for each option evaluated

Harmonisation of EASA-ETSOs and 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. 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.

Adoption of these 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.

In addition, option 3 will facilitate access to ETSOs through the web, based on a numerically ordered list of individual documents, as currently practiced by the FAA.

b. Final assessment and recommendation of a preferred option

Option 3 is therefore the preferred option.

The proposals contained in this NPA introduce new and revised standards and achieve a common international standard, where possible, with regard to the approval of parts and appliances, while facilitating web consultation.

B. Draft Decision

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

1. deleted 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 – GENERAL

2.1 Environmental standards:

Unless otherwise stated in the paragraph 3.1.2 of the specific ETSO, the applicable environmental standards are contained in EUROCAE/RTCA document ED-14D change 3/DO-160D "Environmental Conditions and Test Procedures for Airborne Equipment", change 3 dated December 2002, or ED-14E dated March 2005 or ED-14F dated March 2008 or RTCA-160G dated December 2010.

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

SUBPART B – LIST OF ETSOs (INDEX 1 AND INDEX2)

INDEX 1

~~ETSO-C31d~~	~~HF Transmitting Equipment~~	Cancelled
~~ETSO-C32d~~	~~HF Receiving Equipment~~	Cancelled
ETSO-C55a	Fuel and Oil Quantity Instruments ~~(Reciprocating Engine Aircraft)~~	
ETSO-C62~~d~~e	Aircraft Tyres	
ETSO-C90~~c~~d	Cargo Pallets, Nets and Containers	
ETSO-C95a	Mach Meters	
ETSO-C126a	406MHz Emergency Locator Transmitter	
ETSO-C154c	Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz	
ETSO-C157	Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment	
ETSO-C158	Aeronautical Mobile High Frequency Data Link (HFDL) Equipment	
ETSO-C159a	Avionics Supporting Next Generation Satellite Systems (NGSS) = Iridium Phone	
ETSO-C161a	Ground Based Augmentation System Positioning and Navigation Equipment	
ETSO-C162a	Ground Based Augmentation System Very High Frequency Data Broadcast Equipment	
ETSO-C166~~a~~b	Extended Squitter Automatic Dependent Surveillance - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)	

ETSO-C170	High Frequency (HF) Radio Communications Transceiver Equipment Operating Within the Radio Frequency 1.5 to 30 Megahertz
ETSO-C172	Cargo Restraint Strap Assemblies
ETSO-C179	Rechargeable Lithium Cells and Lithium Batteries
ETSO-C184	Galley Equipment
ETSO-C194	Helicopter Terrain Awareness and Warning System (HTAWS)
ETSO-C195	Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance
ETSO-C196	Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation

INDEX 2

~~ETSO-2C126~~	~~406MHz Emergency Locator Transmitter (ELT)~~	Cancelled
ETSO-2C197	Information Collection and Monitoring Systems	

~~Date : 24.10.03~~
Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: Fuel and Oil Quantity Instruments ~~(RECIPROCATING ENGINE AIRCRAFT)~~

1 - Applicability

This ETSO gives the requirements which Fuel and Oil Quantity 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 AS 405~~B~~C, Fuel and oil quantity Instruments, dated July 2001, as amended and supplemented by this ETSO:

(i) Conformance with the following paragraphs of AS 405~~B~~C is not required: 3.1; 3.1.1, 3.1.2, 3.2 and 4.2.1.

(ii) Substitute the following for paragraph 7: „Performance tests: The following tests, in addition to any others deemed necessary by the manufacturer, shall be the basis for determining compliance with the performance requirements of this standard".

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

As specified in the SAE Aerospace Standard AS 405~~-B~~C.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

The failure condition classification will depend on the system on which the fuel and oil quantity instrument is installed. The classification must be determined by the safety assessment conducted as part of the installation approval. Develop each fuel and oil quantity instrument to at least the design assurance level equal to the failure condition classification of the system on which the fuel and oil quantity instrument is installed.

4 - Marking

4.1 - General

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

4.2 - Specific

~~None~~

a. Mark at least one major component permanently and legibly with all the information in SAE AS405C, Section 3.2 (except paragraph 3.2.b). Also, mark the component with the following information:

(1) The basic type and accuracy classification, and

(2) The fluids for which the instrument is substantiated

b. Mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the ETSO number:

(1) Each component that is easily removable (without hand tools),

(2) Each interchangeable element, and

(3) Each subassembly of the fuel and oil quantity instrument that you determined may be interchangeable.

c. If the fuel and oil quantity instrument includes a digital computer, 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 to show the modification status.

NOTE: Similar software versions, approved to different software levels, must be differentiated by part number.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

~~Date : 24.10.03~~
Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: Aircraft Tyres

1 - Applicability

This ETSO gives the requirements which tyres excluding tailwheel tyres 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 attached Appendix 1, "Federal Aviation Administration Standard for Aircraft Tyres", dated 29/09/2006.

3.1.2 - Environmental Standard

As stated in the Federal Aviation Administration Standard.

3.1.3 – Computer Software

None

3.1.4 - Electronic Hardware Qualification

None

3.2 - Specific

None

3.2.1 Failure Condition Classification

N/A

4 - Marking

4.1 - General

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

~~In lieu of the marking requirements of CS-ETSO Subpart A paragraph 1.2, a tyre must be legibly and permanently marked at least with the following:~~

~~(1) Brand name or registered trademark of the manufacturer responsible for compliance.~~

~~(2) Speed rating, load rating, size, skid depth, serial number, date, manufacturer's part number and plant code, and nonretreadable, if appropriate.~~

~~(3) Applicable ETSO number.~~

4.2 - Specific

~~None~~

1. Balance marker, consisting of a red dot, on the sidewall of the tire immediately above the bead to indicate the lightweight point of the tire.
2. Production date code (may be included in the established serial number).
3. Ply rating must be established. Submit these ratings to the Tire and Rim Association, Inc. (TRA) or European Tyre and Rim Technical Organization (ETRTO). If the ply rating is marked on the tire, the load rating marked on the tire must be consistent with the ply rating established.

    NOTE: for a new programme aircraft, define new tire dimensions and submit them to ETRTO for publication in the ETRTO Data Book. You do not have to wait until your submitted dimensions are incorporated into the Data Book before applying for the ETSO.
4. Serial number: the plant code and production date code may be included.
5. Size and load ratings, established and identified in a timely manner in the TRA *Aircraft Year Book*, latest edition or in the ETRTO *Aircraft Tyre and Rim Data Book*, latest revision. See the NOTE at paragraph g.
6. Skid depth, marked in inches to the nearest one-hundredth as defined in appendix 1.
7. Speed rating, in MPH and as identified in appendix 1, paragraph 4.b that is equal to or less than the speed at which the tire has been qualified.
8. Tire type. Mark tires requiring a tube with the words "Tube type."
9. Non-re-treadable tires must be marked accordingly.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

APPENDIX 1. FEDERAL AVIATION ADMINISTRATION STANDARD FOR AIRCRAFT TIRES DATED SEPTEMBER 7, 1990

1.0 Purpose. This document contains minimum performance standards for new and requalified aircraft tires, excluding tailwheel tires, that are to be identified as meeting the standards of TSO-C62d.

2.0 Scope. These minimum performance standards apply to aircraft tires having speed and load ratings that are established on the basis of the speeds and loads to which the tires have been tested.

3.0 Material requirement. Materials must be suitable for the purpose intended. The suitability of the materials must be determined on the basis of satisfactory service experience or substantiating dynamometer tests.

4.0 Design and construction.

4.1 Unbalance. The moment (M) of static unbalance in inch-ounces may not be greater than the value determined using the formula, moment (M) = $0.025D^2$, rounded off to the next lower whole number: where D = maximum outside diameter of the tire in inches.

4.2 Balance marker. A balance marker, consisting of a red dot, must be affixed on the sidewall of the tire immediately above the bead to indicate the lightweight point of the tire. The dot must remain for any period of storage plus the original tread life of the tire.

4.3 Overpressure. The tire shall withstand for at least 3 seconds a pressure of at least 4.0 times the rated inflation pressure (as specified in paragraph 5.2) at ambient temperature.

4.4 Temperature.

4.4.1 Ambient. It shall be substantiated by applicable tests or shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to the temperature extremes of not higher than -40°F and not lower than +160°F for a period of not less than 24 hours at each extreme.

4.4.2 Wheel rim heat. It must be substantiated by the applicable tests or shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to a wheel-bead seat temperature of not lower than 300°F for at least 1 hour, except that low-speed tires or nose-wheel tires may be tested or analyzed at the highest wheel-bead seat temperatures expected to be encountered during normal operations.

4.5 Tread design. Moved. (See paragraph 7.0)

4.6 Slippage. A tire tested in accordance with the dynamometer tests provided in paragraph 6.0 may not slip on the wheel rim during the first five dynamometer cycles. Slippage that subsequently occurs may neither damage the gas seal of the tyre bead of a tubeless tire nor otherwise damage the tube or valve.

4.7 Leakage. After an initial 12-hour minimum stabilization period, the tire must be capable of retaining inflation pressure with a loss of pressure not exceeding 5 percent in 24 hours from the initial pressure equal to the rated inflation pressure.

5.0 Ratings.

5.1 Load ratings. The load ratings of tyres shall be established. The applicable dynamometer tests in paragraph 6.0 must be performed at the selected rated load.

5.1.1 Load rating (helicopter tires). Airplane tires qualified in accordance with provisions of this standard may also be used on helicopters. In such cases, the maximum static load rating may be increased by 1.5 with a corresponding increase in rated inflation pressure without any additional qualification testing.

5.2 Rated inflation pressure. The rated inflation pressure shall be established at an identified ambient temperature on the basis of the rated load as established under paragraph 5.1.

5.3 Loaded radius. The loaded radius is defined as the distance from the axle centerline to a flat surface for a tire initially inflated to the rated inflation pressure and then loaded to its rated load against the flat surface. The nominal loaded radius, the allowable tolerance on the nominal loaded radius, and the actual loaded radius for the test tire shall be identified.

6.0 Dynamometer test requirements. The tyre may not fail the applicable dynamometer tests specified herein or have any signs of structural deterioration other than normal expected tread wear except as provided in paragraph 6.3.3.3.

6.1 General. The following conditions apply to both low-speed and high-speed tires when these tires are subjected to the applicable dynamometer tests:

6.1.1 Tire test load. Unless otherwise specified herein for a particular test, the tire must be forced against the dynamometer flywheel at not less than the rated load of the tire during the entire roll distance of the test.

6.1.2 Test inflation pressure. The test inflation pressure must be the pressure required at an identified ambient temperature to obtain the same loaded radius against the flywheel of the dynamometer at the loaded radius for a flat surface as defined in paragraph 5.3. Adjustments to the test inflation pressure may not be made to compensate for increases created by temperature rises occurring during the tests.

6.1.3 Test specimen. A single tire specimen must be used in the applicable dynamometer tests specified herein.

6.2 Low-speed tire. A tire operating at ground speeds of 120 mph or less must withstand 200 landing cycles on a dynamometer at the following test temperature and kinetic energy and using either test method A or test method B.

6.2.1 Test temperature. The temperature of the gas contained in the tire or of the carcass measured at the hottest point of the tire may not be lower than 105°F at the start of at least 90 percent of the test cycles. For the remaining 10 percent of the test cycles, the contained gas or carcass temperature may not be lower than 80°F at the start of each cycle. Rolling the tire on the flywheel is acceptable for obtaining the minimum starting temperature.

6.2.2 Kinetic energy. The kinetic energy of the flywheel to be absorbed by the tire must be calculated as follows:

$K.E. = CWV^2 = 162.7W$ = Kinetic energy in foot-pounds.

where:

C = 0.0113,

W = Load rating of the tire in pounds, and

V = 120 mph.

6.2.3 Test method A - variable mass flywheel. The total number of dynamometer landings must be divided into two equal parts having speed ranges shown below. If the exact number of flywheel plates cannot be used to obtain the calculated kinetic energy value or proper flywheel width, a greater number of plates must be selected and the dynamometer speed adjusted to obtain the required kinetic energy.

6.2.3.1 Low-speed landings. In the first series of 100 landings, the maximum landing speed is 90 mph and the minimum unlanding speed is 0 mph. The landing speed must be adjusted so that 56 percent of the kinetic energy calculated under paragraph 6.2.2 will be absorbed by the tire. If the adjusted landing speed is calculated to be less than 80 mph, the following must be done: the landing speed must be determined by adding 28 percent of the kinetic energy calculated under paragraph 6.2.2 to the flywheel kinetic energy at 64 mph, and the unlanding speed must be determined by subtracting 28 percent of the kinetic energy calculated under paragraph 6.2.2 from the flywheel kinetic energy at 64 mph.

6.2.3.2 High-speed landings. In the second series of 100 landings, the minimum landing speed is 120 mph and the nominal unlanding speed is 90 mph. The unlanding speed must be adjusted as necessary so that 44 percent of the kinetic energy calculated under paragraph 6.2.2 will be absorbed by the tire.

6.2.4 Test method B - fixed mass flywheel. The total number of dynamometer landings must be divided into two equal parts having speed ranges indicated below. Each landing must be made in a time period, T, calculated so that the tire will absorb the kinetic energy determined under paragraph 6.2.2. The time period must be calculated using the equation:

$$T_c = \frac{KE_c}{\left[\frac{KE_{W(UL)} - KE_{W(LL)}}{T_{L(UL)} - T_{L(LL)}}\right] - \left[\frac{KE_{W(UL)} - KE_{W(LL)}}{T_{W(UL)} - T_{W(LL)}}\right]}$$

For the 90 mph to 0 mph test, the equation reduces to:

$$T_c = \frac{KE_c}{\left[\frac{KE_{W(UL)}}{T_{L(UL)}}\right] - \left[\frac{KE_{W(UL)}}{T_{W(UL)}}\right]}$$

Where:

T_c = Calculated time, in seconds, for the tyre to absorb the required kinetic energy.

KE_c = Kinetic energy, in foot pounds, the tyre is required to absorb during each landing cycle.

KE_W = Kinetic energy, in foot pounds, of the flywheel at given speed.

T_L = Coast down time, in seconds, with rated tyre load on flywheel.

T_W = Coast down time, in seconds, with no tyre load on flywheel.

(UL) = Subscript for upper speed limit.

(LL) = Subscript for lower speed limit.

6.2.4.1 Low-speed landings. In the first series of 100 landings, the tire must be landed against the flywheel with the flywheel having a peripheral speed of not less than 90 mph. The flywheel deceleration must be constant from 90 mph to 0 mph in the time Tc.

6.2.4.2 High-speed landings. In the second series of 100 landings, the tire must be landed against the flywheel with the flywheel having a peripheral speed of not less than 120 mph. The flywheel deceleration must be constant from 120 mph to 90 mph in the time T_c.

6.3 High-speed tire. Except as provided in the alternate test, a tire operating at ground speeds greater than 120 mph must be tested on a dynamometer in accordance with paragraph 6.3.3. The curves to be used as a basis for these tests shall be established in accordance with paragraph 6.3.3.2. The load at the start of each test must be equal to the rated load of the tire. Alternate tests involving a landing sequence for a tire operating at ground speeds greater than 120 mph and not over 160 mph are set forth in paragraph 6.3.4.

6.3.1 Test temperature. The temperature of the gas contained in the tire or of the carcass measured at the hottest point of the tire may not be lower than 120°F at the start of at least 90 percent of the test cycles specified in paragraph 6.3.3.4 and at least 105°F at the start of the overload test (6.3.3.3) and of at least 90 percent of the test cycles specified in paragraphs 6.3.3.2 and 6.3.4. For the remaining 10 percent of each group of cycles, the contained gas or carcass temperature may not be lower than 80°F at the start of each cycle. Rolling the tire on the dynamometer is acceptable for obtaining the minimum starting temperature.

6.3.2 Dynamometer test speeds. Applicable dynamometer test speeds for corresponding maximum ground speeds are as follows:

Maximum Ground Speed of Aircraft, mph		Speed Rating of Tire, mph	Minimum Dynamometer Speed at S_2, mph
Over	Not Over		
120	160	160	160
160	190	190	190
190	210	210	210
210	225	225	225
225	235	235	235
235	245	245	245

For ground speeds over 245 mph, the tire must be tested to the maximun applicable load-speed-time requirements and appropriately identified with the proper speed rating.

6.3.3 Dynamometer cycles. The test tire must withstand 50 take-off cycles, 1 overload take-off cycle, and 10 taxi cycles described below. The sequence of the cycles is optional.

6.3.3.1 Symbol definitions. The numerical values which are used for the following symbols must be determined from the applicable aircraft load-speed-time data:

L_0 = Tire load at start of take-off, pounds (not less than rated load).

L_1 = Tire load at rotation, pounds.

L_2 = Zero tyre load (lift-off).

RD = Roll distance, feet.

~~S0 = Zero tyre speed.~~
~~S1 = Tire speed at rotation, mph.~~
~~S_2 = Tire speed at liftoff, mph (not less than speed rating).~~
~~T_0 = Start of takeoff.~~
~~T1 = Time to rotation, seconds.~~
~~T2 = Time to liftoff, seconds.~~

~~6.3.3.2 Takeoff cycles. For these cycles the loads, speeds, and distance must conform to either Figure 1 or Figure 2. Figure 1 defines a test cycle that is generally applicable to any aircraft. If Figure 2 is used to define the test cycle, the loads, speeds, and distance must be selected based on the most critical takeoff conditions established by the applicant.~~

~~6.3.3.3 Overload takeoff cycle. The cycle must duplicate the takeoff cycles specified under paragraph 6.3.3.2 except that the tire load through the cycle must be increased by a factor of at least 1.5. Upon completion of the overload takeoff cycle, the tire must be capable of retaining inflation pressure with the loss of pressure not exceeding 10 percent in 24 hours from the initial test pressure. Good condition of the tire tread is not required after completion of this test cycle.~~

~~6.3.3.4 Taxi cycles. The tire must withstand at least 10 taxi cycles on a dynamometer under the following test conditions:~~

~~Number of Test Cycles~~	~~Minimum Tire Load, 1bs.~~	~~Minimum Speed, mph~~	~~Minimum Roll Distance, ft.~~
~~8~~	~~Rated load.~~	~~40~~	~~35,000~~
~~2~~	~~1.2 times rated load.~~	~~40~~	~~35,000~~

~~6.3.4 Alternative dynamometer tests. For a tire with a speed rating of 160 mph, test cycles which simulate landing may be used in lieu of the take-off cycles specified in paragraphs 6.3.3.2 and 6.3.3.3. The tire must withstand 100 test cycles at rated load in accordance with paragraph 6.3.4.1 followed by 100 test cycles at rated load in accordance with paragraph 6.3.4.2.~~

~~6.3.4.1 Low-speed landings. In the first series of 100 landings, the test procedures for low-speed landings established under paragraph 6.2.3 or 6.2.4, as appropriate, must be followed.~~

~~6.3.4.2 High-speed landings. In the second series of 100 landings, the test procedures for low-speed landings established under paragraph 6.2.3 or 6.2.4, as appropriate, must be followed, except that the tire must be landed against the flywheel rotating at a speed of 160 mph with the rated load applied for the duration of the test. The unlanding speed must be adjusted as necessary so that 44 percent of the kinetic energy, as calculated in paragraph 6.2.2, is absorbed by the tire during the series of tests.~~

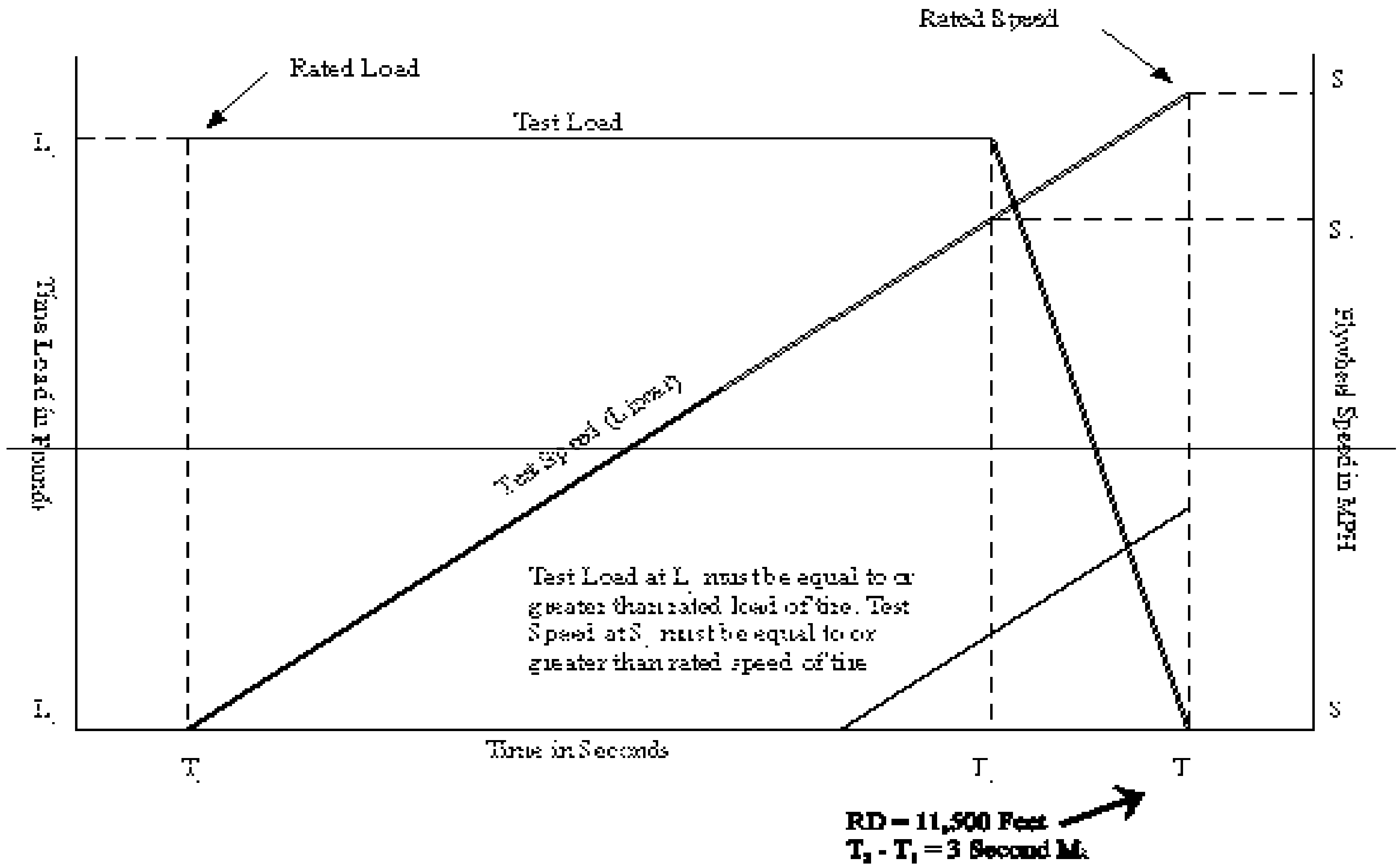
~~7.0 Requalification tests. A tire shall be requalified unless it is shown that changes in materials, tire design, or manufacturing processes could not affect performance. Changes in materials, tire design, or manufacturing processes that affect performance or changes in number or location of tread ribs and grooves or increases in skid depth, made subsequent to the tire qualification, must be substantiated by dynamometer tests in accordance with paragraph 6.0. Requalification in accordance with paragraph 6.0 of a given load rated tire required as a result of a tread design or material change will automatically qualify the same changes in a lesser load rated tire of the same size, speed rating, and skid depth provided~~

~~7.1 The lesser load rated tire has been qualified to the applicable requirements specified in this standard; and~~

~~7.2 The ratio of qualification testing load to rated load for the lesser load rated tire does not exceed the same ratio for the higher load rated tire at any given test condition.~~

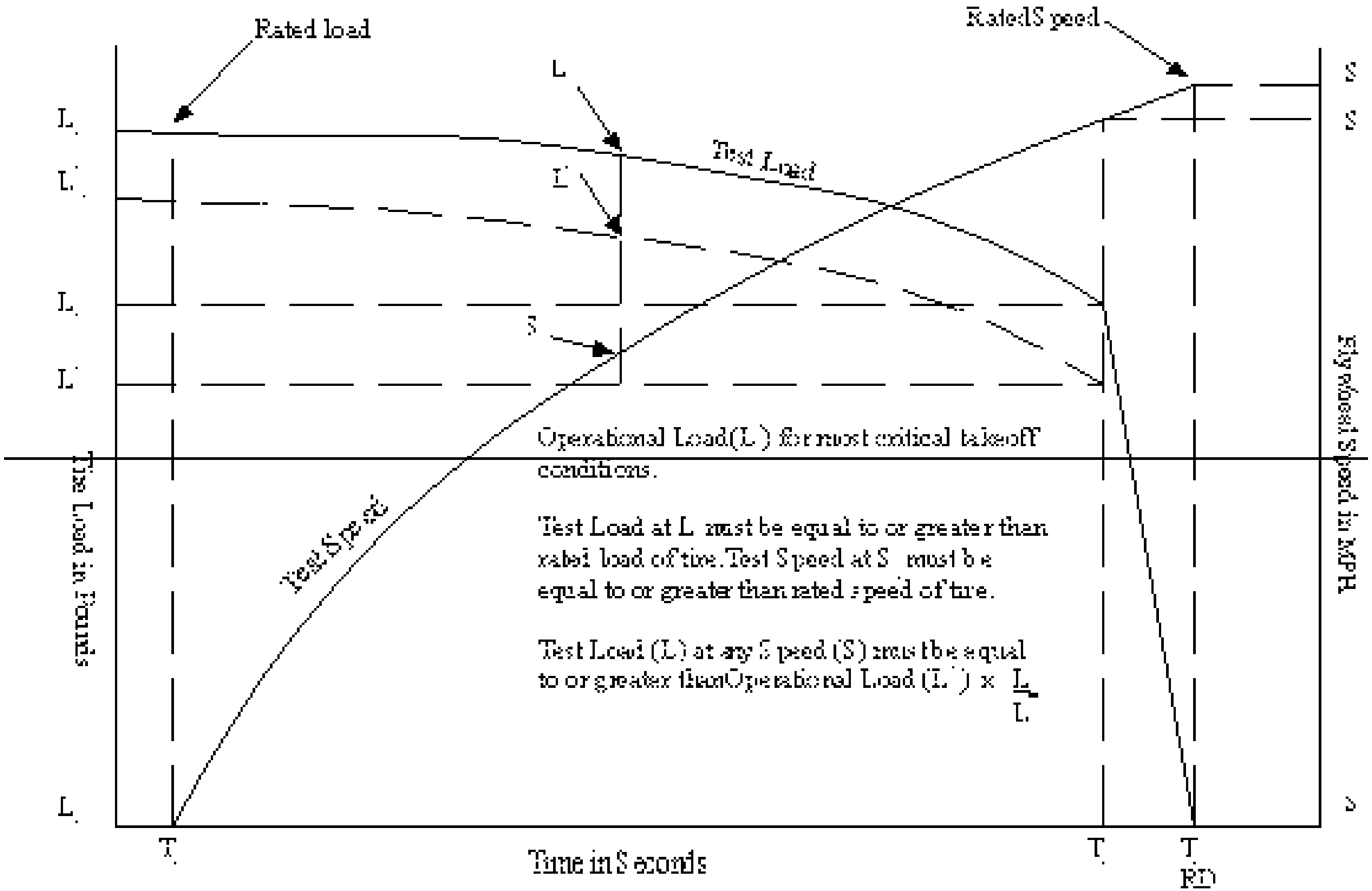
FIGURE 1

GRAPHIC REPRESENTATION OF A UNIVERSAL LOAD-SPEED TIME TEST CYCLE



~~FIGURE 2~~

~~GRAPHIS REPRESENTATION OF A RADIONAL LOAD-SPEED-TIME TEST CYCLE~~



APPENDIX 1. FAA STANDARD FOR AIRCRAFT TIRES

1. PURPOSE. Minimum performance standards for new and re-qualified radial and bias tires, excluding tailwheel tires, to be identified as meeting the standards of ETSO-C62e.

2. SCOPE. Minimum performance standards apply to aircraft tires having speed and load ratings based on the speeds and loads to which the tires have been tested.

3. DEFINITIONS.

Bias tire: a pneumatic tire whose ply cords extend to the beads and are laid at alternate angles substantially less than 90º to the centerline of the tread. May also have a bias belted tire with a circumferential belt.

Radial tire: a pneumatic tire whose ply cords extend to the beads and are laid substantially at 90º to the centerline of the tread, the carcass being stabilised by an essentially inextensible circumferential belt.

Load rating: maximum permissible static load at a specific inflation pressure. Use the rated load combined with the rated inflation pressure when selecting tires for application to an aircraft, and for testing to the performance requirements of this ETSO.

Rated inflation pressure: Specified unloaded inflation pressure which will result in the tire deflecting to the specified static loaded radius when loaded to its rated load against a flat surface.

Static loaded radius (SLR): perpendicular distance between the axle centerline and a flat surface for a tire initially inflated to the unloaded rated inflation pressure and then loaded to its rated load.

Ply rating: an index of tire strength from which a rated inflation pressure and its corresponding maximum load rating are determined for a specific tire size.

Speed rating: maximum ground speed at which the tire has been tested in accordance with this ETSO.

Skid depth: distance between the tread surface and the bottom of the deepest groove as measured in the mold.

4. DESIGN AND CONSTRUCTION .

a. General Standards. Tires selected for use on a specific aircraft must demonstrate suitability through appropriate laboratory simulations described in paragraphs **5.a** or **5.b of** this appendix, as appropriate. Determine material suitability by:

(1) Temperature: show by tests or analysis that the physical properties of the tire materials are not degraded by exposure to temperature extremes of -40°C and +37,8°C (-40ºF and +160ºF) for a period of not less than 24 hours at each extreme.

(2) Wheel rim heat: substantiate by the applicable tests or show by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to a wheel-bead seat temperature of not lower that 148,9°C (300°F) for at least 1 hour, except that low-speed tires or nose-wheel tires may be tested or analysed at the highest wheel-bead seat temperatures expected to be encountered during normal operations.

b. Speed Rating. See Table 1 below for applicable dynamometer test speeds for corresponding maximum takeoff ground speeds. For takeoff speeds over 245 mph, the tire must be tested to the maximum applicable load-speed-time requirements and identified with the proper speed rating.

TABLE 1. Applicable Dynamometer Test Speeds

Max Takeoff Speed *Mph at liftoff over:*	*But not over:*	Max takeoff Speed Of Aircraft *Max Tire mph:*	Min Dynamometer Speed (Figures 1, 2 or 3) *Min Tire mph*:
0	120	120	120
120	160	160	160
160	190	190	190
190	210	210	210
210	225	225	225
225	235	235	235
235	245	245	245

c. Overpressure. The tire must successfully withstand a hydrostatic pressure of at least four times its rated inflation pressure for 3 seconds without bursting.

d. Helicopter tires. You may use aircraft tires qualified according to this ETSO on helicopters. In such cases for standard tires, you may increase the maximum static load rating by a factor of 1.5 with a corresponding increase in rated inflation pressure without additional qualification testing (round loads to the nearest 10 lbs and inflation pressures to the nearest whole psi.). If significant taxi distance is expected, these guidelines may not apply. Consult tire and rim manufacturers for appropriate tire size selection. Maximum permissible inflation for aircraft tires used on helicopters is 1.8 times the rated inflation pressure.

e. Dimensions. Maintain the tire size (outside diameter, shoulder diameter, section and shoulder width), within specified tolerances.

NOTE: for a new programme aircraft, define new tire dimensions and submit them to TRA for publication in the TRA Data Book. You do not have to wait until your submitted dimensions are incorporated into the Data Book before applying for the ETSO.

(1) Outside diameter, shoulder diameter, section width and shoulder width: For the bias ply tire, outside diameter and section width are specified to a maximum and minimum value after a 12 hour growth period at rated inflation pressure. Shoulder diameter and width dimensions are specified to a maximum value after a 12-hour growth period at rated inflation pressure. Radial tire dimensions are **limited by the grown tire envelope according to the static loaded radius (SLR) requirements in paragraph 4.e.(3)** below.

(2) Due to the increased inflation pressures permitted when using an aircraft tire in a helicopter application, we permit tire dimensions to be 4% larger.

(3) Static loaded radius (SLR):

(a) Bias tires: provide the nominal SLR. The actual SLR is determined on a new tire stretched for a minimum of 12 hours at rated inflation pressure.

(b) Radial tires: provide the nominal SLR. The actual SLR of a radial tire is determined at rated inflation pressure after running 50 takeoffs, following paragraph **5.a.(2)** requirements.

(4) Helicopter tires: maximum dimensions for new tires used on helicopters are 4% larger than maximum aircraft tire dimensions. (In calculating maximum overall and shoulder diameters, rim diameter should be deducted before applying 4%.)

f. Inflation retention. After an initial 12-hour minimum stabilisation period at rated inflation pressure, the tire must retain the inflation pressure with a loss of pressure not exceeding 5% of the initial pressure for 24 hours. Measure the ambient temperature at the start and finish of the test to ensure that any pressure change was not caused by an ambient temperature change.

g. Balance. Test all tires for static unbalance. A balance marker, consisting of a red dot, must be affixed on the sidewall of the tire immediately above the bead to indicate the lightweight point of the tire. The dot must remain for any period of storage plus the original tread life of the tire.

(1) Auxiliary tires (not main or tailwheel tires): the moment of static unbalance (M) for auxiliary tires shall not be greater than the value determined using this equation:

$$M = 0.025D^2$$

Round the computed equation values to the next lower whole number where M is in inch-ounces and D is the standardised maximum new tire inflated outside diameter in inches. Your design must include requirements to measure the level of unbalance on each tire, and approved procedures to correct the unbalance within the above limits if necessary.

(2) All main tires and all tires with 46-inch and larger outside diameter: the moment of static unbalance (M) for main tires shall not be greater than the value determined using this equation:

$$M = 0.035D^2$$

Round the computed equation values to the next lower whole number where M is in inch-ounces and D is the standardised maximum new tire inflated outside diameter in inches. Your design must include requirements to measure the level of unbalance on each tire, and approved procedures to correct the unbalance within the above limits if necessary.

5. TIRE TEST REQUIREMENTS.

a. Use a single test specimen for a qualification test. The tire must withstand the following dynamometer cycles without detectable signs of deterioration, other than normal expected tread surface abrasion, except when the overload takeoff condition is run last (see paragraph **5.a.(8)** below).

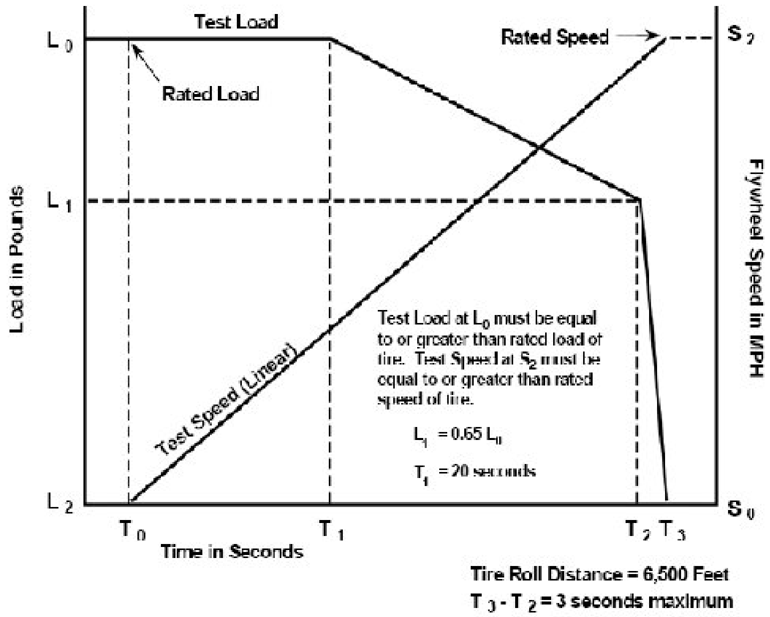
(1) Dynamometer cycle requirements: all aircraft tires must satisfactorily withstand 58 dynamometer cycles as a demonstration of overall performance, plus 3 overload dynamometer cycles as a demonstration of the casing's capability under overload. The 58 dynamometer cycles consists of 50 takeoff cycles, per **5.a.(2)**, and 8 taxi cycles, per **5.a.(7)**. The overload cycles consist of 2 taxi cycles, per **5.a.(7)** at 1.2 times rated load and 1 overload takeoff cycle per **5.a.(8)** starting at 1.5 times rated load. Run the dynamometer cycles in any order. However, if the overload takeoff cycle is not run last, the tire must not show detectable signs of deterioration after the cycle completion, other than normal expected tread surface abrasion.

(2) Takeoff cycles: the 50 takeoff cycles shall realistically simulate tire performance during runway operations for the most critical combination of takeoff weight and speed, and aircraft center-of-gravity position. When determining the most critical combination of the above, be sure to account for increased speeds resulting from high field elevation operations and high ambient temperatures, if applicable. Specify the appropriate load-speed-time data or parameters that correspond to the test envelope in which the tire is to be tested. Figures 1, 2, and 3 are graphic representations of the test. Starting at zero speed, load the tire against the dynamometer flywheel. The test cycles must simulate one of the curves illustrated in Figure 1 or 2 (as applicable to speed rating), or Figure 3.

- Figure 1 defines a test cycle that applies to any aircraft tire with a speed rating of 120 mph or 160 mph.
- Figure 2 defines a test cycle that applies to any aircraft tire with a speed rating greater than 160 mph.
- Figure 3 defines a test cycle that applies for any speed rating, is based on the most critical takeoff loads, speeds, and distances, and is aircraft specific.

Figure 1

Graphic Representation of a Universal Load-Speed-Time Test Cycle
(For 120 MPH and 160 MPH Tires)



Symbol Definitions (Figures 1, 2, and 3)

L_0 Tire load (lbs) at start of takeoff (not less than the load rating), Figures 1, 2, and 3.

L_0^1 Tire load (lbs) at start of takeoff for the operational load curve, Figure 3.

L_1 Tire load (lbs) at rotation, Figures 1 and 3.

L_1^1 Tire load (lbs), Figure 3.

L_2 Tire load at liftoff, 0 lbs, Figures 1, 2, and 3.

S_0 Zero (0) mph, Figures 1, 2, and 3.

S_1 Speed at rotation in mph, Figure 3.

S_2 Tire speed at liftoff in mph (not less than the speed rating), Figures 1, 2, and 3.

T_0 Time at start of takeoff, 0 s, Figures 1, 2, and 3.

T_1 20 seconds, Figure 1.

T_2 Time to rotation in seconds, Figures 1, 2, and 3.

T_3 Time to liftoff in seconds, Figures 1, 2, and 3.

Figure 2
Graphic Representation of a Typical Universal Load-Speed-Time Test Cycle
(For Tires Rated above 160 MPH)

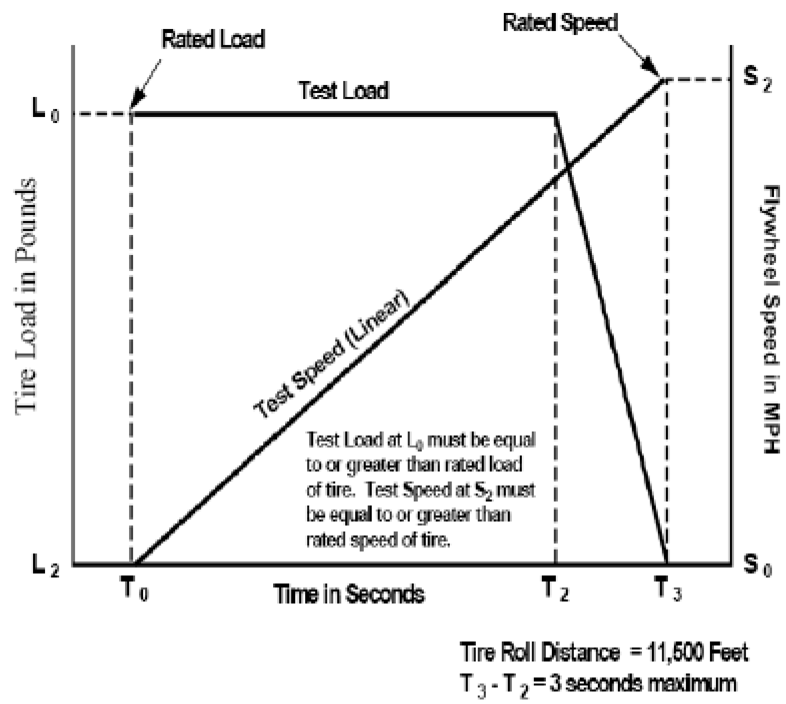
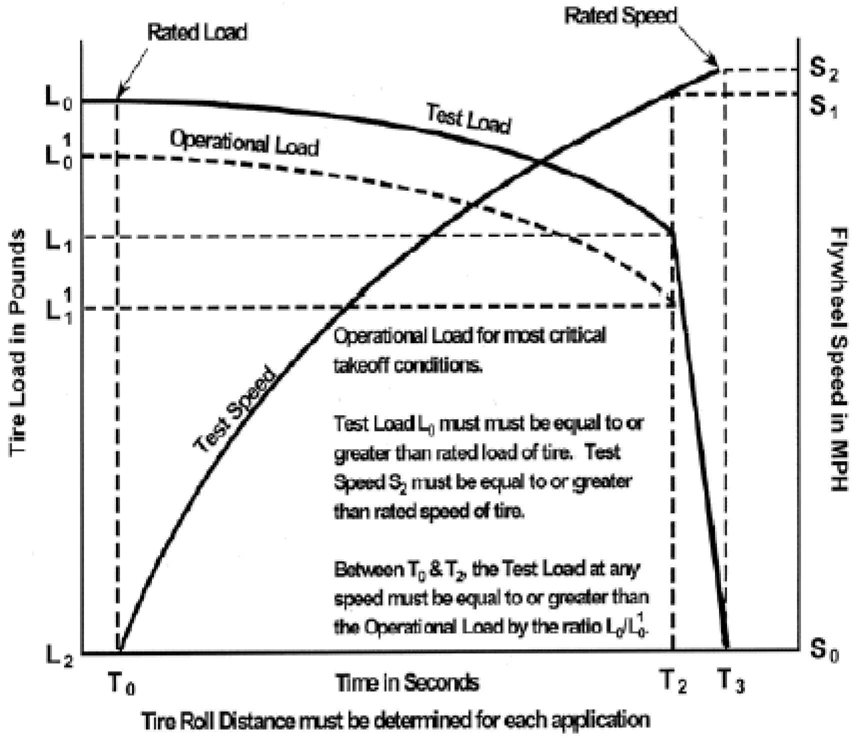


Figure 3
Graphic Representation of a Typical Rational Load-Speed-Time Test Cycle



(3) Test load: the minimum allowable load at the start of the test is the rated load of the tire. The test loads must conform to Figures 1 or 2 (as applicable), or Figure 3. Figures 1 and 2 define a test cycle generally applicable to any aircraft. If you use Figure 3 to define the test cycle, select the loads based on the most critical takeoff conditions you established. At any speed throughout the test cycle, the ratio of the test load to the operational load must be the same as, or greater than, the ratio at the start of the test.

(4) Test inflation pressure: the pressure needed to provide the same loaded radius on the flywheel as was obtained on a flat surface at the rated tire load and inflation pressure. Make both determinations at the same ambient temperature. Do not adjust the test inflation pressure to compensate for changes created by temperature variations during the test.

(5) Test temperatures and cycle interval: the temperature of the gas in the tire or the casing temperature measured at the hottest point of the tire may not be:

(a) Lower than 40,6°C (105ºF) at the start of the overload takeoff cycle and at the start of at least 45 of the 50 takeoff cycles, and

(b) Lower than 48,9°C (120ºF) at the start of at least 9 of the 10 taxi cycles.

For the remaining cycles, the contained gas or casing temperature may not be lower than 26,7°C (80ºF) at the start of each cycle. Rolling the tire on the dynamometer flywheel is an acceptable method for obtaining the minimum starting temperature.

(6) Dynamometer takeoff cycle speeds: see Table 1 for the dynamometer test speeds for the corresponding maximum aircraft takeoff speeds.

(7) Taxi cycles: tire must withstand 10 taxi cycles on a dynamometer under the test conditions in Table 2 below.

TABLE 2. Test Conditions

Number of Taxi Runs	Min Tire Load (lbs)	Min Speed (mph)	Tire speed rating 120/160 mph Min Rolling Distance (ft)	Tire speed rating Over 160 mph Min Rolling Distance (ft)
8	Rated	40	25,000	35,000
2	1.2 x Rated	40	25,000	35,000

(8) Overload takeoff cycle: the overload takeoff cycle shall duplicate the test described in paragraph **5.a.(2)** with the test load increased by a factor of 1.5 throughout. Good condition of the tire tread is not required after completion of this test cycle, if you run this test last. If the overload takeoff cycle is not run last, the tire must withstand the cycle without detectable signs of deterioration, other than normal expected tread surface abrasion.

(9) Diffusion test: after completing the 61 test cycles, the tire must retain the inflation pressure to within 10% of the initial test pressure for a period of 24 hours. Measure the ambient temperature at the start and finish of this test to ensure that any pressure change was not caused by an ambient temperature change.

(10) Tire/wheel slippage: tires should not slip on the wheel rim during the first five dynamometer cycles. Any slippage that subsequently occurs must not damage the tube valve of tube type tires, or the gas seal of the tire bead of tubeless tires.

b. Alternate qualification procedures: 120 mph rated tires. For 120 mph speed rating tires, you may use the following variable mass flywheel procedure:

(1) Test load: load must meet or exceed the tire rated load throughout the entire test roll distance.

(2) Test inflation pressure: pressure needed to provide the same loaded radius on the flywheel as was obtained on a flat surface at the rated tire load and inflation pressure. Make both determinations at the same ambient temperature. Do not adjust the test inflation pressure to compensate for changes created by temperature variations during the test.

(3) Temperature and cycle interval: the temperature of the gas in the tire, or the casing temperature measured at the hottest point of the tire, may not be lower than 40,6°C (105ºF) at the start of at least 180 of the 200 landing cycles. For the remaining cycles, the contained gas or casing temperature may not be lower than 26,7°C (80ºF) at the start of each cycle. Rolling the tire on the dynamometer is an acceptable method for obtaining the minimum starting temperature.

(4) Kinetic energy: calculate the kinetic energy of the flywheel to be absorbed by the tire using this equation:

$$KE = CW(V^2) = \text{Kinetic energy (ft-lbs)}$$

where
C = 0.0113
W = Load rating of the tire (lbs)
V = 120 mph

(5) Dynamometer cycle requirements: tire must satisfactorily withstand 200 landing cycles on a variable mass dynamometer flywheel. If you cannot use the exact number of flywheel plates to obtain the calculated kinetic energy value, select a greater number of plates and adjust the dynamometer speed to obtain the required kinetic energy. Divide the total number of dynamometer landings into two equal parts having the speed ranges provided in paragraphs **5.b.(5)(a)** and **5.b.(5)(b)**.

(a) Low speed landings: in the first series of 100 landings, the maximum landing speed is 90 mph and the minimum unlanding speed is 0 mph. Adjust the landing speed so the tire will absorb 56% of the kinetic energy calculated using the equation in paragraph **5.b.(4)** above. If the adjusted landing speed is calculated to be less than 80 mph, then determine the landing speed by adding 28% of the calculated kinetic energy (see paragraph **5.b.(4)** above) to the flywheel kinetic energy at 64 mph, and determine the unlanding speed by subtracting 28% of the calculated kinetic energy from the flywheel kinetic energy at 64 mph.

(b) High speed landings: in the second series of 100 landings, the minimum landing speed is 120 mph and the nominal unlanding speed is 90 mph. Adjust the unlanding speed as needed to ensure that the tire will absorb 44% of the calculated kinetic energy (see paragraph **5.b.(4)** above).

6. <u>REQUALIFICATION TESTS</u>.

a. Re-qualify altered tires, with changes in materials, design and/or manufacturing processes that could adversely affect the performance and reliability, to the dynamometer tests described under paragraph **5**. Some examples include **(1)** or **(2)** below, or both:

(1) Changes in casing construction, such as the number of plies and/or bead bundles, ply cord makeup (material, denier, number of strands) and configuration (radial and bias).

(2) Changes in tread construction, such as number or composition of tread reinforcing and/or protector plies, tread compound formulations, number and location of tread grooves, and an increase in skid depth.

b. Re-qualification by similarity (based on load rating). Re-qualifying a given load rated tire due to a change in material or tread design, automatically qualifies the same changes in a lesser load tire of the same size, speed rating, and skid depth, if:

(1) The lesser load rated tire was qualified to the applicable requirements specified in this ETSO, and

(2) The ratio of qualification test load to rated load for the lesser load rated tire does not exceed the same ratio to the higher load rated tire at any given test condition.

c. Re-qualification by similarity (blanket change). You can gain re-qualification of any change that affects all sizes by similarity, if:

(1) Five representative sizes, including tires of the highest load rating, speed rating and angular velocity, were qualified to the minimum performance standard with the change, and

(2) You submit data supporting the change in the listed sizes to EASA.

European Aviation Safety Agency

European Technical Standard Order

Subject: Cargo Pallets, Nets and Containers (Unit Load Devices)

1 - Applicability

This ETSO gives the requirements which Cargo Unit Load Devices 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

For new models of Type I ULDs sStandards set forth in standard of Aerospace Industries Association of America, Inc. (AIA), National Aerospace Standard, NAS 3610, "Cargo Unit Load Devices.- Specification for," Revision 10, dated November 1, 1990, as amended and supplemented by this ETSO:
In lieu of NAS 3610, paragraph 3.5, paragraph 4 of this ETSO provides the marking requirements.

For new models of Type II ULDs standards set forth in the Society of Automotive Engineers, Inc. (SAE) Aerospace Standard (AS) 36100, "Air Cargo Unit Load Devices - Performance Requirements and Test Parameters", Revision A, dated April 2006.

For Type I and II ULDs, the standards set forth in SAE AS 36102, Air Cargo Unit Load Devices - Testing Methods, dated March 2005 are applicable.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

None

3.1.4 - Electronic Hardware Qualification

None

3.2 - Specific

In lieu of NAS 3610 Rev. 10, paragraph 3.7 and SAE AS 36100 Rev. A, paragraph

4.7 use the following paragraph which provides the fire protection requirements for ULDs:

The materials used in the construction of pallets, nets and containers must meet the appropriate provisions in CS-25, Appendix F, Part I, paragraph (a)(2)(iv).

Textile Performance: See SAE Aerospace Information Report (AIR) 1490B, Environmental Degradation of Textiles, dated December 2007 for available data for textile performance when exposed to environmental factors. These data shall be taken into account for consideration of the effects of environmental degradation on nets commensurate with the expected storage and service life to satisfy SAE AS 36100 Rev. A, paragraph 4.11.
NOTE: Environmental degradation data other than that documented in AIR1490B may be used if substantiated by the applicant and approved by EASA.
~~None~~

3.2.1 Failure Condition Classification
N/A

4 - Marking

4.1 - General

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

~~In addition, the following information shall be legibly and permanently marked on the major components:~~

~~- The identification of the article in the code system set out in paragraph 1.2.1 of NAS 3610, Revision 8.~~

~~- If the article is not omnidirectional, the words „FORWARD", „AFT", and „SIDE" must be conspicuously and appropriately placed.~~

~~- The burning rate determined for the article under NAS 3610, paragraph 3.7, Revision 8.~~

4.2 - Specific

~~None~~

In addition, the following information shall be legibly and permanently marked on the major components:

1. The identification of the article in the code system explained in
   a. NAS 3610, Revision 10, paragraph 1.2.1, for Type I ULDs.
   b. SAE AS 36100, Rev. A, paragraph 3.5 for Type II ULDs.
2. The weight of the article to the nearest kilogramme or pound, with the applicable unit.
3. If the article is not omni-directional, the words "FORWARD", "AFT", and "SIDE" must be conspicuously and appropriately placed.
4. The burning rate determined for the article under paragraph 3.2 of this ETSO.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

European Aviation Safety Agency

European Technical Standard Order

Subject: Mach Meters

1 - Applicability

This ETSO gives the requirements which Mach Meters 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 8018A, Mach Meters, dated 01/09/1996.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

4 - Marking

4.1 - General

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

4.2 - Specific

None, marking in accordance with AS 8018A addendum 1 section 2 is optional.

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: 406MHz Emergency Locator Transmitter

1 - Applicability

This ETSO gives the requirements which 406MHz Emergency Locator Transmitter 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-62A, Minimum Operational Performance Specification for Aircraft Emergency Locator Transmitters 406 MHz and 121.5 MHz (Optional 243 MHz), dated Februar 2009.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

4 - Marking

4.1 - General

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

4.2 - Specific

See EUROCAE ED-62A paragraph 2.7.3 ~~None~~

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

European Aviation Safety Agency

European Technical Standard Order

Subject: Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz

1 - Applicability

This ETSO gives the requirements which Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on the Frequency of 978 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-282B, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance Broadcast (ADS-B), dated 02/12/2009.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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. Find the equipment class in RTCA/DO-282B, Section 2.1.11.

If component can:	***Mark it with:***	***Sample marking pattern:***
Transmit and receive	Equipment class it supports	Class A1H or Class A3
Transmit, but not receive	Equipment class it supports	Class B1 or Class A3 - Transmit Only
Receive, but not transmit	Equipment class it supports	Class A2 - Receive Only
Perform the optional frequency diplexer function developed under this ETSO	The words "UAT Diplexer," Maximum amplitude attenuation between the antenna port (A) and UAT port (U) of the diplexer, and Maximum amplitude attenuation between the antenna port (A) and transponder port (T) of the diplexer	

5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

European Aviation Safety Agency

European Technical Standard Order

Subject: Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment

1 - Applicability

This ETSO gives the requirements which Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and 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-267A, Minimum Aviation System Performance Standards (MASPS) for Flight Information Services-Broadcast (FIS-B) Data Link, dated 04/04/2004.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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

Subject: Aeronautical Mobile High Frequency Data Link (HFDL) Equipment

1 - Applicability

This ETSO gives the requirements which Aeronautical Mobile High Frequency Data Link (HFDL) 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-265, Minimum Operational Performance Standards for Aeronautical Mobile High Frequency Data Link (HFDL)", dated 14/12/2000.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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

Subject: Avionics Supporting Next Generation Satellite Systems (NGSS) = Iridium Phone

1 - Applicability

This ETSO gives the requirements which Avionics Supporting Next Generation Satellite Systems (NGSS) = Iridium Phone 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-262A, Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS), dated 16/12/2008.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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.

ETSO-C161a

Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: Ground Based Augmentation System Positioning and Navigation Equipment

1 - Applicability

This ETSO gives the requirements which Ground Based Augmentation System Positioning and Navigation Equiptment 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-253C, Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment, dated 16/12/2008 (section 2) as modified by appendices 1 and 2 of this ETSO for airborne equipment class (AEC) C to support Category I precision approach. These standards also apply to equipment that implements the optional GBAS positioning service. The positioning and navigation functions are defined in section 2.3 of RTCA/DO-253C. In accordance with section 2.1 of RTCA DO-253C, equipment obtaining this ETSOA must also comply with the position, velocity and time (PVT) output requirements of either, ETSO-C145c, ETSO-C146c or ETSO-C196.This ETSO does not apply to AEC D equipment as the additional requirements to support the GBAS Approach Service Type D and Category III precision approaches have not been validated. A new ETSO or a revision to this ETSO for AEC D equipment will be issued once these additional requirements are validated.

Note: ETSO-C196, which is based on RTCA/DO-316, Minimum Operational Performance Standards for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment, dated 14/04/2009, is not referenced in RTCA DO-253C. RTCA/DO-316 was published after the publication of DO-253C. ETSO-C129a is not applicable to this ETSO.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition for the malfunction of position data and a hazardous failure condition for the malfunction of precision approach navigation data.

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition for the loss of position data and a minor failure condition for the loss of precision approach navigation data.

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. MINIMUM PERFORMANCE STANDARD FOR GROUND BASED AUGMENTATION SYSTEM POSITIONING AND NAVIAGATION EQUIPMENT

This appendix prescribes the minimum performance standards (MPS) for GBAS equipment for airborne equipment class (AEC) C and equipment using the GBAS Positioning Service. The applicable standard is RTCA/DO-253C, *Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment*, dated 16/12/2008, section 2. The applicable standard is modified as follows:

1. Except as modified by appendix 2 of this ETSO, for all RTCA/DO-253C references to RTCA/DO 246(), use RTCA/DO-246B, *GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-In-Space Interface Control Document (ICD)*, dated 28/11/2001.

2. Page 35, section 2.3.6.4.1, ***modify*** Table 2-7 and the note under the table as highlighted below (rest of section unchanged):

Table 2-7 GPS Tracking Constraints for DD DLL Discriminators

Region (see Figure 2-3)	3 dB Pre-correlation bandwidth, BW	Average Correlator Spacing (d_1 and $2d_1$) [C/A chips]	Instantaneous Correlator Spacing (d_1 and $2d_1$) [C/A chips]	Differential Group Delay	Applicable AEC
1	(-50*x)+12<BW≤7 MHz	0.1-0.2	0.09-0.22	≤ 600 ns $-D_A - D_C$	C
	2<BW≤7 MHz	0.2-0.6	0.18-0.65		
2	(-50*x)+12<BW≤(133.33*x)+2.667 MHz	0.07-0.085	0.063-0.094	≤ 150 ns $-D_A - D_C$	C & D
	(-50*x)+12<BW≤14MHz	0.085-0.1	0.077-0.11		
	7<BW≤14 MHz	0.1-0.24	0.09-0.26		
3	14<BW≤16 MHz	0.1-0.24	0.09-0.26	≤ 150 ns $-D_A - D_C$	C & D
	(133.33*x)+2.667<BW≤16MHz	0.085-0.1	0.077-0.11		

Note (1): D_A *is the differential group delay contribution of the antenna through the output of the pre-amp.* D_C *is the differential group delay contribution of the installation specific connection between the antenna and the PAN equipment*.

Note (2): x *denotes the average correlator spacing for* d_1 *in C/A chips*.

3. Page49, section 2.3.8.1.3, ***add*** a new paragraph g. to the list of conditions as follows:

g) The distance (slant range) between the aircraft and the GBAS reference point is less than the maximum GBAS usable distance, if the maximum GBAS usable distance (D_{max}) is provided in the Type 2 message being used *[LAAS-281]*.

4. Page 57, section 2.3.9.5, ***replace*** the differential correction magnitude check, δPR_i equation as follows:

$\delta PR_i = PRC_i + RRC_i*(t-t_{zcount}) + TC_i$

5. Page A-6, ***replace*** the Maximum Use Distance (D_{max}) definition as follows:

Maximum Use Distance (Dmax) – the maximum distance from the GBAS reference point for which the integrity is assured.

6. If a manufacturer elects to provide the authentication capability in its equipment as specified in section 2.3.7.3 of RTCA/DO-253C, the equipment shall also perform the differential correction magnitude check in section 2.3.9.5.

NOTE: There are additional sections of RTCA DO-246D that are applicable when VDB authentication is implemented. These are specified in appendix **2**.

7. Summary of ETSO changes relative to DO-253C.

LAAS Requirement Designator [LAAS-xxx]	Change Status from DO-253C
093	Changed
123	Changed
281	Changed
351 and 352	New application (see item 6 above)

APPENDIX 2. MINIMUM PERFORMANCE STANDARD FOR GNSS-BASED PRECISION APPROACH LOCAL AREA AUGMENTATION SYSTEM (LAAS) SIGNAL-IN-SPACE INTERFACE CONTROL DOCUMENT (ICD)

This appendix prescribes the interface control document for GBAS as it applies to AEC C for this ETSO. The applicable standard is RTCA/DO-246B, GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-in-Space Interface Control Document, dated 28/11/2001. The applicable standard is modified as follows:

1. Page 22, ***replace*** the ephemeris CRC bit order of transmission in section 2.4.3.2. *Message Type 1* parameters, ***with*** the updated definition in the latest revision, RTCA/DO-246D, dated December 16, 2008, section 2.4.3.2.

> NOTE: This change reorders the bits of the ephemeris CRC from their previous transmission order of r1, r2, r3, r4 … r16, where r1 is the least significant bit and bit r16 is the most significant bit, to r9, r10, r11 … r16, followed by r1, r2, … r8, where r9 and r1 are the first bits of each byte into the bit scrambler. This change is not backwards compatible with the existing standard. The change was adopted for compatibility with a significant number of current implementations of ground equipment and avionics. This change affects [LAAS-107], [LAAS-117], [LAAS-118], and [LAAS-214]. Other changes to RTCA/DO-246B, reflected in RTCA/DO-246D, to support the newly incorporated GBAS Approach Service Type D are not relevant for this ETSO and should not be implemented.

2. Appendix A, ***replace*** appendix A, *Cyclic Redundancy Checks (CRCs)*, ***with*** RTCA/DO-246D, appendix A.

3. Page B-2, ***replace*** Table B-1 *Example of Type 1 Message*, with RTCA/DO-246D, Table B-1.

4. Page B-4, ***replace*** Table B-2 *Example of Type 1 and Type 2 Messages in One Burst* ***with*** RTCA/DO-246D, Table B-2.

5. Page B-7, ***replace*** Table B-3 *Example of Type 4 Message* ***with*** RTCA/DO-246D, Table B-4 as modified below for the runway number valid range.

> The valid range for runway number is 0-36.

6. Page B-10, ***replace*** Table B-4 *Example of Type 5 Message* ***with*** RTCA/DO-246D, appendix B, Table B-6, *Example of Type 5 Message*.

7. If a manufacturer elects to provide the authentication capability in its equipment as specified in section 2.3.7.3 of RTCA/DO-253C, the following paragraphs from RTCA DO-246D, dated 16/12/2008 are applicable:

> a. *Message Type 2, Additional Data Block 4, VDB Authentication Parameters* description and Table 2-16 in DO-246D, section 2.4.4.1, pages 33 and 35.
>
> b. *Message Type 3 – Null Message* and Table 2-17 *Format of Message Type 3* in DO246D, section 2.4.5, page 37.
>
> c. *Reference Path Identifier* in DO-246D, section 2.4.6.4, page 53.

8. Summary of RTCA/DO-253C requirements affected by these modifications to DO-246B.

Appendix 2 Item number	LAAS Requirement Designator [LAAS-xxx]
1	107, 117, 118, 214
2	Editorial
3	Editorial
4	Editorial
5	Editorial
6	Editorial
7	328, 329, 330 and 331

European Aviation Safety Agency

European Technical Standard Order

Subject: Ground Based Augmentation System Very High Frequency Data Broadcast Equipment

1 - Applicability

This ETSO gives the requirements which Ground Based Augmentation System Very High Frequency Data Broadcast 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-253C, Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment, dated 16/12/2008.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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.

Date : 24.10.03
Date: xx.xx.2011

European
Aviation
Safety
Agency

European Technical Standard Order

Subject: Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services (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

~~Section 2 of RTCA DO-260A " *Squiter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services - Broadcast (TIS-B)"*, dated April 10, 2003, as modified by Change 1 to RTCA/DO-260A, dated June 27, 2006, and Change 2 to DO-260A, dated December 13, 2006. The 1090 MHz equipment classes applicable to this ETSO are defined in RTCA/DO-260A, Section 2.1.11.~~

Standards set forth in the RTCA DO-260B, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services - Broadcast (TIS-B), dated 02/12/2009.

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

(a) Class A equipment includes Classes A0, A1, A2 and A3. This standard requires 1090 MHz airborne Class A equipment to include the capability of receiving both ADS-B and TISB 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.

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

3.1.2 - Environmental Standard

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

~~The means for verifying equipment performance must be consistent with the test procedures specified in section 2.3 of RTCA/DO-260A dated April 10, 2003 Change 1 to RTCA/DO-260A, dated June 27, 2006, and Change 2 to DO-260A, dated December 13, 2006.~~

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 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

4 - Marking

4.1 - General

Marking 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-260~~A~~B provides the equipment class in Section 2.1.11, and the receiving equipment type in Section 2.2.6.

If component can:	***Mark it with:***	***Sample marking pattern:***
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 Referenced Document

See CS-ETSO Subpart A paragraph 3.

ETSO-C170

Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: High Frequency (HF) Radio Communications Transceiver Equipment Operating Within the Radio Frequency 1.5 to 30 Megahertz

1 - Applicability

This ETSO gives the requirements which High Frequency (HF) Radio Communications Transceiver Equipment Operating Within the Radio Frequency 1.5 to 30 Megahertz that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

This ETSO cancels ETSO-C31d "High Frequency (HF) Radio Communications Transmitting Equipment Operating within the Radio Frequency Range 1.5-30 Megahertz" and ETSO-C32d "High Frequency (HF) Radio Communications Receiving Equipment Operating within the Radio Frequency Range 1.5-30 Megahertz".

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-163, Minimum Operational Performance Standards - Airbirne HF Radio Communications Transmitting and Receiving Equipment Operating within the Radio-Frequency Range of 1.5 to 30 MHz, dated 09/03/1976.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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

Subject: Cargo Restraint Strap Assemblies

1 - Applicability

This ETSO gives the requirements which Cargo Restraint Strap Assemblies 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 5385C, Cargo Restraint Straps - Design Criteria and Testing Methods, dated January 2007.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

None

3.1.4 - Electronic Hardware Qualification

None

3.2 - Specific

None

3.2.1 Failure Condition Classification

N/A

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.

ETSO-C179

Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: Rechargeable Lithium Cells and Lithium Batteries

1 - Applicability

This ETSO gives the requirements which Rechargeable Lithium Cells and Lithium Batteries 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 Underwriter Laboratories (UL) 1642, dated 19/09/2005.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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

Subject: Airplane Galley Insert Equipment, Electrical/Pressurized

1 - Applicability

This ETSO gives the requirements which Airplane Galley Insert Equipment, Electrical/Pressurised that is manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 - Procedures

2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 - Specific

None.

3 - Technical Conditions

3.1 - Basic

3.1.1 - Minimum Performance Standard

Standards set forth in the Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8057, Minimum Design and Performance of Airplane Galley Insert Equipment, Electrical/Pressurized, issued July, 2008 as modified by appendix 1 of this document.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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. MINIMUM PERFORMANCE STANDARD FOR AIRPLANE GALLEY INSERT EQUIPMENT, ELECTRICAL / PRESSURIZED

This Appendix prescribes the minimum performance standards (MPS) for airplane galley insert equipment. The applicable standard is SAE AS 8057, *Minimum Design and Performance of Airplane Galley Insert Equipment, Electrical/Pressurized,* issued July, 2008. We modified it as follows:

1. Page 5, replace paragraph 1.3.b. with:
"The word "should" indicates a criterion for which an alternative, including non-compliance, may be applied."

2. Page 9, replace paragraph 2.2 Definitions: INTERCHANGEABILITY with:
"INTERCHANGEABILITY: That quality which allows an assembly or part to substitute or be substituted for another and to meet all physical, functional, and structural requirements of the original."

3. Page 9, replace paragraph 2.2 Definitions: MAXIMUM NORMAL OPERATING PRESSURE (MNOP) with: "MAXIMUM NORMAL OPERATING PRESSURE (MNOP): The maximum attainable pressure of the equipment's pressure system when all the equipment's components are functioning normally."

4. Page 9, replace paragraph 2.2 Definitions: OPTION with
"OPTION: A function capable of being included as part of equipment. It must be fully developed and able to be incorporated without adverse effects to meeting the performance requirements of this AS included in this ETSO."

5. Page 10, replace paragraph 3.1 with:
"Table 1 identifies applicable requirements for typical galley insert equipment designs. Novel designs may require compliance to additional requirements in Table 1 not identified by a bullet. To use the table, find the equipment in question along the top row, and then read down that column; the row in which a bullet appears indicates requirements that must be addressed. A bullet in brackets indicates that the requirements are applicable for only a part of the equipment in question."

6. Page 11, replace paragraph 3.2.1 with:
"Materials".

7. Page 12, replace paragraph 3.2.1.2.c with:
"Aluminium honeycomb core must be finished for corrosion resistance."

8. Page 12, replace paragraph 3.2.1.8 with:
"Components must be protected against deterioration or loss of strength in service due to environmental causes. Selection and finishing of material (including fasteners), where dissimilar metals may be placed in contact, must be per MIL-STD-889 or equivalent. Material not inherently corrosion resistant must be finished with a protective treatment or coating. Magnesium alloys must not be used."

9. Page 14, replace paragraph 3.2.2.4 with:
"Bonded joints must not be loaded primarily in tension." Disregard paragraphs from 3.2.2.4.a to 3.2.2.4 d.

10. Page 14, replace paragraph 3.2.3 with:
"Construction for Trash Compactors"

Trash compactors must be constructed of fire resistant materials (see 14 CFR § 1.1, Amendment 1-63) capable of containing fire (see 3.10) under the conditions expected to result in service."

11. Page 15, replace paragraph 3.2.5 with:
"Interface clearances between equipment and the surrounding galley or structure required for ventilation, heat dissipation, installation, loading, etc. must be clearly defined on the equipment Interface Control Document."

12. Page 15, replace paragraph 3.2.6. with:
"Equipment must comply with US Food and Drug Administration (FDA) requirements for sanitary construction in Sections 1, 2, 4, and 6 of Attachment 3 *Guidelines for Sanitary Construction of Aircraft Galleys and Galley Equipment*, to FDA document, *Guide to Inspections of Interstate Carriers and Support Facilities*, (Reference 2.1.5)."

13. Page 16, replace paragraph 3.3.1.a. with:
"Equipment must be designed to meet the structural loading as specified in 4.2.1."

14. Page 16, replace paragraph 3.3.2.a. with:
"The structure of equipment must address the load case in each direction and be verified according to 4.2.1."

15. Page 16, replace paragraph 3.3.2.b with:
"The loading conditions must be determined by assuming installation of equipment around the z-axis of the airplane (see Figure 1)."

16. Page 16, replace paragraph 3.3.2.d. with:
"Failure must not occur under ultimate load cases. All permanent deformation that occurs under ultimate or limit load cases must be reported in the data furnished with each article."

17. Page 16, replace paragraph 3.3.3 with:
"A local attachment factor of 1.33 must be applied in addition to the design load factors for attachments (such as door hinges, latches and retaining devices)."

18. Page 16, replace paragraph 3.3.4 with:
"Material strength properties must be based on tests of material meeting industry specifications to establish design values on a statistical basis. Design values must be chosen to minimise the probability of structural failure due to material variability. The applicable specifications are Metallic Materials Process Development and Standardization (MMPDS, formerly MIL Handbook-5) and MIL Handbook-7.

Analytical substantiation of material strength must be based on material design values shown to be statistically reliable by repeated structural testing."

19. Page 18, replace paragraph 3.3.5.i. with:
"Forces generated by the conditions tested in 3.17, 4.2.1., or the weight of the retaining device itself, must not cause the retaining device to release."

20. Page 18, replace paragraph 3.3.5.m. with:
"Equipment with a stowage compartment (e.g., trash compactors, ovens, refrigerators and freezers, wine chillers) must be designed such that the stowage compartment completely encloses its contents.

21. Page 18, correct 3.3.6.b.2. to read:
"maximum wet weight, including associated components used for normal operation of the equipment (with the exception of attached hoses, tubes, pipes and/or electrical conduit),

maximum amount of water in the equipment plumbing system and including water in tank, beverage in server, soaked pillow pack (if applicable).”

22. Page 19, replace paragraph 3.3.8. with:
“Equipment (e.g., trash compactors) integrated in a cart or container must meet the strength requirements of AS 8056, 3.3.3.”

23. Page 19, replace paragraph 3.3.9.a. with:
“The weight of fully loaded equipment (e.g., trash compactor) installed in a cart compartment must be uniformly distributed over the cart compartment base.”

24. Page 20, replace paragraph 3.4.4 with:
“Equipment must be designed to be capable of withstanding over-voltage events without arcing, sparking, smoke or fire. Equipment must be designed to pass the following dielectric tests: (Note: Components (filters, protection diodes) normally not capable of withstanding the dielectric withstanding voltage test without damage may be disconnected or individually disabled (e.g., short circuited) for these tests. The dielectric withstanding voltage test must be run prior to the insulation resistance test.)” Paragraphs 3.4.4.a and b. remain unchanged.

25. Page 21, replace paragraph 3.4.7. with:
“In addition to the requirements of this document, microwave ovens must meet 21 CFR § 1030.10, Performance Standards for Microwave and Radio Frequency Emitting Products.”

26. Page 21, replace paragraph 3.4.8.a. with:
“Equipment must be designed to minimise the generation of or susceptibility to electromagnetic interference.”

27. Page 22, replace paragraph 3.4.9.b. with:
“Hidden installed equipment (e.g., remote water heater, air chiller) may have a separate control module capable of being installed on the front of the galley for the following functions:” Information in bullets remains unchanged.

28. Page 23, replace paragraph 3.6.2.a. with:
“Show the complete equipment plumbing interface on the Interface Control Document.”

29. Page 23, replace paragraph 3.6.3 with:
“Equipment, capable of being connected to the potable water system of an airplane, that heats and stores water must incorporate a feature for sensing a low water condition. Indication of low water must both illuminate a warning light and interrupt power to the equipment heating elements.”

30. Page 23, replace paragraph 3.6.4.a. with:
“Equipment capable of being connected to an airplane potable water system must incorporate a self venting device.”

31. Page 23, replace paragraph 3.6.4.b. with:
“Equipment capable of being connected to an airplane potable water system must be self-draining.”

32. Page 24, replace paragraph 3.6.6.a. with:
“Demonstrate equipment proof and burst pressure values by test and list results in the CMM or other documentation required to be furnished with each article.”

33. Page 25, replace paragraph 3.6.7.b. with:

"Water taps/faucets must be self-closing unless the Interface Control Document specifies this equipment is intended for installation above a sink in the galley monument."

34. Page 25, replace paragraph 3.9 with:
"Materials (including finishes or decorative surfaces applied to the materials) must comply with the appropriate paragraphs of 14 CFR part 25, App. F at Amendment 25-111, as follows:"

35. Page 25, replace paragraph 3.9.1.a. with:
"Equipment must comply with the appropriate flammability requirements of 14 CFR part 25 when tested per appendix F, Part I."

36. Page 25, replace paragraph 3.9.1.b. with:
"Thermal and acoustic insulation material and components (batting, cover foil, foam, etc.) must comply with the flame propagation requirements of 14 CFR part 25, Appendix F, Part VI, at Amendment 25-111. Consult Advisory Circular AC 25.856-1, *Thermal/Acoustic Insulation Flame Propagation Test Method Details*, for appropriate guidance."

37. Page 26, replace paragraph 3.9.2. with:
"Exposed surfaces of equipment, when stowed, must meet the heat release and smoke density requirements of 14 CFR part 25, Appendix F, Parts IV and V, at Amendment 25-66."

38. Page 26, replace paragraph 3.10.a. with:
"Equipment dedicated to, or that may be used for, waste stowage (e.g., trash compactors) must meet AC 25-17A *Transport Airplane Cabin Interiors Crashworthiness Handbook* Appendix 8 *Fire Containment Test Methods,* Sections 4.2 CARTS and 5.2 ACCEPTANCE CRITERIA."

39. Page 26, replace paragraph 3.11. with:
"Equipment must be marked using materials and/or processes that will ensure legibility during its lifespan. Markings must be conspicuous and worded in mandatory "command" English. Non-English language marking is acceptable, in addition to English. Non-English marking may be used alone when airworthiness requirements are not involved. Marking location, style and wording should be consistent. Weight placards must include both English and metric units.

The location and wording of placards must be shown on the Interface Control Document."

40. Page 26, replace paragraph 3.11.3.a. with:
""No Cigarette Disposal" must be placed on or near each waste receptacle disposal door (e.g., the waste disposal flap of a trash compactor)."

41. Page 27, replace paragraph 3.17 Notes on Pass/Fail criteria at bottom of Table 2 with:
"(1) Equipment must comply with the performance requirements of this ETSO in each instance RTCA/DO-160 reads 'DETERMINE COMPLIANCE WITH APPLICABLE EQUIPMENT PERFORMANCE STANDARDS'.
(2) See note (1)."

42. Page 30, replace paragraph 3.18.1 with:
"The power consumption of the equipment must be defined in the Interface Control Document."

43. Page 32, replace paragraph 3.19. with:
"A Failure Mode and Effects Analysis (FMEA) must be performed at the equipment level independent of the aircraft. The analysis must include typical and hidden failure modes throughout the entire operating range and include the effects of mishandling."

44. Page 33, replace paragraph Table 3 Note (2) with:
"(2) Load factors may be increased to meet aircraft flight and ground cases. If increased factors are used, they must be listed in CMM or other appropriate document."

45. Page 33, replace paragraph 4.2.1.c. with:
"Equipment (e.g., trash compactors) integrated in a cart or container must be tested in accordance with AS 8056, 4. 2."

46. Page 34, replace paragraph 4.2.4.a. with:
"Proof Pressure Test: The qualification unit must have its pressurised components tested to the required proof pressure; this pressure must be held for five minutes. The equipment must not be damaged nor leak as a result of the test."

47. Page 35, replace paragraph 4.2.6.2.b. with:
"The top, sides and front surfaces of equipment must be tested per 14 CFR part 25, Appendix F (at Amendment 25-66), Parts IV and V."

48. Page 35, correct 4.2.7. to read:
"Trash compactors used to receive combustible material must comply with the fire containment requirements of 3.10, when substantiated per AS 8056, 4.6."

49. Page 37, replace paragraph 4.2.15. with:
"Conduct and prepare the FMEA in accordance with ARP 4761 at the equipment level independent from the aircraft."

50. Page 39, replace paragraph 5.1.b.12 with:
"Maximum amount of discharge air emitted by equipment, if applicable."

51. Page 8, disregard paragraph 2.2 Definitions: "ACCEPTANCE TEST", "ASSOCIATED COMPONENTS, item 2.", "DETRIMENTAL PERMANENT DEFORMATION", "FAILURE", and "FAIL-SAFE".

52. Page 9, disregard paragraph 2.2 Definitions: "PERIODIC TESTING".

53. Page 10, disregard paragraph 2.2 Definitions: "PROCESS SPECIFICATION"

54. Page 11, disregard paragraphs 3.2.1 and 3.2.1.1.

55. Page 12, disregard paragraph 3.2.1.2.a.

56. Page 12, disregard paragraphs 3.2.1.4. through 3.2.1.6.

57. Page 13, disregard paragraphs 3.2.1.9. through 3.2.2.3.

58. Page 14, disregard paragraph 3.2.2.5.

59. Page 15, disregard paragraph 3.2.4.

60. Page 16, disregard paragraph 3.2.8.

61. Page 16, disregard paragraph 3.3.2.c.

62. Page 16, disregard "NOTE" following paragraph 3.3.2.d.

63. Page 21, disregard paragraph 3.4.8.b.

64. Page 23, disregard paragraphs 3.6.2.c and 3.6.2.d.

65. Page 27, disregard paragraphs 3.14.a, 3.14.b, and 3.14.c.

66. Page 27, disregard paragraphs 3.15 and 3.16.

67. Page 32, disregard paragraph 4.1.

68. Page 38, disregard section 4.3.

69. Page 40, disregard section 5.2.

70. Page 41, disregard section 6.

Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: Helicopter Terrain Awareness and Warning System (HTAWS)

1 - Applicability

This ETSO gives the requirements which Helicopter Terrain Awareness and Warning System (HTAWS) 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-309, Minimum Operational Performance Standards (MOPS) for Helicopter Terrain Awareness and Warning System (HTAWS) Airborne Equipment, dated 13/03/2008.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

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

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.

ETSO-C195

Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)

1 - Applicability

This ETSO gives the requirements which Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance Applications (ASA) 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 Section 2 of RTCA Document No. RTCA/DO-317, Minimum Operational Performance Standards for Aircraft Surveillance Applications System, dated April 14, 2009 as modified by the functional equipment classes and other changes in Appendix 1 and Appendix 2 of this ETSO.

Functional equipment classes for this ETSO are defined by the avionics equipment functionality they provide for one or more of the four applications defined in Appendix 1. The three equipment functionalities are Cockpit Display of Traffic Information (CDTI) (Surface Only), CDTI, and Airborne Surveillance and Separation Assurance Processing (ASSAP). Applicable performance standards for these classes are identified in Appendix 2 and are based on Section 2 of RTCA/DO-317 as revised by Appendix 1. The functional equipment classes are shown in the following table.

Application \ Avionics	CDTI (Surface Only) (A)	CDTI (B)	ASSAP (C)
Airborne (1)	**Not Permitted**	CLASS B1	CLASS C1
Surface (2) (Runways Only)	CLASS A2	CLASS B2	CLASS C2
Surface (3) (Runways & Taxiways)	CLASS A3	CLASS B3	CLASS C3
Enhanced Visual Approach (4)	**Not Permitted**	CLASS B4	CLASS C4

Table 1 – ASA Functional Equipment Classes

Note: Appendix 1 does not revise or delete any requirements for the Conflict Detection application from RTCA/DO-317. DO-317 identifies the need for additional development of these requirements and acknowledges they "are not intended to be referenced by regulatory guidance". DO-317 requirements for the Conflict Detection application are not invoked in this ETSO.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition for malfunctions causing the display of hazardously misleading information in airborne aircraft and aircraft on the ground greater than 80 knots. Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition for malfunctions causing the display of hazardously misleading information in aircraft on the ground less than 80 knots groundspeed. Loss of function 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.

APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR ADS-B ASA EQUIPMENT

This appendix defines changes to MOPS for ADS-B ASA equipment. The applicable standard is RTCA/DO-317, "*Minimum Operational Performance Standards (MOPS) For Aircraft Surveillance Applications System (ASAS)*", dated April 14, 2009. The changes shown in this appendix modify DO-317 in three ways:

1) to include changes required for Version 2 of the 1090ES and UAT link MOPS;
2) to adopt agreed harmonisation with Safety, Performance and Interoperability Requirements documents developed by the Requirements Focus Group; and
3) to create a functional equipment class structure for this initial ADS-B ASA equipment that accommodates the evolutionary development of future functional classes of equipment.

Modifications to DO-317 are shown in this Appendix in italicised text. For text in notes that is already italicised, the text is underlined. In some cases, some of the original text may be deleted and no markings are shown.

While not invoked as part of the requirements, changes to key concepts and background in Section 1 and appendices of DO-317 are also provided. Acronyms are as shown in DO-317 Appendix A unless indicated otherwise.

Positioning system requirements to achieve the required horizontal and vertical position quality are not addressed in this ETSO, but can be found in advisory guidance.

1. DO-317 is modified as follows:

1.1 Page 4, replace paragraph 1.3.1 with:

Initial Applications

The five initial applications defined in DO-289 are all considered to be traffic "situation awareness" applications because the applications do not add new pilot tasks and responsibilities. For these applications, the CDTI provides additional information to augment current flight crew tasks such as see and avoid (14 Code of Federal Regulations (CFR) 91.113(b)).

- Enhanced Visual Acquisition (EVAcq).
- Conflict Detection (CD)
- Airport Surface Situational Awareness (ASSA).
- Final Approach and Runway Occupancy Awareness (FAROA).
- Enhanced Visual Approach (EVApp).

EVAcq defines the basic use of ASAS for enhanced traffic situational awareness when airborne, and support for this application is the minimum requirement for all airborne ASAS implementations. Other applications that may be used when airborne (CD, ASSA, FAROA and EVApp) are optional.

A description of each of these supported applications follows:

Enhanced Visual Acquisition: CDTI provides traffic information to assist the flight crew in visually acquiring traffic out the window when airborne. The CDTI can be used to initially acquire traffic (that the pilot might not have known about otherwise) or as a supplement to an Air Traffic Control (ATC) traffic advisory. This application is expected to improve both safety and efficiency by providing the flight crew enhanced traffic awareness.

- Note: While there is no defined application for general traffic situational awareness beyond the visual range, CDTI will display traffic to enable such awareness using the requirements for the EVAcq application.

Conflict Detection (CD): The CDTI is used to alert the flight crew of situations in which a loss of separation (LOS) or collision is predicted. The conflict and collision alerts may prompt the flight crew to exercise see-and-avoid procedures or to contact ATC. Conflict avoidance maneuvers are not provided by this application. This application is expected to improve safety by advising the flight crew of non-TCAS equipped aircraft about potential conflicting traffic and by providing information that can augment current flight crew tasks of see and avoid per 14 CFR 91.113(b).

Note: Conflict detection is not included under this ETSO. If it is implemented, the applicant should identify this functionality as a non-ETSO function. Reference paragraph 5.o in main body of this ETSO.

Airport Surface Situational Awareness (ASSA), and Final Approach and Runway Occupancy Awareness (FAROA): In these applications, the CDTI is used to support the flight crew in making decisions about taxiing, takeoff and landing. These applications are expected to increase efficiency of operations on the airport surface and reduce the possibility of runway incursions and collisions.

Enhanced Visual Approach (EVApp): The CDTI is used to assist the flight crew in acquiring and maintaining visual contact during visual approaches. The CDTI is also used in conjunction with visual, out-the-window contact to follow the lead aircraft during the approach (i.e., during conduct of the visual separation task). The application is expected to improve both the safety and the performance of visual approaches. It could allow for the continuation of visual approaches when they otherwise would have to be suspended due to the difficulty of visually acquiring and tracking the other aircraft.

Requirements Focus Group Applications

The Requirements Focus Group (RFG) has also developed initial traffic situation awareness applications based in part on DO-289, but also designed to satisfy the safety, performance and interoperability requirements of DO-264. The RFG's comparable traffic situation awareness applications also augment current flight crew tasks of see and avoid per 14 CFR 91.113(b). The following applications represent situational awareness applications approved by RTCA SC-186:

- *Enhanced traffic situational awareness during flight operations*
- *Enhanced visual separation on approach*
- *Enhanced traffic situational awareness on the airport surface*

A description of each of these equivalent applications follows:

Enhanced traffic situational awareness during flight operations (ATSA-AIRB): This application enhances the flight crew's traffic situational awareness through the provision of an appropriate on-board graphical display of airborne surrounding traffic that transmits ADS-B data of a sufficient quality. It is expected that this enhanced traffic situational awareness will contribute to improve flight safety and flight operations.

Enhanced visual separation on approach (ATSA-VSA): This application enhances the flight crew's traffic situational awareness during visual approaches through the provision of an appropriate on-board graphical display of traffic that they may use in the visual search for preceding traffic they are cleared to follow on a visual approach. The graphical *display of traffic for this application may also be used to support flight crews in maintaining visually a safe distance from this preceding aircraft.*

<u>Enhanced traffic situational awareness on the airport surface (ATSA-SURF):</u> This application enhances the flight crew's traffic situational awareness during taxi, take-off, final approach, and landing operations. It is expected to reduce the potential for errors, runway and taxiway incursions, and collisions while operating an aircraft on the airport surface.

Equivalence of Initial DO-317 and RFG Situational Awareness Applications

The following table indicates the ETSO application name that will be used to describe equivalent situational awareness applications along with the respective DO-317 and RFG application names.

***Table 1-1** ETSO Application Name Equivalence*

ETSO Application Name	***DO-317 Initial Application Name***	***Requirements Focus Group Application Name***
Airborne	***Enhanced Visual Acquisition (EVAcq)***	***Enhanced traffic situational awareness during flight operations (ATSA-AIRB)***
Enhanced Visual Approach	***Enhanced Visual Approach (EVApp)***	***Enhanced visual separation on approach (ATSA-VSA)***
Surface (Runways & Taxiways)	***Airport Surface Situational Awareness (ASSA) / Final Approach Runway Occupancy Awareness (FAROA)***	***Enhanced traffic situational awareness on the airport surface (ATSA-SURF)***
Surface (Runways Only)	***Final Approach Runway Occupancy Awareness (FAROA)***	***No Equivalent***

1.2 Page 7, replace paragraph 1.5.1.4 with:

1090ES Duplicate 24 Bit Address

In the 1090ES system, decoding messages and correlating data to the correct aircraft/vehicle depends on unique addresses. Although duplicate address events should be unlikely, provisions are included to handle such occurrences. 1090ES receiving subsystems compliant with DO-260B or later are required to output separate reports for aircraft/vehicles containing a duplicate address. The 1090ES receiver produces and outputs separate reports when duplicate addressed aircraft/vehicles are within receiver coverage. Although non-position information is included, it cannot be correctly associated with the proper aircraft/vehicle. Data from the other participant will often be contained in a report. Therefore, ASSAP cannot correlate the information to the proper individual track unless additional processing is performed. These tracks are identified by the 1090ES receiver as duplicates so ASSAP should discard non-position information, unless ASSAP includes additional processing to improve correlation beyond the minimum requirements of DO-260B. Without additional data tracking, tracks identified as duplicates will be processed as Version 0 since the status messages which contain the Version indication cannot be correlated.

Version 1 compliant 1090ES receiving subsystems providing reports to ASSAP designed to the minimum requirements do not detect duplicate address conditions and will output position reports for a single track from aircraft/vehicles with duplicate addresses. In these cases, ASSAP will not be aware of a duplicate address condition. ASSAP processing of a report that results from multiple aircraft/vehicles containing a duplicate address could result in depictions on the CDTI of erratic, misleading and missing traffic information.

1.3 Page 8, replace paragraph 1.5.1.6 with:

Dual Link Receiver

ASSAP requirements and test scenarios and the reference system design in Appendix C do not address the case of dual link receivers on the ownship. *The FAA Ground infrastructure utilises bits in the Version 2 ADS-B transmissions to detect the receiver capability on the aircraft. However, d*ual link receivers may receive ADS-B on one link and ADS-R on the other link for the same aircraft. In this case, ADS-R may be disregarded. *While it is not prohibited to use ADS-R to update a track, it is not a minimum requirement.*

1.4 Page 8, replace paragraph 1.5.1.8 with:

TIS-B On Airport Surface

As of this revision of the ASAS MOPS, ASSAP requirements and test scenarios do not specifically address spatial correlation between TIS-B surface position reports and other sources (ADS-B, ADS-R) or ownship for the airport surface. The geometric filters used for determining spatial correlation would be unable to function properly in the dense traffic environment that could exist on the surface, potentially resulting in a higher rate of ghosting between ADS-B and TIS-B traffic and possibly ghosting ownship as well.

At airports where TIS-B is supported on the airport surface, the following factors should be considered:

- Reliable correlation of an update from a surface surveillance system (e.g., Multilateration) may only be possible via the 24 bit address available in ADS-B and from the Mode S transponder.
- Likewise, reliable TIS-B/ADS-B correlation may not be possible on ADS-B equipped aircraft with Air Traffic Control Radar Beacon System (ATCRBS) transponders. Users should expect ghost targets or shadows of ownship for aircraft equipped this way.
- On the surface, ASSAP will only correlate a TIS-B track with ADS-B/ADS-R track if it has the same 24 bit address.

At airports with both Secondary Surveillance Radar (SSR) and multilateration systems, the ground infrastructure *may change the TIS-B track ID of a target aircraft as it transitions from a surface service volume (<2000 ft AGL and within 7 NM of the airport reference point) to a terminal service volume.*

1.5 Page 9, replace paragraph 1.5.1.11 with:

1090ES Version*s*

1090ES receiving subsystems supporting *this version of* ASAS will process Version *2 messages formatted per the requirements of DO-260B, as well as Version* 1 messages formatted per the requirements of DO-260A (ETSO/TSO-C166a*), and* Version 0 messages formatted per the requirements of DO-260, DO-181C (TSO-C112) or ICAO Annex 10 Amendment 77. This MOPS assumes that reports sent to ASSAP will be labeled as to whether they are from *Version 0, 1, or 2* transmitting systems. *Version 0* reports will have Navigation Uncertainty Category (NUC) converted to the Navigation Integrity Category (NIC), Navigation Accuracy Category for position (NACp) and Surveillance Integrity Level (SIL) parameters per Appendix N of DO-*260B. Version 1 reports, where they differ from Version 2, will also be addressed per Appendix N of DO-260B*.

Ownship 1090ES transmitting and receiving subsystems supporting ASAS installations will comply with DO-*260B* or later.

The ground system will suppress TIS-B uplinks for *all qualified ADS-B equipped* aircraft.

The FAA Ground infrastructure implementing ADS-R service does not provide ADS-R or TIS-B of 1090ES version 0 equipped aircraft. There was more than one version 0 implementation, and they were not appropriately validated. In the future, ADS-R of 1090ES and UAT version 1 transmitters may not be provided.

1.6 Page 9, new paragraph 1.5.1.13 reads as follows:

UAT Versions

UAT receiving subsystems supporting this version of ASAS will process Version 2 messages formatted per the requirements of DO-282B, as well as Version 1 messages formatted per the requirements of DO-282A (TSO-C154b). This MOPS assumes that reports sent to ASSAP will be labeled as to whether they are from Version 1 or 2 transmitting systems. Version 1 reports, where they differ from Version 2, will be addressed per Appendix R of DO-282B.

Ownship UAT transmitting and receiving subsystems supporting ASAS installations will comply with ETSO/TSO-C154c or later.

The ground system will suppress TIS-B uplinks for all qualified ADS-B equipped aircraft.

1.7 Page 14, replace paragraph 2.1.7 with:

Design Assurance

Malfunctions of applications in this document *used to display traffic in aircraft that are airborne or on the ground at groundspeeds greater than 80 knots* are considered to be of *major failure condition* criticality. *Malfunctions of applications used to display traffic while ownship is on the ground and less than 80 knots groundspeed are considered to be of minor failure condition criticality. Loss of function for all applications is considered to be of minor failure condition criticality.* Advisory Circular (AC) 25.1309-1() and AC 23.1309-1() *provide guidance on how the hardware design assurance level and the software level for these criticalities may be met.* The hardware and software **shall** be designed and developed such that the probability of providing misleading information (MI) and the probability of loss of function are *commensurate with these failure condition classifications*. These requirements apply when the equipment is in its installed configuration for the most stringent operation supported. To demonstrate compliance, it will be necessary to conduct a safety assessment to evaluate the system's implementation against known failure conditions. This safety assessment should be based upon the guidance of AC 23.1309-1() for Part 23 aircraft, AC 25.1309-1() for Part 25 aircraft, AC 27-1() for normal category rotorcraft, and AC 29-2() for transport category rotorcraft.

Note: For ASSAP architectures integrating with functions requiring a higher level of design assurance (e.g., TCAS), the system designer can apply a single design assurance level to an entire hardware item (based upon most severe application) or a hardware item may be partitioned to ensure separate functional failure paths (FFPs) in order to accommodate a mix of design assurance levels. The hardware safety assessment may use various qualitative and quantitative assessment methods. These may include fault tree analysis (FTA), common mode analysis, failure modes and effects analysis, and statistical reliability analysis methods for applicable quantitative assessment of random faults.

1.8 Page 14, replace paragraph 2.2.1 with:

1. INTRODUCTION

ASSAP is a function that receives surveillance reports on other aircraft/vehicles from multiple sources and derives traffic surveillance and application-specific information for visual and/or aural display to the CDTI for the flight crew. ASSAP receives ADS-B/ADS-R/TIS-B reports that are assembled by the ADS-B/ADS-R/TIS-B Receive subsystem from corresponding ADS-B/ADS-R/TIS-B messages. ASSAP surveillance processing consists of correlation, and track processing of ADS-B, ADS-R, TIS-B and TCAS (if equipped) traffic reports. ASSAP application processing provides the application-specific processing of all ASA applications.

- *Note: Future ASAS MOPS that include other applications may also provide guidance information to the CDTI.*

It is recognised that manufacturers may implement separate ASSAP and CDTI functions, or a single integrated function that satisfies the requirements of both the ASSAP and CTDI functions. The ASSAP requirements have been written to allow this implementation flexibility. For the purposes of these MOPS and the following sections, the phrase “ASSAP equipment” refers to the equipment providing the ASSAP functionality and does not imply any implementation or design.

This section defines the general requirements for the ASSAP function. The ASSAP subsystem provides the necessary surveillance and application-specific processing of ASA. ASSAP also maintains the interface with the CDTI Display and Control Panel subsystem. The combination of the aircraft data sources on the receiving aircraft, the ADS-B/ADS-R/TIS-B Receive Subsystem and the ASSAP function make up the ASA Receive system. This is illustrated in Figure 2-1.

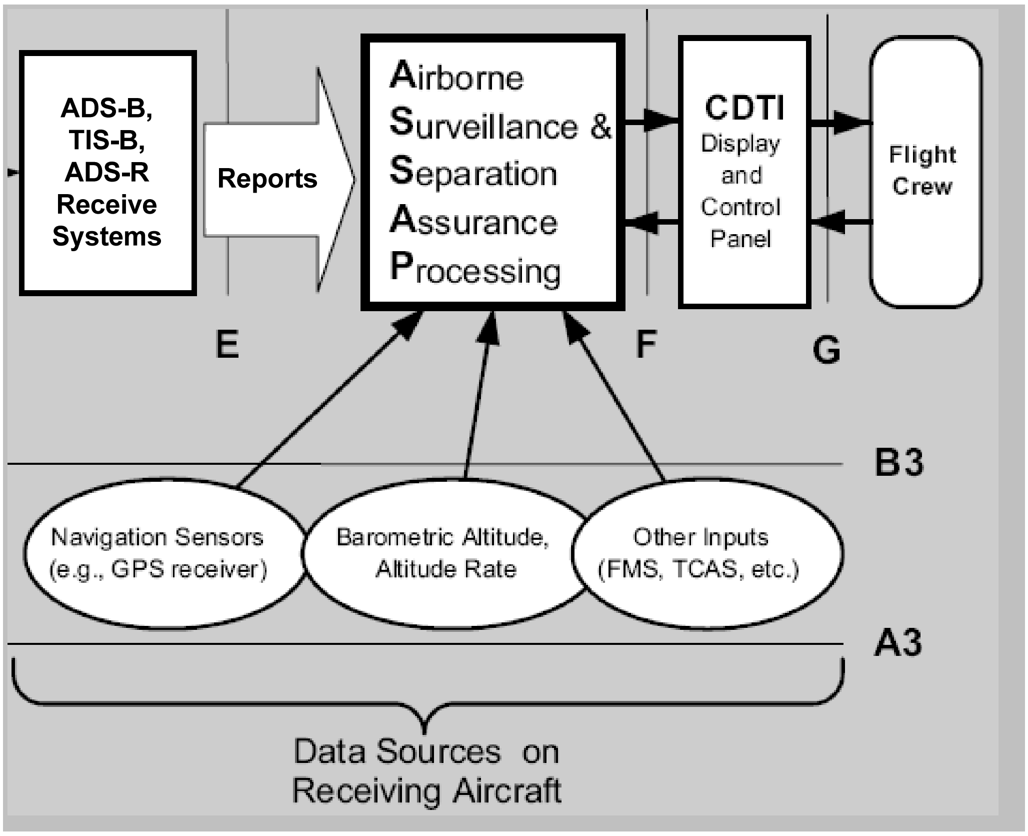


Figure 2-1 Subsystems for ASA Receive Participant

The entire ASA Receive System is responsible for the reception and processing of ownship data as well as the reception of ADS-B, ADS-R and TIS-B messages from other A/Vs and ground systems. This is for the purpose of supporting ASA application processing and providing aural and visual ASA-specific display information to the flight crew. Section 2.2 specifies requirements that apply specifically to the ASSAP functionality occurring between interfaces E and F as illustrated in Figure 2-1.

ASSAP surveillance requirements include track initiation, update, deletion, extrapolation and prediction; track merging and splitting; inter-source correlation (TIS-B & ADS-B/ADS-R; TCAS & others; TIS-B & Ownship) and best selection of data sources. A functional representation of the ASSAP surveillance processing is shown in Figure 2-3.

The ASSAP function may be implemented in stand-alone equipment, integrated with the ADS-B/ADS-R/TIS-B Receive equipment or integrated with other systems. The ASSAP requirements remain applicable when integrated in these alternative implementations.

ASA functional equipment classes are defined by the combination of avionics equipment functionality they provide and the applications they support. These elements that comprise the functional equipment classes are discussed below.

Avionics include the equipment used to process the ADS-B messages and other surveillance information from other aircraft along with the required ownship information. Three types of avionics are defined to address equipment required to support the four ASA applications as defined below:

> *ASSAP is used to process ADS-B, ADS-R, TIS-B, and TCAS (if installed) to surveillance data provide CDTI equipment with consolidated tracks and application specific data.*
>
> *CDTI (Surface Only) is used to control supported applications and graphically display ownship position and the relative positions of aircraft and surface vehicles over a moving map of runways and taxiways for supported airports while ownship is on the ground and less than 80 knots groundspeed.*
>
> *CDTI is used to control supported applications and graphically display ownship position and the relative positions of aircraft and surface vehicles while ownship is airborne or on the surface. This avionics may optionally display over a moving map of runways and taxiways for supported airports.*

ASA functional equipment classes may support one or more of the four current applications as shown in the table below.

Note: ASA functional equipment classes are different from the equipment classes described in ADS-B link MOPS (i.e. DO-260B, DO-282B). The four current applications may be supported with all classes of ADS-B receivers.

Avionics ***Application***	*CDTI* *(Surface Only)* *(A)*	*CDTI* *(B)*	*ASSAP* *(C)*
Airborne (1)	***Not Permitted***	*CLASS B1*	*CLASS C1*
Surface (2) *(Runways Only)*	*CLASS A2*	*CLASS B2*	*CLASS C2*
Surface (3) *(Runways & Taxiways)*	*CLASS A3*	*CLASS B3*	*CLASS C3*

Enhanced Visual Approach (4)	***Not Permitted***	*CLASS B4*	*CLASS C4*

When implementing multiple functional equipment classes, mark all applicable classes. For example, CDTI avionics equipment approved for all ASA applications is marked as CLASS B1, B2, B3, B4.

Although the functional requirements for avionics are based on the current ASA applications, the same avionics may also support future applications of the same or lesser criticality. Designers are expected to carefully consider the use and expandability of the equipment for additional applications and make sufficient provisions for future changes and expansion. Applications in addition to the ones listed above may be implemented in the future.

ASSAP functional equipment must support integration of TCAS source tracks on aircraft equipped with TCAS II.

The remainder of Section 2.2 is organised by: Input/Output, Surveillance Processing, Application Processing and Monitoring.

1.9 Page 21, replace paragraph 2.2.2.3.2 with:

Ownship Quality Data Input Requirements

Ownship quality data is very similar to traffic quality data; however, as the information comes directly from the ownship position source, it is not yet categorised into NIC, NAC and SIL values. The following ownship quality data is required for ASSAP.

a. The ASSAP function **shall** (2046) receive the Horizontal Position Uncertainty.

b. The ASSAP function **shall** (2047) receive the Vertical Position Uncertainty.

c. The ASSAP function **shall** (2048) receive the Horizontal Velocity Uncertainty when available. (Note: If the GPS position source does not provide an appropriate horizontal velocity uncertainty, other methods may be necessary to infer the horizontal velocity uncertainty.)

d. The ASSAP function **shall** (2050) receive the Horizontal Position Integrity Containment Region when available.

e. The ASSAP function **shall** (2052) receive the *Source* Integrity Level when available (requirements defined in the RTCA/DO-*260B and DO-282B*).

1.10 Page 23, replace paragraph 2.2.2.5.1.2.2 with:

Traffic Output Priority for TCAS/ASAS Integrated Systems

For TCAS/ASAS integrated systems, the ASSAP function **shall** (2059) provide the highest priority tracks to the CDTI based on the following priority:

1. Resolution Advisory.
2. Traffic Advisory.
3. Airborne Proximate Traffic (when TCAS alerts are present).
4. Coupled Traffic.
5. Selected Traffic.
6. Airborne Proximate Traffic (when no TCAS alerts are present).

7. Other Traffic

The TCAS Proximate Traffic prioritization scheme **shall** (2060) be applied to the integrated group of TCAS and ASAS airborne Proximate Traffic. Thus it is possible for an ASAS Only Proximate Traffic to be a higher priority than a TCAS Proximate Traffic.

- *Note: Additional tracks should be sent to the CDTI based on existing track prioritisation defined in DO-185B or alternative criteria suited to the specific application.*

1.11 Page 24, replace paragraph 2.2.2.5.1.4 with:

Traffic Identification

For installations supporting EVApp and/or traffic selection, the ASSAP function **shall** (2064) provide a Flight ID for traffic sent to the CDTI when available.

- *Note: ICAO terminology is Aircraft ID.*

1.12 Page 26, replace paragraph 2.2.2.5.1.10 with:

Traffic Altitude

a. The ASSAP function **shall** (2073) provide Traffic Altitude for airborne traffic sent to the CDTI when available.

b. Traffic Altitude **shall** (2074) be provided as either actual pressure altitude *(i.e., barometric pressure altitude referenced to a standard pressure of 29.92 inches Hg (1013.25 millibars))* or altitude relative to ownship altitude.

Note 1: Traffic Altitude is used for displaying *actual or relative* altitudes for traffic. Ownship pressure correction is also needed for the CDTI to calculate *the* actual altitude *for displayed traffic using the same pressure correction used to display ownship altitude.*

Note 2: The display of actual altitude should be consistent with DO-185B, section 2.2.6.1.2.5.

- 1.13 Page 28, replace paragraph 2.2.2.5.1.16 with:

- **Traffic Application Capability**

- *Note: "Traffic Application Capability" is equivalent to the term "Traffic Information Quality" as used in DO-289.*

a. The ASSAP function **shall** (2090) provide a Traffic Application Capability for traffic sent to the CDTI.

b. The Traffic Application Capability **shall** (2091) include that the traffic application capability is Invalid or Valid.

c. The Traffic Application Capability **shall** (2092) be provided for all available applications (not just the active applications).

For the EVAcq application, the traffic application capability is one of the following states (EVAcq is for airborne traffic and for surface traffic when not overlaid over an airport map):

Invalid: N/A.

- *Note: Based on the Best Track Selection requirements, the traffic will be replaced with a correlated TCAS track if available. For an ADS-B, ADS-R, or TIS-B track not correlated with a TCAS track, ASSAP will not send the traffic to the CDTI since it does not meet the performance for the minimum required application (EVAcq).*

Valid: Traffic meets *qualified for EVAcq performance criteria per the requirements of paragraph 2.2.4.1.2*.

For the ASSA and FAROA applications, the traffic application capability is one of the following states (ASSA and FAROA are for surface traffic when overlaid over an airport map):

Invalid: Traffic not qualified for ASSA and FAROA.

Valid: Traffic qualified for ASSA and FAROA *per the requirements of paragraph 2.2.4.2.2.*

For the EVApp Application, the traffic application capability is one of the following states:

Invalid: Traffic not qualified for EVApp.

Valid: Traffic qualified for EVApp *per the requirements of paragraph 2.2.4.4.2.*

- 1.14 Page 35, change title of paragraph 2.2.3.1.3.2 to:

Duplicate Address Processing *for* UAT Systems

- 1.15 Page 36, new paragraph 2.2.3.1.3.3 reads as follows:

Duplicate Address Processing for 1090 MHz Systems

*ADS-B reports from 1090 MHz equipped traffic which do not pass the Report Validity Checks given in Section 2.2.3.1.3.1 **shall** be subject to further processing to determine if they are the result of a duplicate address as specified below. ADS-B reports from DO-260B compliant receivers will mark reports as duplicate under certain criteria. In cases where the ASAS function is integrated with a DO-260B receiver, there is no need to implement both criteria. A single criteria can meet the minimum requirements of both specifications.*

a. *For reports where no duplicate track exists with a matching participant address and ADS-B source, ASSAP **shall** (2117A) begin the track initiation process.*

b. *For each report containing an updated position and/or velocity, and where there is an existing duplicate address track, ASSAP **shall** (2118A) update that track with the report only when it passes the Report Validity Tests given in Section 2.2.3.1.3.1.*

c. *All data from the following 1090 MHz Message Type Codes **shall** (2118B) be invalidated: Types 1 - 4, 19, and 23 – 31. ADS-B reports from DO-260B compliant receivers are allowed to pass on this data without correlating it when duplicate addresses are detected.*

- *Note: The Enhanced Visual Approach application will be unavailable for a duplicate address track because horizontal velocity will not be available for this traffic.*

- 1.16 Pages 42 and 43, replace Table 2-2 with:

8. Table 2-2 Traffic Vehicle Application Specific Requirements Summary

Requirement Category	Requirement	Applicable Subsystem Interfaces (See Figure 1-1)	(Airborne) EVAcq	(Surface) ASSA / FAROA	(Enhanced Visual Approach) EVApp
State Data	Horizontal Position Uncertainty (95%)	A1→B1	0.5 NM (NACp ≥ 5)	30 meter (m) (NACp ≥ 9) *(Note 6)*	0.3 NM (NACp ≥ 6)
	Horizontal Velocity Uncertainty (95%)	A1→B1	N/A	< 3 m/s (Note 1)	< 10 m/s (Note 1)
	Vertical Position Uncertainty (95%)	A1→B1	Valid Pressure or Geometric (Note 4)	On Ground or Valid Pressure or Geometric [Note 4 & 5]	Valid Pressure or Geometric (Note 4)
	Vertical Velocity Uncertainty (95%)	A1→B1	N/A	N/A	N/A
State Data Integrity	*Source* Integrity Level	A1→B1	N/A	N/A	10e-5/hr (SIL ≥ 2)
	Navigation Integrity Category	A1→B1	N/A	N/A	0.6 NM (NIC ≥ 6)
	System Design Assurance (Note 3)	*A1→D*	*1*	*1*	*2*
State Data Timing	Maximum Latency	A1→A4	0.5 s	0.5 s	0.5 s
		A4→G	4.5 s	4.5 s	4.5 s
		A4→B1	0.4 s	0.4 s	0.4 s
		B1→D	1.1 s	1.1 s	1.1 s
		D→E	0.5 s	0.5 s	0.5 s
		E→F	2 s	2 s	2 s
		F→G	0.5 s	0.5 s	0.5 s
	Maximum Data Age until Dropped	at E	25 s	11 s (moving) 25 s (static)	15 s
ID/Status Information	Maximum Latency	A1→G	30 s	30 s	30 s

- *Notes:*
- *1. Many Version 0 and 1 implementations report NACv as "unavailable" despite reporting velocity that meets the Horizontal Velocity Uncertainty requirement. Derived velocity may be used to validate the reported velocity is meeting the performance requirement in lieu of reported velocity quality.*
- *2. NOTE REMOVED.*

- *3. System Design Assurance (SDA) is defined in Version 2 equipment or later. SIL values from Version 1 equipment may be used to derive SDA using the backward compatibility provisions of DO-260B (Appendix N) or DO-282B (Appendix R). Version 0 equipment may be assumed to have an SDA of 1.*
- *4. For Version 1 reports, if valid baro is unavailable, geometric altitude may be used when NACp ≥ 9. NACp categories less than 9 do not constrain the accuracy of geometric altitude. For Version 2 reports, if valid baro is unavailable, geometric altitude may be used when the value for Geometric Vertical Accuracy (GVA) > 1.*
- *5. Traffic vehicle vertical requirements for ASSA/FAROA are described in 2.2.4.2.2.*
- *6. The ASSA/FAROA horizontal position uncertainty requirement for airborne traffic is 50 meters (95%) (NACp ≥9) for use with parallel runways with centerline-to-centerline spacing of less than 676 meters (2218 feet) and 185.2 meters (95%) (NACp ≥7) for all other runway geometry.*

- 1.17 Page 44, replace Table 2-3 with:

9. Table 2-3 Ownship Application Specific Requirements Summary

Requirement Category	Requirement	Applicable Subsystem Interfaces (See Figure 2-1)	(Airborne) EVAcq	(Surface) ASSA / FAROA	(Enhanced Visual Approach) EVApp
State Data Uncertainty	Max Horizontal Position Uncertainty (95%)	A3→B3	0.5 NM	50 m (Note 1)	0.3 NM
	Maximum Horizontal Velocity Uncertainty (95%)	A3→B3	N/A	N/A	< 10 m/s
	Vertical Position Uncertainty (95%)	A3→B3	Valid Pressure Altitude (Note 3)	On Ground Status (while on surface) or Valid Pressure (while airborne) [Note 3]	Valid Pressure Altitude (Note 3)
	Vertical Velocity Uncertainty (95%)	A3→B3	N/A	N/A	N/A
State Data Integrity	Surveillance Integrity Risk	A3→B3	N/A	N/A	10e-3/hr (SIL ≥ 1)
	Horizontal Position Integrity Containment Region	A3→B3	N/A	N/A	0.6 NM

- *Notes:*
- *1. These constraints are based on a total system error (TSE) budget derived from RTCA/DO-272A and RTCA/ DO-257A (Aerodrome Moving Map Display (AMMD)), using more restrictive allocations for runway and taxiway database accuracies. GNSS sensors that assume Selective Availability ON are known to report very conservative accuracy metrics and mitigations are provided in paragraph 2.2.4.2.1 to assure the 50 meter (95%) accuracy requirement is met..*
- *2. It is assumed that vertical rate derived from barometric altimetry measurements will be sufficient to support this application. Geometric altitude rate based on GPS (with SA off), or a baro /geo rate are considered better than baro only.*
- *3. If valid pressure altitude is unavailable, geometric altitude may be used when VFOM < 45m.*

1.18 Page 45, replace paragraph 2.2.4.1.2 with:

Traffic Vehicle Requirements for EVAcq (*Airborne*)

All existing versions of the 1090ES and UAT ADS-B links are capable of producing EVAcq traffic data (e.g., DO-260 Version 0), and all future versions are expected to be developed to be capable of producing EVAcq traffic data.

An EVAcq traffic **shall** (2139) be derived from a track with valid horizontal position. A traffic track with NACp less than 5 **shall** (2140) not be provided to the CDTI interface.

An EVAcq traffic may not be reporting barometric altitude. This condition is known as non-altitude reporting or NAR. *In this case relative geometric altitude may be computed. In order to compute relative geometric altitude, the following* ***shall*** *(2141) apply*:

a. *For Version 0 or 1 traffic, NACp must be 9 or greater.*

b. *For Version 2 traffic, GVA must be 2 or greater.*

c. *Ownship geometric altitude uncertainty (95%) must be less than 45m.*

EVAcq traffic with an SDA less than 1 ***shall*** *(2141A) not be provided to the CDTI interface*.

If an EVAcq track's data age exceeds 25 seconds, ASSAP **shall** (2142) remove the traffic from the CDTI interface. This is the maximum data age allowed based on an enroute SSR TIS-B update.

Note: The initial application safety assessment determined the integrity requirement of this application to be 10^{-2}. This is the same order of magnitude as the accuracy parameter. As a result, RTCA Special Committee 186 (SC-186) has decided that the accuracy parameter was sufficient to determine validity for this application.

1.19 Page 46, replace paragraph 2.2.4.2.1 with:

Ownship Requirements for ASSA/FAROA (*Surface)*

ASSAP may perform the ASSA/FAROA application as follows when Ownship horizontal position and vertical position is valid and of sufficient quality.

When airborne, Ownship data must meet the following criteria or ASSAP **shall** (2143) signal that ASSA/FAROA is inoperative via the CDTI interface:

- A valid Horizontal Position with a horizontal uncertainty (95%) less than *50* meters AND pressure altitude is valid.

OR

- A valid Horizontal and Vertical Position (Geometric Altitude) with a horizontal uncertainty (95%) less than *50* meters and vertical uncertainty (95%) less than 45 meters.

When on ground, Ownship data must meet the following criteria or ASSAP **shall** (2144) signal that ASSA/FAROA is inoperative via the CDTI interface:

- A valid Horizontal Position with a reported horizontal uncertainty (95%) less than *50* meters.

AND

- For Class A functional equipment (i.e., Class A2, A3), ownship horizontal velocity is less than 80 knots

If a Runway database is not available for depiction of the Runway Surfaces and Extended Centerline, or Final Approach Course, ASSAP **shall** (2145) signal that FAROA is Unavailable (fail) via the CDTI interface.

If an Airport Surface database is not available for depiction of the Runway Surfaces, Extended Centerline or Final Approach Course, Taxiways, and Movement Surfaces, ASSAP **shall** (2146) signal that ASSA is Unavailable (fail) via the CDTI interface.

- *Note: The requirements for determining the availability of databases is written within the context of the functional separation of responsibility between ASSAP and CDTI as defined by DO-289. It does not imply a requirement on the allocation of functions to hardware. It is fully expected that the determination of the availability of data for display will likely reside in a multi-function display that is implementing CDTI and moving map functionality. In that case, the Multi-Function Display (MFD) is implementing a piece of the ASSAP function.*

1.20 Page 47, replace paragraph 2.2.4.2.2 with:

Traffic Vehicle Requirements for ASSA/FAROA *(Surface)*

All versions of the 1090ES and UAT ADS-B links are capable of producing ASSA/FAROA traffic data (e.g., DO-260 Version 0), and all future versions are expected to be developed to be capable of producing ASSA/FAROA traffic data.

When AIRBORNE traffic meets the following criteria, ASSAP **shall** (2147) mark the traffic valid for ASSA/FAROA on the CDTI interface:

Horizontal Position

- Traffic is reporting valid Horizontal Position with *185.2 meters (95%) (e.g., NACp ≥7) or greater accuracy when runway geometry does not include parallel runways with centerline-to-centerline spacing less than 676 meters (2218 feet).*

OR

- *Traffic is reporting valid Horizontal Position with 50 meters (95%) (e.g., NACp ≥9) or greater accuracy when runway geometry includes parallel runways with centerline-to-centerline spacing less than 676 meters (2218 feet).*

AND

Pressure Altitude or Geometric Altitude

- Traffic is reporting valid pressure altitude OR valid geometric altitude with a NACp of 9 or greater *(Version 0 or 1) OR valid geometric altitude with a GVA of 2 or greater (Version 2)*.

AND

Message Reception

- Traffic position message has been received within the last 11 seconds.

AND
Horizontal Velocity

- *Traffic is reporting valid horizontal velocity with 3 m/s (95%) or greater accuracy.*

System Design Assurance

- *Traffic is reporting a system design assurance (or equivalent) of 1 or greater.*

When ON GROUND traffic meets the following criteria, ASSAP **shall** (2148) mark the traffic valid for ASSA FAROA on the CDTI interface:

- Traffic is reporting valid horizontal position with 30 meters (95%) or greater *accuracy.*

AND

- Traffic is in motion and a position message has been received within the last 11 seconds, OR traffic is not in motion and a position message has been received within the last 25 seconds.

AND

- *Traffic is reporting valid horizontal velocity with 3 m/s (95%) or greater accuracy.*

AND

- *Traffic is reporting a system design assurance (or equivalent) of 1 or greater.*

1.21 Page 50, replace paragraph 2.2.4.4.1 with:

***Ownship* Requirements**

ASSAP may perform the Enhanced Visual Approach application when own aircraft horizontal and vertical positions are valid and of sufficient quality.

Vertical position is satisfied by geometric altitude or pressure altitude. When own aircraft horizontal or vertical position is invalid, ASSAP **shall** (2165) signal that EVApp is Unavailable (fail) via the CDTI interface. When own aircraft horizontal position uncertainty (95%) is greater than 0.3 NM (556 m), ASSAP **shall** (2166) signal that EVApp is Unavailable (fail) via the CDTI interface. When geometric altitude is used for vertical position and own aircraft vertical position uncertainty (95%) is greater than 45 m, ASSAP **shall** (2167) signal that EVApp is Unavailable (fail) via the CDTI interface.

ASSAP may perform the Enhanced Visual Approach application when own aircraft horizontal velocity is of sufficient quality. When own aircraft horizontal velocity uncertainty (95%) is greater than or equal to 10 m/s, ASSAP **shall** (2168) signal that EVApp is Unavailable (fail) via the CDTI interface.

When the ownship SIL is zero or the horizontal position *integrity* is greater than *0.6* NM, ASSAP **shall** (2169) signal that EVApp is Unavailable (fail) via the CDTI interface.

1.22 Page 50, replace paragraph 2.2.4.4.2 with:

Traffic Vehicle Requirements

a. An EVApp traffic **shall** (2170) be derived from traffic with valid horizontal and vertical position. Vertical position is satisfied by pressure altitude or geometric altitude. When pressure altitude is used for vertical position, traffic **shall** (2171) have a NACp of 6 or greater to be marked as a valid EVApp traffic. When geometric altitude is used for vertical position, *Version 0 or 1* traffic **shall** (2172) have a NACp of 9 or greater to be marked as a valid EVApp traffic. *When geometric altitude is used for vertical position, Version 2 traffic **shall** (2172A) have a GVA of 2 or greater to be marked as a valid EVApp traffic.*

b. Traffic **shall** (2173) have a NACv of 1 or greater to be marked as a valid EVApp traffic.

- *Note: Most current implementations report NACv as "unavailable" despite reporting velocity that meets the requirement. Other methods may be used to infer the velocity uncertainty in the near term.*

c. Traffic track **shall** (2174) have a SIL of 1 or greater and a NIC of 6 or greater to be marked as a valid EVApp traffic.

Note: Validation of horizontal position integrity for version 0 and version 1 traffic is not required for this application, but may be required for future applications.

d. If EVApp traffic is not updated within the maximum data age of 15 seconds, ASSAP **shall** (2175) mark the traffic as invalid for the EVApp application.

e. EVApp traffic with a SDA less than 2 ***shall*** *(2175A) be marked as invalid for the EVApp application.*

1.23 Page 51, replace paragraph 2.3.1 with:

General CDTI Requirements

The CDTI is defined as *the displays and controls necessary to support the applications included in this document. At a minimum, CDTI includes* a graphical plan-view (top down) traffic display. The CDTI is required (in Section 2.3.4.1) to indicate ownship position and (in Section 2.3.1.2) to show the positions, relative to the ownship, of traffic.

The basic (minimal) application of the CDTI is enhanced traffic situational awareness. At a minimum, enhanced traffic situational awareness is provided by the EVAcq application within the visual range described for that application. The same requirements apply for enhanced traffic situational awareness beyond the EVAcq visual range. CDTI **shall** (3000) support the EVAcq *(Airborne)* requirements.

Additionally, the CDTI may support these applications:

1. Airport Surface Situational Awareness/Final Approach and Runway Occupancy Awareness (ASSA/FAROA) *(Surface (Runways and Taxiways))*.
2. *Final Approach and Runway Occupancy Awareness (FAROA) (Surface (Runways Only))*.
3. Enhanced Visual Approach (EVApp) *(Enhanced Visual Approach).*

The minimum CDTI requirements specified in this version of these MOPS are based on these operational applications that are described in DO-289, *and applications subsequently approved by RTCA SC-186.* For each application that is implemented, all of the application's requirements must be met.

ASA functional equipment classes are defined by the combination of avionics equipment functionality they provide and the applications they support. These elements that comprise the functional equipment classes are discussed below.

Avionics include the equipment used to process the ADS-B messages and other surveillance information from other aircraft along with the required ownship information. Three types of avionics are defined to address equipment required to support the four ASA applications as defined below:

ASSAP is used to process ADS-B, ADS-R, TIS-B, and TCAS (if installed) surveillance data to provide CDTI equipment with consolidated tracks and application specific data.

CDTI (Surface Only) is used to control supported applications and graphically display ownship, the relative positions of aircraft and surface vehicles, over a moving map of runways and taxiways or runways only for supported airports while ownship is on the ground and less than 80 knots groundspeed.

CDTI is used to control supported applications and graphically display ownship position and the relative positions of aircraft and surface vehicles while ownship is airborne or on the surface. This avionics may optionally display over a moving map of runways and taxiways or runways only for supported airports.

ASA functional equipment classes may support one or more of the four current applications as shown in Table 1 – ASA Functional Equipment Classes in the ETSO Requirements paragraph 3. A total ADS-B ASA system will include one or more CDTIs and ASSAP that supporting at least one of the applications.

When implementing multiple functional equipment classes, mark all applicable classes. For example, CDTI avionics equipment approved for all ASA applications is marked as CLASS B1, B2, B3, B4.

Although the functional requirements for avionics are based on the current ASA applications, the same avionics may also support future applications of the same or lesser criticality. Designers are expected to carefully consider the use and expandability of the equipment for additional applications and make sufficient provisions for future changes and expansion.

CDTI ***shall*** *(3000A)* also support integration *of TCAS source tracks into ASAS on aircraft equipped with TCAS II.*

1.24 Page 64, replace paragraph 2.3.4.2.3.2.6 with:

Alerts

The following requirements apply generally to CDTI alerts based on both ASAS and TCAS systems. Additional TCAS-specific alert symbol requirements are provided in section 2.3.4.2.3.3.

Traffic that triggers an alert **shall** (3040) be indicated on the traffic display with a symbol variation. The following requirements only apply to the alerted traffic symbol:

a. If traffic directionality is valid, directionality information **shall** (3041) be displayed during alerts.

b. The traffic symbol **shall** (3042) change to amber/yellow for caution level alerts.

c. The traffic symbol **shall** (3043) change to red for warning level alerts.

d. For traffic without valid directionality:

- If traffic has a caution level alert, the traffic symbol may be modified by changing the shape to a circle.
- If traffic has a warning level alert, the traffic symbol may be modified by changing the shape to a square.

e. For traffic with valid directionality:

- If traffic has a caution level alert, the traffic symbol may be modified by changing the shape to a circle with a directional inlay.
- If traffic has a warning level alert, the traffic symbol may be modified by changing the shape to a square with a directional inlay.
- *Note: Caution and Warning level alerts may use the same traffic symbology as TCAS Traffic Alerts and Resolution Advisories, respectively. (See sections 2.3.4.2.3.3.1 and 2.3.4.2.3.3.2)*

*f. For airborne applications, a*lerting traffic that lies outside the configured traffic display range should be positioned at the measured relative bearing, and at the configured display maximum range (i.e., edge of display), and with a symbol shape modification that indicates that the traffic is off-scale.

Note: A half-symbol at the display edge is one acceptable indication method. Automatic scaling to position alerting traffic within the configured traffic display range is another acceptable method

Note: Future applications with alerts on the surface may need to develop an alternate indication method in order to accommodate the need for determining off-scale position information relative to airport surface features such as runways.

1.25 Page 68, replace paragraph 2.3.4.3 with:

Number of Traffic Element

A traffic element is an aircraft or vehicle.

a. The CDTI **shall** (3051) be capable of displaying at least 16 traffic elements.

Note: The limit of 16 is considered as a display capability, so that future applications may make use of it (e.g., computation limits). A setting to another limit (e.g., 8) is an acceptable way to proceed, and it is not required that the number of traffic to display is modifiable by the pilots in real time.

b. The CDTI should provide an indication when the number of traffic elements meeting the traffic display criteria exceeds the maximum number of traffic elements that can be displayed.

Note: Traffic will be displayed based on the Traffic Display Criteria (see section 2.3.1.1). Traffic of interest to the flight crew may not be included within the first 16 traffic in this list. For example, an aircraft at the other end of the runway may be of interest while 16 aircraft are closer to ownship. A higher limit of traffic elements may be appropriate.

1.26 Page 72, replace paragraph 2.3.5.5.2 with:

Traffic Actual Altitude

Actual Altitude is the traffic's reported altitude instead of the relative altitude between ownship and traffic. *If the actual altitude is to be shown on a continuous basis after selection by the flight crew, it **shall** (3072) be corrected for the local barometric pressure using the same correction used by the flight crew.* The following requirements apply if the Actual Altitude feature is implemented.

A clear and unambiguous indication **shall** (3069) be provided on the display that the actual altitude mode has been selected. Actual altitude tags **shall** (3070) be positioned above or below the traffic symbol in a manner consistent with relative altitude data tags.

Actual altitude **shall** (3071) be displayed as a 3-digit number representing hundreds of feet above MSL (e.g., “007” represents 700 feet MSL and “250” represents 25,000 feet MSL.)

1.27 Page 73, replace paragraph 2.3.5.7 with:

Traffic Identification

Traffic identification may also be referred to as flight identification or flight ID (e.g., the aircraft flight number or the tail number). The following requirements apply *for traffic identification:*

- *Note: Traffic identification may not be available for all traffic.*
- *Note: ICAO terminology for Traffic Identification is Aircraft Identification.*

a. The CDTI **shall** (3076) be capable of displaying eight alphanumeric characters for the traffic identification.

- *Note: The ICAO standard for aircraft identification is a maximum of eight alphanumeric characters.*

b. The location of traffic identification field with respect to the traffic symbol ***shall (3076A)*** be consistent for all displayed traffic.

1.28 Page 84, replace paragraph 2.3.9.2 with:

ASSA / FAROA (*Surface*)

For installations that support the ASSA/FAROA applications (reference ASA MASPS Appendices E and F):

a. The CDTI **shall** (3134) be capable of indicating the directionality of traffic for which directional information is available.

b. The CDTI should provide this additional information:

- Traffic ID.

c. (Deleted)

d. Ownship and traffic vehicle position symbology **shall** (3136) correspond to the underlying airport map, when displayed. Aircraft positions **shall** (3137) not be adjusted to snap to runways or taxiways (i.e., they should reflect the received position).

e. The CDTI **shall** (3138) be adjustable to a range of 1.0 NM or less in the direction of ownship travel as measured from the ownship position to the edge of the viewable screen.

f. When the ASSA application is active, a graphical depiction of the airport surface including taxiways and runways **shall** (3139) be present as an underlay. *If an Airport Surface database is not available for depiction of the runways and taxiways (as they are defined in DO-257A), CDTI **shall** (2146) indicate that ASSA (Surface – Runways and Taxiways) is Unavailable by the absence of an Airport Moving Map display or some other acceptable means (e.g., display message or crew alert message).*

Note: It is expected that the determination of the availability of data for display will reside in a multi-function display that is implementing CDTI and moving map functionality.

g. When the FAROA application is active, a graphical depiction of the airport surface including runways **shall** (3140) be present as an underlay. *If a Runway database is not available for depiction of the runways (as they are defined in DO-257A), CDTI **shall** (3140A) indicate that FAROA (Surface – Runways Only) is Unavailable by the absence of an Airport Moving Map display or some other acceptable means (e.g., display message or crew alert message).*

Note: It is expected that the determination of the availability of data for display will reside in a multi-function display that is implementing CDTI and moving map functionality.

1.29 Page 88, replace paragraph 2.4 with:

Equipment Performance – Environmental Conditions

The environmental tests and performance requirements described in this section are intended to provide a laboratory means of determining the overall performance characteristics of the equipment under conditions representative of those that may be encountered in actual aeronautical operation.

Unless otherwise specified, the test procedures applicable to a determination of equipment performance under environmental test conditions are contained in RTCA Document *DO-160* Environmental Conditions and Test Procedures for Airborne Equipment. General information on the use of *RTCA/DO-160* is contained in sections 1 through 3 of that document. Also, a method of identifying which environmental tests were conducted and other amplifying information on the conduct of the tests is contained in Appendix A of *RTCA/DO-160*.

Some of the performance requirements in sections §2.2 and §2.3 are not required to be tested to all of the conditions contained in *RTCA/DO-160*. Judgment and experience have indicated that these particular parameters are not susceptible to certain environmental conditions and that the level of performance specified in sections §2.2 and §2.3 will not be measurably degraded by exposure to these conditions.

Review of the requirements provided in sections §2.2 and §2.3 indicates that such requirements will be satisfied through software implementations which are not normally affected by environmental conditions. Therefore, the environmental test procedures of Table 2-7 are established in order to verify only the various interface functions of the Airborne Surveillance Application Processing function under environmental conditions. These test procedures are to be performed only for non-integrated Airborne Surveillance Application Processing implementations. When the ASAS implementation is integrated with a TCAS receiver the environmental tests specified in DO-185B are sufficient to validate the environmental performance of ASAS.

1.30 Page 92, replace paragraph 2.5.2.1.1 with:

Verification of Traffic State Vector Report Input Requirements (§2.2.2.1.1)

Test Tool Requirements:

It will be necessary to be able to modify the injected scenarios used in this section to conduct negative tests to exercise data field values outside the expected values (e.g.) reserved values, to ensure that such data field values are properly handled by ASSAP as data not available.

Test Procedure:

Step 1: Inject Scenario 1-1 from section 2.5.7.1 as stimulus to ASSAP, but without the TCAS source. Use 1090ES or UAT report format as appropriate for the installation. Ensure ASSAP is configured to provide all available data to the CDTI interface.

Verify that the track appears on the CDTI interface and the extrapolation of that track is consistent with the truth data. Verify that all applicable State Vector Report data for the track appears on the CDTI interface.

Repeat this step with a modified version of Scenario 1-1 where each data field that has reserved values has one of the reserved values set in a given ADS-B/ADS-R/TIS-B report in order to exercise each data field for those data fields that have reserved values. Verify that ASSAP treats any data field with a reported value outside the normal expected values as data not available at the CDTI interface.

Step 2: Inject Scenario 1-2 from section 2.5.7.1 as stimulus to ASSAP, but without the TCAS source. Use 1090ES or UAT report format as appropriate for the installation. Ensure ASSAP is configured to provide all available data to the CDTI interface.

Verify that the appropriate tracks appear on the CDTI interface and the extrapolation of that track is consistent with the truth data. Verify that all applicable State Vector Report data for the track appears on the CDTI interface.

Repeat this step with a modified version of Scenario 1-2 where each data field that has reserved values has one of the reserved values set in a given ADS-B/ADS-R/TIS-B report in order to exercise each data field for those data fields that have reserved values. Verify that ASSAP treats any data field with a reported value outside the normal expected values as data not available at the CDTI interface.

Step 3: Inject Scenario 1-3 from section 2.5.7.1 as stimulus to ASSAP, but without the TCAS source. Use 1090ES or UAT report format as appropriate for the installation. Ensure ASSAP is configured to provide all available data to the CDTI interface.

Verify that the appropriate tracks appear on the CDTI interface and the extrapolation of that track is consistent with the truth data. Verify that appropriate State Vector Report data for the track appears on the CDTI interface.

Repeat this step with a modified version of Scenario 1-3 where each data field that has reserved values has one of the reserved values set in a given ADS-B/ADS-R/TIS-B report in order to exercise each data field for those data fields that have reserved values. Verify that ASSAP treats any data field with a reported value outside the normal expected values as data not available at the CDTI interface.

1.31 Page 93, replace paragraph 2.5.2.1.2 with:

Verification of Traffic ID/Status Data Report Input Requirements (§2.2.2.1.2)

Test Tool Requirements:

It will be necessary to be able to modify the injected scenarios used in this section to conduct negative tests to exercise data field values outside the expected values (e.g.) reserved values, to ensure that such data field values are properly handled by ASSAP as data not available.

Test Procedure:

Step 1: Inject Scenario 1-1 from section 2.5.7.1 as stimulus to ASSAP, but without the TCAS source. Use 1090ES or UAT report format as appropriate for the installation. Ensure ASSAP is configured to provide all available data to the CDTI interface.

Verify that the track appears on the CDTI interface and the extrapolation of that track is consistent with the truth data. Verify that the Traffic ID/Status Report data for the track appears on the CDTI interface.

Repeat this step with a modified version of Scenario 1-1 where each data field that has reserved values has one of the reserved values set in a given ADS-B/ADS-R/TIS-B report in order to exercise each data field for those data fields that have reserved values. Verify that ASSAP treats any data field with a reported value outside the normal expected values as data not available on the CDTI interface.

Step 2: Inject Scenario 1-2 from section 2.5.7.1 as stimulus to ASSAP, but without the TCAS source. Use 1090ES or UAT report format as appropriate for the installation. Ensure ASSAP is configured to provide all available data to the CDTI interface.

Verify that the appropriate tracks appear on the CDTI interface and the extrapolation of that track is consistent with the truth data. Verify that the Traffic ID/Status Report data for the track appears on the CDTI interface.

Repeat this step with a modified version of Scenario 1-2 where each data field that has reserved values has one of the reserved values set in a given ADS-B/ADS-R/TIS-B report in order to exercise each data field for those data fields that have reserved values. Verify that ASSAP treats any data field with a reported value outside the normal expected values as data not available.

Step 3: Inject Scenario 1-3 from section 2.5.7.1 as stimulus to ASSAP, but without the TCAS source. Use 1090ES or UAT report format as appropriate for the installation. Ensure ASSAP is configured to provide all available data to the CDTI interface.

Verify that the appropriate tracks appear on the CDTI interface and the extrapolation of that track is consistent with the truth data. Verify that the Traffic ID/Status Report data for the track appears on the CDTI interface.

Repeat this step with a modified version of Scenario 1-3 where each data field that has reserved values has one of the reserved values set in a given ADS-B/ADS-R/TIS-B report in order to exercise each data field for those data fields that have reserved values. Verify that ASSAP treats any data field with a reported value outside the normal expected values as data not available on the CDTI interface.

1.32 Page 99, replace paragraph 2.5.2.5.1.7 with:

Verification of Traffic Horizontal Position (§2.2.2.5.1.7)

Generate a scenario including airborne and surface target elements that include Traffic Horizontal Position information as latitude/longitude, for some of the traffic elements, and as relative range and bearing referenced from ownship position for other traffic elements in the scenario.

Verify at the CTDI interface that those elements with a latitude/longitude were received with the latitude/longitude information included.

Verify at the CTDI interface that those elements with a relative range and bearing referenced from ownship position were received with the relative range and bearing information included and *calculated based on the ownship horizontal position source* defined in Section 2.2.2.3.1 of this document.

1.33 Page 99, replace paragraph 2.5.2.5.1.8 with:

Verification of Traffic Ground Speed (§2.2.2.5.1.8)

Generate a scenario including surface target elements with Ground Speed information included.

Verify at the *CDTI* interface that those elements with a Ground Speed were received with the Ground Speed information included.

For designs that validate the reported horizontal velocity uncertainty in lieu of a reported NACv, generate scenarios that cause the velocity quality validation to fail. Verify that those traffic elements are marked as invalid. If the approach and surface applications are implemented, generate scenarios for both the 3 m/s validation and 10 m/s validation.

1.34 Page 101, replace paragraph 2.5.2.5.1.16 with:

Verification of Traffic Application Capability (§2.2.2.5.1.16)

Generate a scenario including target elements that include Traffic Application Capability information as valid, for some of the traffic elements, and as invalid for other traffic elements in the scenario. Be sure to include at least one valid and one invalid traffic element for each available application whether active or not.

Verify at the CTDI interface that those elements with a valid indication were received with the Traffic Application Capability information marked as valid as appropriate for the application definitions defined in Section 2.2.2.5.1.16 of this document.

Verify at the CTDI interface that those elements with an invalid indication were received with the Traffic Application Capability information marked as invalid as appropriate for the application definitions defined in Section 2.2.2.5.1.16 of this document.

- 1.35 Page 106, change title of paragraph 2.5.3.1.3.2 to:

Verification of Duplicate Address *Processing for UAT Systems* (§2.2.3.1.3.2)

- 1.36 Page 106, new paragraph 2.5.3.1.3.3 reads as follows:

Verification of Duplicate Address Processing for 1090 MHz Systems (§2.2.3.1.3.3)

Step 1: Inject Scenario 2-5 from Section 2.5.7.2.

Verify that the duplicate addresses result in a new track within 2 updates for 1090.

Step 2: Inject Scenario 3-5 from Section 2.5.7.2.

Verify that the duplicate addresses result in a new track within 2 updates for 1090.

1.37 Page 106, replace paragraph 2.5.4.1.2 with:

Verification of Traffic Vehicle Requirements for EVAcq (§2.2.4.1.2)

Test Tool Requirements:

This test will require the generation of multiple traffic scenarios as a prerequisite.

Test Procedure:

Case 1: Generate a scenario with a track that initially has NACp greater than or equal to 5. Have the NACp value drop below 5. Verify that the track is dropped from the CDTI at this time.

Case 2*a*: *For Version 1 traffic, g*enerate a scenario with a track that initially has NACp greater than or equal to 9 but without barometric altitude information. Use relative Geometric altitude. Verify that the track is marked valid on the CDTI and displays the correct relative altitude.

Case 2b: For Version 2 traffic, generate a scenario with a track that initially has GVA greater than or equal to 2, but without barometric altitude information. Use relative Geometric altitude. Verify that the track is marked valid on the CDTI and displays the correct relative altitude.

Case 3: Generate a scenario with a track that initially has NACp less than 9 but without altitude information. Verify that the relative altitude tag is dropped from the track.

Case 4: Generate a scenario with a track that initially has NACp greater than or equal to 5. Update this track in 24 seconds and verify that the track remains on the CDTI. Update the track again in 26 seconds and verify that the track was dropped prior to the second update.

Case 5: Generate a scenario with a track that has an SDA of 0. Verify that the track is not displayed on the CDTI. Change the SDA for this track to a value greater than or equal to 1. Verify the track is displayed on the CDTI.

1.38 Page 113, replace paragraph 2.5.4.2.1 with:

Verification of Ownship Requirements for ASSA/FAROA (§2.2.4.2.1)

Test Procedure:

Step 1:

Generate an airborne scenario with ownship having a valid Horizontal Position with a horizontal uncertainty < 50m and with a valid pressure altitude.

Verify that ASSA/FAROA was operative at the CDTI interface.

Generate an airborne scenario with ownship having a valid Horizontal Position with a horizontal uncertainty > 50m and with a valid pressure altitude.

Verify that ASSA/FAROA was inoperative at the CDTI interface.

Generate an airborne scenario with ownship having a valid Horizontal Position with a horizontal uncertainty < 50m and a valid Vertical Position (Geometric Altitude) with a reported vertical position uncertainty < 45m.

Verify that ASSA/FAROA was operative at the CDTI interface.

Generate an airborne scenario with ownship having a valid Horizontal Position with a horizontal uncertainty > 50m with a valid pressure altitude and a reported vertical position uncertainty > 45m.

Verify that ASSA/FAROA was inoperative at the CDTI interface.

Generate an airborne scenario with ownship having a valid Horizontal Position with a horizontal uncertainty < 50m and a reported vertical position uncertainty > 45m.

Verify that ASSA/FAROA was inoperative at the CDTI interface.

Generate a surface scenario with ownship having a valid Horizontal Position with a horizontal uncertainty < 50m.

Verify that ASSA/FAROA was operative at the CDTI interface.

Generate a surface scenario with ownship having a valid Horizontal Position with a horizontal uncertainty > 50m.

Verify that ASSA/FAROA was inoperative at the CDTI interface.

(For Class A functional equipment) Generate a surface scenario with ownship on ground having a valid Horizontal Position with a horizontal uncertainty < 50m and a valid Horizontal Velocity < 80 knots.

Verify that ASSA/FAROA was operative at the CDTI interface.

(For Class A functional equipment) Generate a surface scenario with ownship on ground having a valid Horizontal Position with a horizontal uncertainty < 50m and a valid Horizontal Velocity > 80 knots.

Verify that ASSA/FAROA was inoperative at the CDTI interface.

Step 2: Generate Ownship data with the Runway database not available for the depiction of Runway Surfaces and Extended Centerline or Final Approach Course. Verify that ASSAP signals that FAROA is unavailable via the CDTI interface.

Step 3: Generate Ownship data with the Runway database not available for the depiction of Runway Surfaces and Extended Centerline or Final Approach Course, Taxiways and Movement Surfaces. Verify that ASSAP signals that ASSA is unavailable via the CDTI interface.

1.39 Page 115, replace paragraph 2.5.4.2.2 with:

Verification of Traffic Vehicle Requirements for ASSA/FAROA (§2.2.4.2.2)

Test Procedure:

Step 1: Generate an airborne scenario where a traffic element is reporting valid horizontal position and geometric altitude with a NACp *7* and is reporting a *valid horizontal velocity with 3 m/s or greater accuracy and* valid pressure altitude and where the traffic position message has been received within the last 11 seconds.

Verify that the traffic is marked as valid for ASSA/FAROA on the CDTI interface.

Step 2: Repeat Step 1, but change the update rate to greater than 11 seconds and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface.

Step 3a: Repeat Step 1, but remove the pressure altitude and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface.

Step 3b: Repeat Step 1, but change the horizontal velocity accuracy to greater than 3 m/s and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface.

Step 4*a*: Repeat Step 1 *for Version 0 and 1 traffic*, but remove the pressure altitude and change the target NACp to 9. Verify that the traffic is marked as valid for ASSA/FAROA on the CDTI interface.

Step 4b: Repeat Step 1 for Version 2 traffic, but remove the pressure altitude and set the GVA to 2 or greater. Verify that the traffic is marked as valid for ASSA/FAROA on the CDTI interface.

Step 5: Repeat Step 1, but change NACp to *6* and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface.

Step 6: (For functional equipment intended for use with runway geometry that includes parallel runways with centerline-to-centerline spacing less than 676 meters (2218 feet). Repeat Step 1, but change NACp to 8 and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface

Step 7: Generate a surface scenario where the *on ground* traffic is reporting valid horizontal position with a NACp *9, a valid horizontal velocity with 3 m/s or greater accuracy* and is in motion with a position message not having been received within the last *11* seconds.

Verify that the traffic is marked as *valid* for ASSA/FAROA on the CDTI interface.

Step 8: Repeat Step 7, but change the NACp to 8 and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface.

Step 9: Repeat Step 7, but change the horizontal velocity accuracy to greater than 3 m/s and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface.

Step 10: Repeat Step 7, but change the on ground traffic to no longer be in motion with a position message not having been received within the last 25 seconds and verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI interface.

Step 11: Generate an airborne scenario where the traffic has an SDA of 0. Verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI. Change the SDA for this traffic to a value greater than or equal to 1. Verify the traffic is marked as valid for ASSA/FAROA on the CDTI interface.

Step 12: Generate a surface scenario where the traffic has an SDA of 0. Verify that the traffic is marked as invalid for ASSA/FAROA on the CDTI. Change the SDA for this traffic to a value greater than or equal to 1. Verify the traffic is marked as valid for ASSA/FAROA on the CDTI interface.

1.40 Page 117, replace paragraph 2.5.4.4.1 with:

Verification of Ownship Requirements for EVApp (§2.2.4.4.1)

Test Tool Requirements:

This test will require a source for the generation of Ownship data.

Test Procedure:

Case 1: Generate Ownship data with the Ownship horizontal position invalid and verify that ASSAP signals that EVApp is inoperative via the CDTI interface.

Case 2: Generate Ownship data, in an airborne state, with the Ownship vertical position invalid and verify that ASSAP signals that EVApp is inoperative via the CDTI interface.

Case 3: Generate Ownship data with the Ownship horizontal position uncertainty set greater than 0.3 NM and verify that ASSAP signals that EVApp is inoperative via the CDTI interface.

Case 4: Generate Ownship data, in the airborne state using geometric altitude for vertical position where the vertical position uncertainty is set greater than 45m, and verify that ASSAP signals that EVApp is inoperative via the CDTI interface.

Case 5: Generate Ownship data with the Ownship horizontal velocity uncertainty set greater than 10m/s and verify that ASSAP signals that EVApp is inoperative via the CDTI interface.

Case 6: Generate Ownship data with the Ownship R_C greater than 0.*6* NM and verify that ASSAP signals that EVApp is inoperative via the CDTI interface.

1.41 Page 118, replace paragraph 2.5.4.4.2 with:

Verification of Traffic Vehicle Requirements for EVApp (§2.2.4.4.2)

Test Tool Requirements:

This test will require the generation of traffic tracks.

Test Procedure:

Case 1: Generate traffic data with a valid horizontal and vertical position and verify that ASSAP signals that a EVApp traffic is derived via the CDTI interface.

Case 2: Generate traffic data with a pressure source for altitude and a NACp value set to 5, NACv set to 1, SIL set to 1 and NIC set to 6 and verify that ASSAP signals that the track is marked as invalid for EVApp.

Case 3: Generate traffic data with a pressure source for altitude and a NACp value set to 6, NACv set to 1, SIL set to 1 and NIC set to 6 and verify that ASSAP signals that a EVApp traffic element is derived via the CDTI interface. Repeat this case with NACv set to 0 and verify that ASSAP signals that the track is marked as invalid for EVApp. Repeat this case with SIL set to 0 and verify that ASSAP signals that EVApp is inoperative via the CDTI interface. Repeat this case with NIC set to 5 and verify that ASSAP signals that EVApp is inoperative via the CDTI interface. *Repeat this case for Version 2 traffic data with SDA set to 0 and verify that ASSAP signals that EVApp is inoperative via the CDTI interface.*

Case 4*a*: Generate *Version 1* traffic data with a geometric altitude source for altitude and a NACp value set to 8, NACv set to 1, SIL set to 1 and NIC set to 6 and verify that ASSAP signals that the track is marked as invalid for EVApp.

Case 4b: Generate Version 2 traffic data with a geometric altitude source for altitude and a GVA value set to 1, NACp set to 6, NACv set to 1, SIL set to 1, SDA set to 2 and NIC set to 6 and verify that ASSAP signals that the track is marked as invalid for EVApp.

Case 5*a*: Generate *Version 0 and 1* traffic data with a geometric altitude source for altitude and a NACp value set to 9, NACv set to 1, SIL set to 1 and NIC set to 6 and verify that ASSAP signals that an EVApp traffic element is derived via the CDTI interface. Repeat this case with NACv set to 0 and verify that ASSAP signals that the track is marked as invalid for EVApp. Repeat this case with SIL set to 0 and verify that ASSAP signals that the track is marked as invalid for EVApp. Repeat this case with NIC set to 5 and verify that ASSAP signals that the track is marked as invalid for EVApp.

Case 5b: Generate Version 2 traffic data with a geometric altitude source for altitude and a GVA value set to 2, NACp value set to 6, NACv set to 1, SIL set to 1, SDA set to 2 and NIC set to 6 and verify that ASSAP signals that an EVApp traffic element is derived via the CDTI interface. Repeat this case with NACv set to 0 and verify that ASSAP signals that the track is marked as invalid for EVApp. Repeat this case with SIL set to 0 and verify that ASSAP signals that the track is marked as invalid for EVApp. Repeat this case with NIC set to 5 and verify that ASSAP signals that the track is marked as invalid for EVApp. Repeat this case with SDA set to 1 and verify that ASSAP signals that the track is marked as invalid for EVApp.

Case 6: Generate traffic data with a valid horizontal and vertical position and verify that ASSAP signals that EVApp traffic is derived via the CDTI interface. Allow more than 15 seconds to pass without an update. Verify that ASSAP signals that the traffic is invalid for the EVApp application.

1.42 Page 131, replace paragraph 2.6.1 entries for requirement paragraph 2.3.1 and 2.3.9.2 in Table 2-10 with:

2.3.1 (3000) & (3000A)	*2.6.2.1, 2.6.2.3 & 2.6.2.4*	*D*	*The system meets the requirements for the EVAcq application.*
2.3.9.2 (3135)	*Deleted*		

1.43 Page 168, replace paragraph 2.6.2.18 with:

Verification – ASSA / FAROA

If the installation supports the ASSA/FAROA application, then using CDTI Test Setups #1, #2, and #10 as specified in 2.6.3.1, 2.6.3.2, and 2.6.3.10 respectively verify compliance to the following requirements.

Provide valid Ownship and sufficient traffic information (valid and invalid directionality, good, invalid traffic data quality, and a valid surface map.

Verify all traffic with valid directionality is displayed with directionality.

Cycle through the full set of selectable ranges and verify compliance with the following:

1. Verify that the display is adjustable to 1 NM or less in the direction of ownship travel as measured from the ownship position to the edge of the viewable screen.
2. Verify that the display is adjustable to 40 NM or greater in the direction of ownship travel as measured from the ownship position to the edge of the viewable screen.

Simulate an airport surface map and display on the CDTI display.

3. Verify the displayed traffic corresponds to the underlying surface map.
4. Verify the displayed traffic are displayed at their actual received positions.

1.44 Page C-4, replace paragraph C.3.1.1.1 with:

Track Generation (1090ES Implementation)

Upon reception of a state vector report, ASSAP searches for a track of the same type (ADS-B, ADS-R, TIS-B) and with the same 24-bit address as the report. If no match is found, ASSAP generates a new track containing the following parameters:

a. System time (track time of applicability).

b. Position time of applicability.

c. Velocity time of applicability.

d. Track type (ADS-B, ADS-R, TIS-B).

e. 24-bit address.

f. Position (latitude, longitude, altitude).

g. Velocity (East/West velocity, North/South velocity, altitude rate).

h. NIC.

i. [1]NACp = 5

j. [1]NACv = 1

k. [1]SIL = 0

l. [1]GVA = 1 (Version 2)

m. [2]State covariance matrices.

A.1.1.1.1.1.1.1 *Note:*

- *1. Track quality parameters are initially set to the minimum values allowed by the Enhanced Visual Acquisition application (with the exception that NACv is set to 1 in order to make the velocity uncertainty a known value and, for Version 2 reports, GVA is set to 1 to make the geometric vertical accuracy a known value). Reception of these parameters in subsequent Mode Status reports will overwrite this data.*
- *2. State covariance matrices are derived from estimated position and velocity uncertainties in the local East/North/Up (ENU) coordinate frame:*

Initial covariance matrix for the x-dimension

$$\begin{pmatrix} \sigma_x^2 & \sigma_{x\dot{x}} \\ \sigma_{x\dot{x}} & \sigma_{\dot{x}}^2 \end{pmatrix} = \begin{pmatrix} \sigma_{epu}^2 & \sigma_{epu}\sigma_{hva} \\ \sigma_{epu}\sigma_{hva} & \sigma_{hva}^2 \end{pmatrix}$$

Initial covariance matrix for the y-dimension

$$\begin{pmatrix} \sigma_y^2 & \sigma_{y\dot{y}} \\ \sigma_{y\dot{y}} & \sigma_{\dot{y}}^2 \end{pmatrix} = \begin{pmatrix} \sigma_{epu}^2 & \sigma_{epu}\sigma_{hva} \\ \sigma_{epu}\sigma_{hva} & \sigma_{hva}^2 \end{pmatrix}$$

where

σ_{epu} (standard deviation of estimated position uncertainty) is derived from NACp (described in Table C-1A).

σ_{hva} (standard deviation of horizontal velocity accuracy) is derived from NACv (described in Table C-2).

Initial covariance matrix for the z-dimension

$$\begin{pmatrix} \sigma_z^2 & \sigma_{z\dot{z}} \\ \sigma_{z\dot{z}} & \sigma_{\dot{z}}^2 \end{pmatrix} = \begin{pmatrix} \sigma_{vepu}^2 & \sigma_{vepu}\sigma_{vva} \\ \sigma_{vepu}\sigma_{vva} & \sigma_{vva}^2 \end{pmatrix}$$

where

σ_{vepu} (standard deviation of vertical estimated position uncertainty) is derived from NACp if geometric altitude is used and NACp ≥ 9 *(Version 1), from the reported geometric vertical accuracy (Version 2),* or an assumed value *for pressure altitude uncertainty (e.g., 100 ft)* otherwise.

σ_{vva} (standard deviation of vertical velocity accuracy) is derived from NACv if geometric altitude rate is used, or an assumed value *for pressure altitude rate uncertainty (e.g., 25 ft/s)* otherwise.

5. <u>Table C-1*A*</u> Navigation Accuracy Categories for Position (NACp) *(Version 1)*

NACP	95% Horizontal and Vertical Accuracy Bounds (EPU and VEPU)
0	EPU ≥ 18.52 km (10 NM)
1	EPU < 18.52 km (10 NM)
2	EPU < 7.408 km (4 NM)
3	EPU < 3.704 km (2 NM)
4	EPU < 1852 m (1NM)
5	EPU < 926 m (0.5 NM)
6	EPU < 555.6 m (0.3 NM)
7	EPU < 185.2 m (0.1 NM)
8	EPU < 92.6 m (0.05 NM)
9	EPU < 30 m and VEPU < 45 m
10	EPU < 10 m <u>and</u> VEPU < 15 m
11	EPU < 3 m <u>and</u> VEPU < 4 m

Note: NACp accuracy bounds for Version 2 are the same except Version 2 does not have VEPU.

6. <u>Table C-1B</u> Geometric Vertical Accuracy (GVA) (Version 2)

GVA	***Vertical Figure of Merit (VFOM) from GNSS Position Source***
0	*Unknown or > 150 meters*
1	*≤ 150 meters*
2	*≤ 45 meters*
3	*Reserved – may be decoded as < 45 meters*

- *Note: Where σ_{epu} and σ_{vepu} (if applicable) are derived from 95% values assumed to correspond to a Gaussian distribution. For example, a NACp of 5 equates to an EPU of 926 meters, where σ_{epu} = EPU/1.96 = 472.449 meters.*

7. **Table C-2 Navigation Accuracy Categories for Velocity (NACv)**

Navigation Accuracy Category for Velocity	
NACv	***Horizontal Velocity Error***
0	***Unknown or ≥ 50 feet (15.24 m) per second or***
1	***< 50 feet (15.24 m) per second***
2	***< 15 feet (4.57 m) per second***
3	***< 5 feet (1.52 m) per second***
4	***< 1.5 feet (0.46 m) per second***

Note: Where σ_{hva} and σ_{vva} (if applicable) are derived from 95% values assumed to correspond to a Gaussian distribution. For example, a NACv of 1 equates to an HVA of 10 m/s, where σ_{hva} = HVA/1.96 = 5.102 m/s.

1.45 Page C-9, replace paragraph C.3.1.1.2.1.1 with:

State Assembly With Position Updates

Equations (1), (2), and (3) are used to convert a position update from WGS84 to local ENU coordinates. Measurement position variances are derived from the NACp value stored in the candidate track. It is important to note that this is the technique used to link state vector and mode status reports. It is possible that a mode status report updated NACp and NACv in the track milliseconds before the arrival of the state vector update. First, the residual (or innovation) variances are calculated with extrapolated track position variances and estimated measurement position variances (based on most current NACp):

$$\sigma_{v_x}^2 = \sigma_{\hat{x}}^2 + \sigma_{epu}^2$$

$$\sigma_{v_y}^2 = \sigma_{\hat{y}}^2 + \sigma_{epu}^2$$

$$\sigma_{v_z}^2 = \sigma_{\hat{z}}^2 + \sigma_{vepu}^2 \qquad (6)$$

where

$\left(\sigma_{\hat{x}}^2, \sigma_{\hat{y}}^2, \sigma_{\hat{z}}^2\right)$ are extrapolated track position variances

$\left(\sigma_{epu}^2, \sigma_{vepu}^2\right)$ are estimated measurement position variances derived from NACp *(Version 1), from the reported geometric vertical accuracy (Version 2),* or an assumed value for vertical pressure altitude uncertainty *(e.g., 100 ft).*

Gain vectors are then calculated with extrapolated track and residual variances:

$$k_{0_x} = \frac{\sigma_{\hat{x}}^2}{\sigma_{v_x}^2},\ k_{1_x} = \frac{\sigma_{\hat{x}\hat{\dot{x}}}}{\sigma_{v_x}^2}$$

$$k_{0_y} = \frac{\sigma_{\hat{y}}^2}{\sigma_{v_y}^2},\ k_{1_y} = \frac{\sigma_{\hat{y}\hat{\dot{y}}}}{\sigma_{v_y}^2} \quad (7)$$

$$k_{0_z} = \frac{\sigma_{\hat{z}}^2}{\sigma_{v_z}^2},\ k_{1_z} = \frac{\sigma_{\hat{z}\hat{\dot{z}}}}{\sigma_{v_z}^2}$$

The assembled state is generated as follows:

$$x_a = \hat{x} + k_{0x}(x_m - \hat{x})$$

$$y_a = \hat{y} + k_{0_y}(y_m - \hat{y})$$

$$z_a = \hat{z} + k_{0z}(z_m - \hat{z})$$

$$\dot{x}_a = \hat{\dot{x}} + k_{1x}(x_m - \hat{x}) \quad (8)$$

$$\dot{y}_a = \hat{\dot{y}} + k_{1y}(y_m - \hat{y})$$

$$\dot{z}_a = \hat{\dot{z}} + k_{1z}(z_m - \hat{z})$$

where

(x_m, y_m, z_m) are measurement positions in local ENU

It is important to note that in cases where altitude is measured with a barometric sensor, the error characteristics associated with the original measurement (i.e., assumed pressure altitude uncertainty) are used to filter the calculated relative geometric altitude, as these characteristics have not changed.

The assembled state covariance matrices are calculated as follows:

$$\sigma_{x_a}^2 = (1 - k_{0_x})\sigma_{\hat{x}}^2$$

$$\sigma_{x\dot{x}a} = (1 - k_{0_x})\sigma_{\hat{x}\hat{\dot{x}}}$$

$$\sigma_{\dot{x}_a}^2 = \sigma_{\hat{\dot{x}}}^2 - k_{1_x}\sigma_{\hat{x}\hat{\dot{x}}}$$

$$\sigma_{y_a}^2 = (1 - k_{0_y})\sigma_{\hat{y}}^2$$

$$\sigma_{y\dot{y}a} = (1 - k_{0_y})\sigma_{\hat{y}\hat{\dot{y}}} \quad (9)$$

$$\sigma_{\dot{y}_a}^2 = \sigma_{\hat{\dot{y}}}^2 - k_{1_y}\sigma_{\hat{y}\hat{\dot{y}}}$$

$$\sigma_{z_a}^2 = (1 - k_{0_z})\sigma_{\hat{z}}^2$$

$$\sigma_{z\dot{z}a} = (1 - k_{0_z})\sigma_{\hat{z}\hat{\dot{z}}}$$

$$\sigma_{\dot{z}_a}^2 = \sigma_{\hat{\dot{z}}}^2 - k_{1_z}\sigma_{\hat{z}\hat{\dot{z}}}$$

The assembled state and track state (both in local ENU coordinates) are then sent to the correlation window function.

1.46 Page C-13, replace paragraph C.3.1.1.2.2 with:

Correlation Window

The correlation window is used to perform a final check that ensures the received state vector report truly corresponds to the candidate track. The correlation window is an estimated maximum distance between two reported positions, based on the concepts shown in Figure C-3.

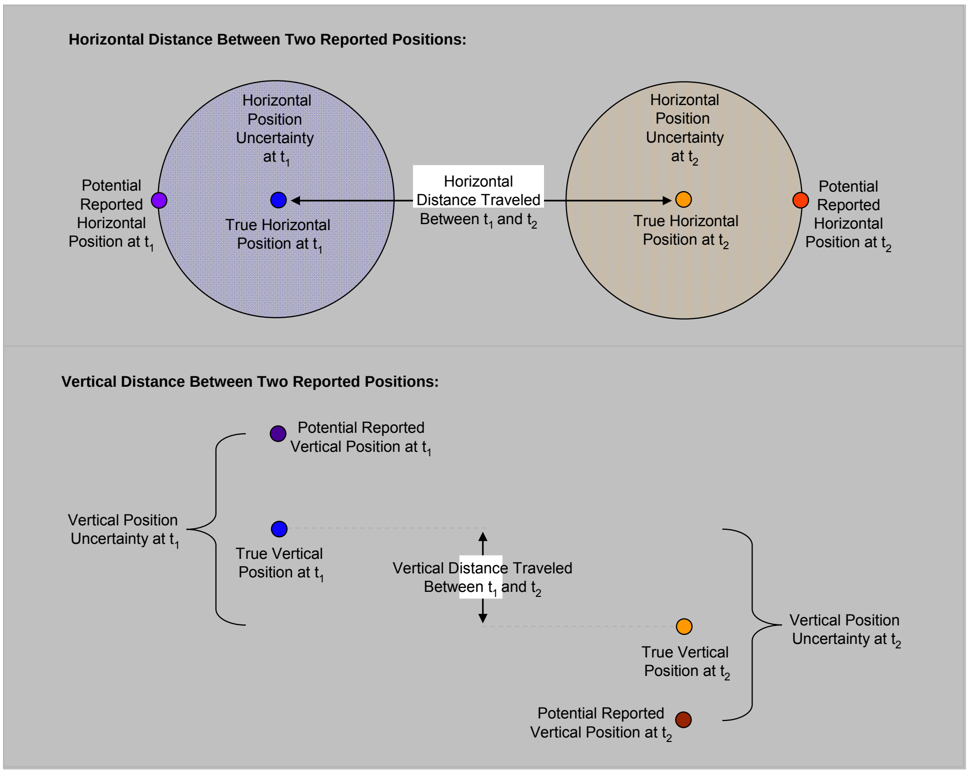


Figure C-3 Estimated Maximum Horizontal and Vertical Distances Between Two Reported Positions

The correlation window is calculated as follows:

$$r_h = \sqrt{\dot{x}_a^2 + \dot{y}_a^2}(dt) + 2(6\sigma'_{epu}) \qquad (14)$$

$$r_v = |\dot{z}_a|dt + 2(6\sigma'_{vepu})$$

where

σ'_{epu}, σ'_{vepu} are derived from degrading NACp to NACp – 1 *(Version 1), from degrading GVA to GVA-1(Version 2)*, or an assumed value is used for vertical pressure altitude uncertainty *(e.g., 100 ft)*.

r_h is an estimated maximum horizontal distance between the assembled and track positions.

r_v is estimated maximum vertical distance between the assembled and track positions.

- *Note: These estimates assume linear dynamics (no acceleration).*

Next, differences between assembled and track positions are calculated:

$$d_h = \sqrt{(x_a - x)^2 + (y_a - y)^2}$$

$$d_v = |z_a - z| \qquad (15)$$

where

d_h is the difference between assembled/filtered and track horizontal positions.

d_v is the difference between assembled/filtered and track vertical positions.

If $d_h \le r_h$ and $d_v \le r_v$, spatial correlation occurs.

1.47 Page C-30, replace paragraph C.3.2.2.2 with:

Non-Mode S Address (or Unmatched Mode S Address) TCAS Track Processing

For all ADS-B/ADS-R/TIS-B tracks in the track file database that have not been previously labelled as invalid for correlation with the TCAS track (i.e., *track(i).TCAS_IDs(j)= current TCAS track ID* and *track(i).TCAS_correlation_status(j)* has not been set equal to -1), track position is converted to local ENU coordinates with equations (1), (2), and (3). Relative geometric altitude (‘*z*’) is replaced with relative pressure altitude using (21). The track ENU position is then predicted to the time of applicability of the TCAS track with equation (4). Each ADS-B/ADS-R/TIS-B track is compared to the TCAS track with a dynamic correlation window that changes size to account for a number of error sources. The dynamic window consists of horizontal (core and buffer) and vertical components. The horizontal window’s core (depicted in Figure C-10) is a trapezoid based on potential range and bearing error in the TCAS track and error in the calculation of two-dimensional range.

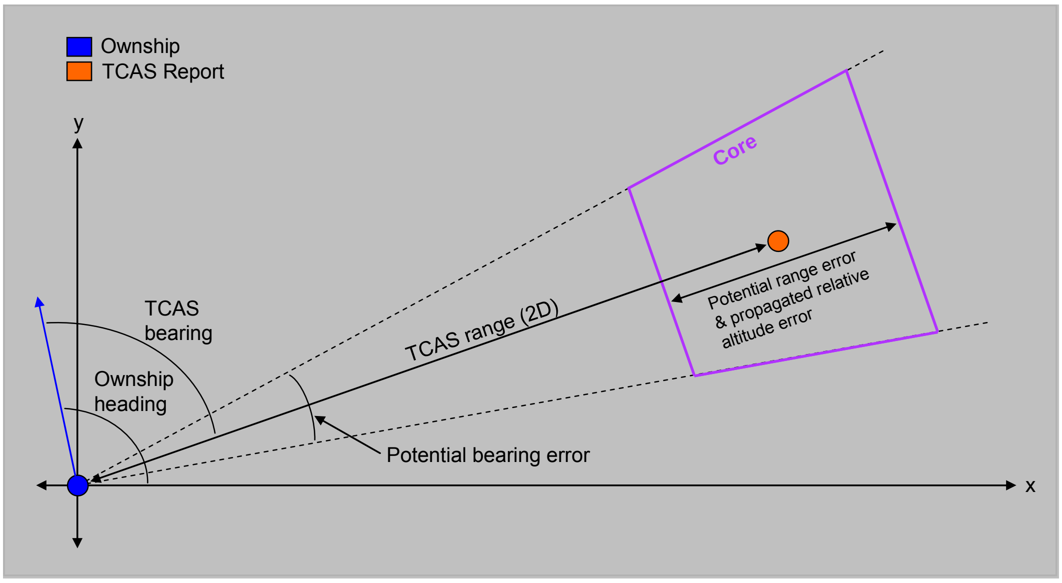


Figure C- 10 Dynamic TCAS Correlation Window – Horizontal Core

The horizontal core of the dynamic TCAS window is defined as follows:

$$L = 2s_l(6\sigma_r)$$

$$\beta = s_b(6\sigma_b)$$

$$p_1 = \left[\left(r_{xy} - \frac{L}{2}\right)\cos\alpha + \left(r_{xy} - \frac{L}{2}\right)\tan\beta\cos\left(\alpha + \frac{\pi}{2}\right), \left(r_{xy} - \frac{L}{2}\right)\sin\alpha + \left(r_{xy} - \frac{L}{2}\right)\tan\beta\sin\left(\alpha + \frac{\pi}{2}\right)\right] \quad (25)$$

$$p_2 = \left[\left(r_{xy} + \frac{L}{2}\right)\cos\alpha + \left(r_{xy} + \frac{L}{2}\right)\tan\beta\cos\left(\alpha + \frac{\pi}{2}\right), \left(r_{xy} + \frac{L}{2}\right)\sin\alpha + \left(r_{xy} + \frac{L}{2}\right)\tan\beta\sin\left(\alpha + \frac{\pi}{2}\right)\right]$$

$$p_3 = \left[\left(r_{xy} + \frac{L}{2}\right)\cos\alpha + \left(r_{xy} + \frac{L}{2}\right)\tan\beta\cos\left(\alpha + \frac{3\pi}{2}\right), \left(r_{xy} + \frac{L}{2}\right)\sin\alpha + \left(r_{xy} + \frac{L}{2}\right)\tan\beta\sin\left(\alpha + \frac{3\pi}{2}\right)\right]$$

$$p_4 = \left[\left(r_{xy} - \frac{L}{2}\right)\cos\alpha + \left(r_{xy} - \frac{L}{2}\right)\tan\beta\cos\left(\alpha + \frac{3\pi}{2}\right), \left(r_{xy} - \frac{L}{2}\right)\sin\alpha + \left(r_{xy} - \frac{L}{2}\right)\tan\beta\sin\left(\alpha + \frac{3\pi}{2}\right)\right]$$

where

s_l = adaptable length scalar.

s_b = adaptable width (bearing) scalar.

[1]σ_b = assumed standard deviation of bearing error = 6.67 degrees = 0.1164 radians.

p_1, p_2, p_3, p_4 = points that define the horizontal core (as illustrated by Figure C-11).

A.1.1.1.1.1.1.2 *Note: The bearing error standard deviation of 6.67 degrees was empirically arrived at to balance false and correct correlations*

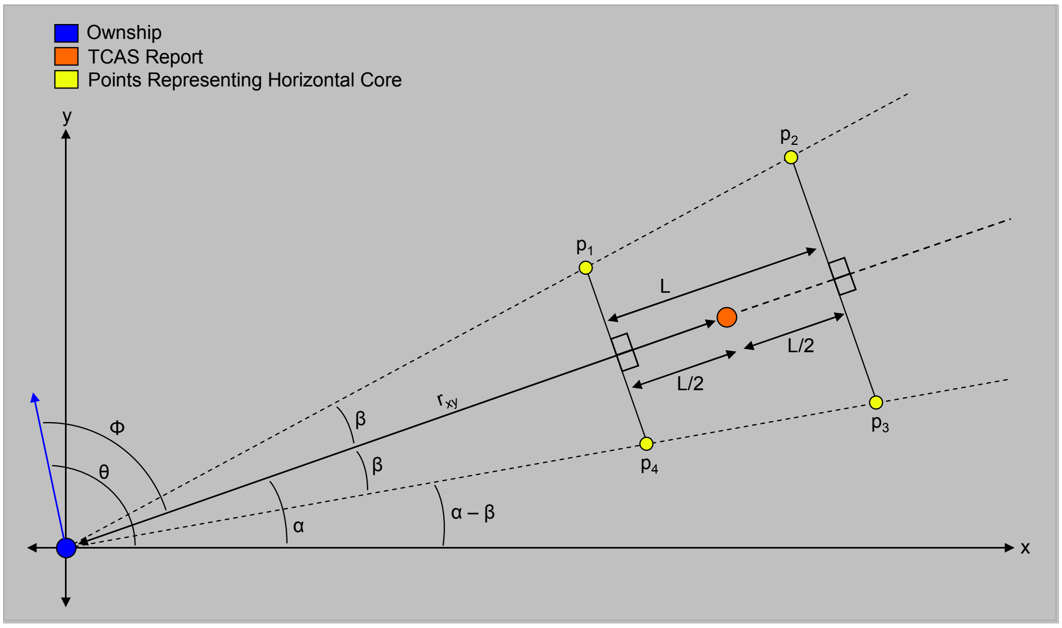


Figure C- 11 Dynamic TCAS Correlation Window – Points Representing the Horizontal Core

Table C-5 contains optimal values for s_l and s_b identified through intensive simulation testing with operational and synthesized data.

8. Table C- 5 Optimal Length Scalar for the Dynamic TCAS Correlation Window

A.1.1.1.1.1.1.2.1 **Scalar**	A.1.1.1.1.1.1.2.2 **Optimal Value**
A.1.1.1.1.1.1.2.3 s_l	A.1.1.1.1.1.1.2.4 41.000
A.1.1.1.1.1.1.2.5 s_b	A.1.1.1.1.1.1.2.6 1.0833

A.1.1.1.1.1.1.3 *Note: In the case where address matching is not possible, it is important to note that the word optimal does not imply perfection. Large length and width scalars (and hence a large window) will increase the probability of correlation; however, they also increase the potential for miscorrelation. Therefore the window should be large enough to achieve a high correlation rate, but small enough to minimise the probability of miscorrelation. The values listed in Table C-5 produced a very high association rate with operational flight test data involving few aircraft and stressful dynamics, yet these values also produced no miscorrelations with synthesised (dense) terminal traffic data.*

It is extremely important to note that a special case exists in which the dynamic TCAS window will warp if a small algorithm change is not performed. If the TCAS target is within close proximity of ownship (i.e., 1 NM or less), then the origin in the ENU coordinate frame (ownship position) is within the TCAS window – this causes significant warping that will negatively impact performance. This case can be detected when $r_{xy} - L/2 < 0$. If this case is detected, the core points p_1 and p_4 are both set to (0,0) and the width scalar s_b is slightly increased to 1.625, resulting in a triangular core.

The horizontal window's buffer (depicted in Figure C-12) is a 12-sided polygon based on track horizontal position error and prediction error introduced when tracks are extrapolated to the TOA of the TCAS report. The buffer is an estimate of the shape that would be formed when a circle representing track position uncertainty is moved completely around the core, with the center of the circle remaining on the border of the trapezoid. Buffer widths can change dramatically depending on the track being examined.

For tracks with poor NACp values (e.g., 4), the buffer will be large due to potential position error. If the time difference between the TCAS update and track update is significant (e.g,, 10 seconds), the buffer will be large due to potential prediction error.

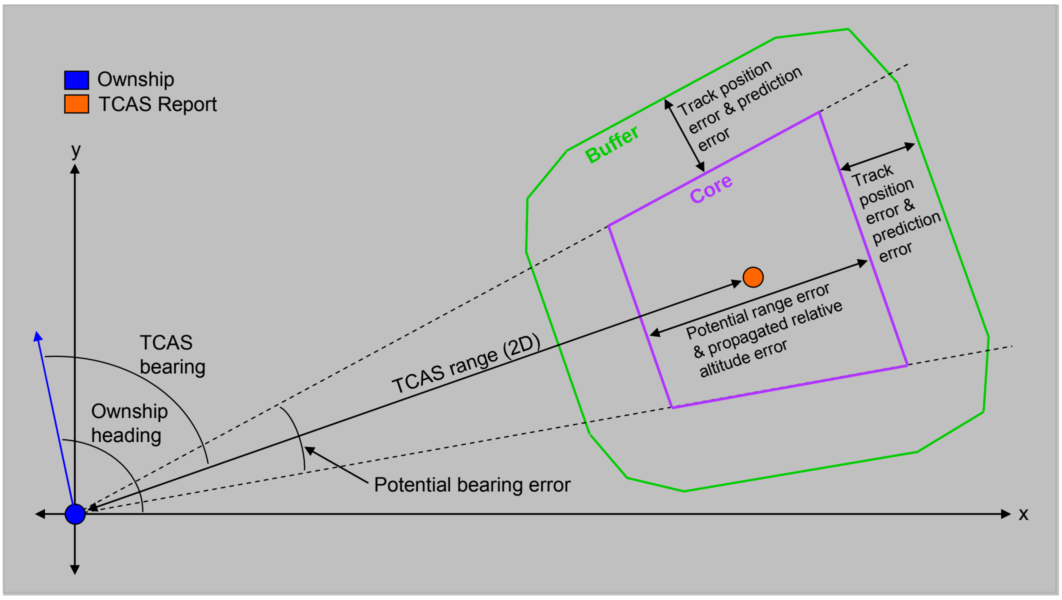


Figure C- 12 Dynamic TCAS Correlation Window – Horizontal Buffer

First, the width of the buffer is defined as follows:

$$w = 3\sigma_{epu} + v(dt) \qquad (26)$$

where

σ_{epu} = is the standard deviation of track position uncertainty (derived from NACp).

v = track speed (along-track horizontal velocity).

dt = time difference between the TCAS track TOA and track file TOA.

The buffer (and hence the horizontal window) is then defined by rotating radii (equal to the buffer width) about the points that make up the core:

$$\mu = \frac{\pi - 2\beta}{4}$$

$$\gamma = \frac{\pi + 2\beta}{4}$$

$$q_1 = p_1 + \left[w\cos\left(\alpha + \beta + \frac{\pi}{2} + 2\mu\right), w\sin\left(\alpha + \beta + \frac{\pi}{2} + 2\mu\right) \right]$$

$$q_2 = p_1 + \left[w\cos\left(\alpha + \beta + \frac{\pi}{2} + \mu\right), w\sin\left(\alpha + \beta + \frac{\pi}{2} + \mu\right) \right]$$

$$q_3 = p_1 + \left[w\cos\left(\alpha + \beta + \frac{\pi}{2}\right), w\sin\left(\alpha + \beta + \frac{\pi}{2}\right) \right]$$

$$q_4 = p_2 + [w\cos(\alpha + 2\gamma), w\sin(\alpha + 2\gamma)]$$

$$q_5 = p_2 + [w\cos(\alpha + \gamma), w\sin(\alpha + \gamma)]$$

$$q_6 = p_2 + [w\cos\alpha , w\sin\alpha]$$

$$q_7 = p_3 + \left[w\cos\left(\alpha - \beta - \frac{\pi}{2} + 2\gamma\right), w\sin\left(\alpha - \beta - \frac{\pi}{2} + 2\gamma\right) \right]$$

$$q_8 = p_3 + \left[w\cos\left(\alpha - \beta - \frac{\pi}{2} + \gamma\right), w\sin\left(\alpha - \beta - \frac{\pi}{2} + \gamma\right) \right]$$

$$q_9 = p_3 + \left[w\cos\left(\alpha - \beta - \frac{\pi}{2}\right), w\sin\left(\alpha - \beta - \frac{\pi}{2}\right) \right]$$

$$q_{10} = p_4 + \left[w\cos\left(\alpha - \beta - \frac{\pi}{2}\right), w\sin\left(\alpha - \beta - \frac{\pi}{2}\right) \right]$$

$$q_{11} = p_4 + \left[w\cos\left(\alpha - \beta - \frac{\pi}{2} - \mu\right), w\sin\left(\alpha - \beta - \frac{\pi}{2} - \mu\right) \right]$$

$$q_{12} = p_4 + \left[w\cos\left(\alpha - \beta - \frac{\pi}{2} - 2\mu\right), w\sin\left(\alpha - \beta - \frac{\pi}{2} - 2\mu\right) \right] \quad (27)$$

where

μ, γ = angles used to rotate radii (buffer width) about points that make up core.

$q_1, q_2, \ldots q_{12}$ = points that define the horizontal buffer and horizontal window (as illustrated by Figure C-13).

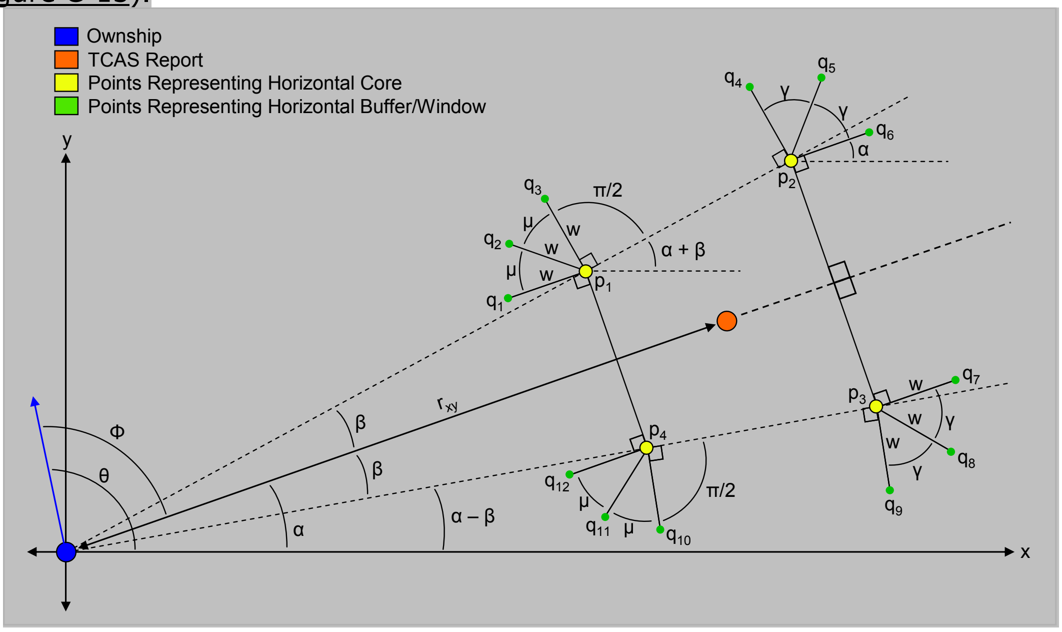


Figure C- 13 Dynamic TCAS Correlation Window – Points Representing the Horizontal Buffer / Window

The vertical component of the dynamic TCAS window is based upon estimated TCAS altitude error, track vertical estimated position uncertainty, and a height scalar:

$$h = s_h(3\sigma_z + 3\sigma_{vepu}) \qquad (28)$$

where

σ_z = *assumed standard deviation of TCAS altitude error = 3.889 meters.*

σ_{vepu} = *standard deviation of track vertical position uncertainty (derived from NACp if the original altitude measurement was geometric and NACp ≥ 9 (Version 1), from the reported geometric vertical accuracy (Version 2), or an assumed value for pressure altitude uncertainty (e.g., 100 ft) otherwise.*

s_h = *height scalar, optimal value = 6.359.*

If the predicted horizontal track position ($\hat{x}, \hat{y}$) falls within the horizontal window ($q_1, q_2, \ldots q_{12}$) and predicted track vertical position ($\hat{z}$) falls within the range *[z – h, z + h]*, where *z* is *the* previously computed TCAS relative altitude, *then* spatial correlation succeeds. Otherwise, spatial correlation fails.

The data storage and success/failure criteria for full TCAS correlation are very similar to that used for the ownship shadow detection described previously Upon a failed TCAS correlation window test, a "0" is added to the end of a 6-bit FIFO queue stored in the ADS-B/ADS-R/TIS-B track file (i.e., *track(i).TCAS_correlation_patterns(j)*), removing any value that may exist in the first index if the queue is full. TCAS correlation patterns are initialised when an ADS-B/ADS-R/TIS-B track is generated and grow to a maximum of six bits. For example, if a newly generated i-th ADS-B/ADS-R/TIS-B track failed the correlation window test upon track initiation and five subsequent updates with the j-th TCAS track, the correlation pattern *track(i).TCAS_correlation_patterns(j)* in the track file would transition as follows: [0], [00],…,[000000].

If the TCAS correlation window succeeds, a "1" is added to the appropriate correlation pattern in the track file. Upon three consecutive full correlations (i.e., *track(i).TCAS_correlation_patterns(j) = [111] or track(i).TCAS_correlation_patterns(j) = [100111]*) the TCAS track is determined to be fully correlated with the ADS-B/ADS-R/TIS-B track if the following *two* conditions are met:

1) The ADS-B/ADS-R/TIS-B track is not already fully correlated with another TCAS track (reflected in correlation status and TCAS ID fields in the track file).

2 The TCAS track is not already fully correlated with a different ADS-B/ADS-R/TIS-B track (reflected in correlation status and TCAS ID fields in a different track file).

If these conditions are met, the track file is marked appropriately (i.e., *track(i).TCAS_correlation_status(j) = 1, track(i).TCAS_correlation_tag = 1*). Otherwise, only the correlation pattern is updated. This "monogamous correlation" approach ensures that rampant miscorrelations are not transferred to the CDTI. If a TCAS track is erroneously correlated with the incorrect ADS-B/ADS-R/TIS-B track file, "tentative decorrelation" must occur before full correlation with a different track file can be obtained.

Tentative decorrelation occurs after three consecutive correlation window failures (i.e., *track(i).TCAS_correlation_patterns(j) = [111000], track(i).TCAS_correlation_status(j) = 0*) *.* Note that in this case, the ADS-B/ADS-R/TIS-B track is still valid for future correlation with this TCAS track*;* however, it is also valid for correlation attempts with other TCAS tracks. However, upon six consecutive correlation window failures (*track(i). TCAS_correlation_patterns(j) = [000000]*), the ADS-B/ADS-R/TIS-B track is invalidated from future comparisons with this TCAS track (i.e., *track(i).TCAS_correlation_status(j) = -1*).

Once full correlation occurs, the inter-source correlation function will no longer send the TCAS track to the traffic state file generator (and on to the CDTI), unless one of the following conditions occurs:

1) Tentative decorrelation occurs (i.e., *track(i).TCAS_correlation_patterns(j) = [111000] and* track*(i).TCAS_correlation_status(j) = 0*). Note that this is typically a precursor for full decorrelation.

2) TCAS is determined to be the best surveillance source for the target when the ADS-B/ADS-R/TIS-B track quality parameters fall below the minimum acceptable values for the Enhanced Visual Acquisition application. In this case, a field in the track file (i.e., *track(i).suppress*) is set so that the traffic state file generator does not forward the track to the CDTI.

1.48 Page C-38, replace paragraph C.3.2.3.1 with:

ICAO Address TIS-B Track Processing

If the TIS-B track has an ICAO address, ASSAP searches the track file database for an ADS-B/ADS-R track which 1) has the same ICAO address as the TIS-B track, and 2) has not been previously labeled as invalid for correlation (i.e., *track(i).TISB_IDs(j)= current TIS-B track ID* and *track(i).TISB_correlation_status(j)* has not been set equal to -1). If the ADS-B/ADS-R track has an ICAO address which does not match that of the TIS-B track (i.e., *track(i).address ≠ current TIS-B track ID*), the ADS-B/ADS-R track is determined to be not correlated with the TIS-B track and invalidated from future comparisons with this TIS-B track (i.e., *track(i).TISB_IDs(j)= current TIS-B track ID* and *track(i).TISB_correlation_status(j)* = -1).

If the above conditions are satisfied (i.e., an ICAO address match is obtained with an ADS-B/ADS-R track that is valid for correlation), the ADS-B/ADS-R track position is converted to local ENU coordinates with equations (1), (2) and (3), then predicted to the time of applicability of the TIS-B track with equation (4).

The candidate ADS-B/ADS-R track is then compared to the TIS-B track using a correlation window based on the position accuracies of the tracks. In this case, horizontal range between the two targets is computed *as*:

$$dx = x - \hat{x}$$
$$dy = y - \hat{y}$$
$$hr = \sqrt{dx^2 + dy^2} \qquad (29)$$
$$hr_{threshold} = s_h\left(3\sigma_{epu_{TISB}} + 3\sigma_{epu_{ADS}}\right)$$

where

(x, y) = *horizontal ENU coordinates of TIS-B track.*

$(\hat{x}, \hat{y})$ = *predicted horizontal ENU coordinates of ADS track.*

$\sigma_{epu_{TISB}}$ = *standard deviation of TIS-B track position uncertainty (derived from NACp).*

$\sigma_{epu_{ADS}}$ = *standard deviation of ADS track position uncertainty (derived from NACp).*

The horizontal range threshold ($hr_{threshold}$) is derived from the estimated position uncertainties of TIS-B and ADS tracks and a scalar (s_h) that compensates for prediction error (with optimal values of 1.92 and 1.40 for 1090ES and UAT implementations, respectively).

If $hr \le hr_{threshold}$, horizontal spatial correlation succeeds. The vertical correlation technique is slightly different and is defined as follows:

$$vr_{TISB} = \left[z - 3s_v\sigma_{vepu_{TISB}}, z + 3s_v\sigma_{vepu_{TISB}}\right] \qquad (30)$$
$$vr_{ADS} = \left[\hat{z} - 3s_v\sigma_{vepu_{ADS}}, \hat{z} + 3s_v\sigma_{vepu_{ADS}}\right]$$

where

z = *vertical ENU position of TIS-B track.*

$\hat{z}$ = *predicted vertical ENU position of ADS track.*

$\sigma_{vepu_{TISB}}$ = *standard deviation of TIS-B track vertical position uncertainty (derived from NACp if the original altitude measurement was geometric and NACp ≥ 9(Version 1), from the reported geometric vertical accuracy (Version 2), or an assumed value for pressure altitude uncertainty (e.g., 100 ft) otherwise.*

$\sigma_{vepu_{ADS}}$ = *standard deviation of ADS track vertical position uncertainty (derived from NACp if the original altitude measurement was geometric and NACp ≥ 9 (Version 1), from the reported geometric vertical accuracy (Version 2), or an assumed value for pressure altitude uncertainty (e.g., 100 ft) otherwise.*

The vertical range threshold scalar (s_v) compensates for prediction error (with optimal values of 0.91 and 0.20 for 1090ES and UAT implementations, respectively).

If the vertical ranges overlap *overlap* (i.e., $z_i \in vr_{TISB}$ and $z_i \in vr_{ADS}$ *),* vertical spatial correlation succeeds. If both horizontal and vertical correlation succeed, full spatial correlation occurs; otherwise, full spatial correlation fails. If full spatial correlation occurs, the ADS track is tagged as having a correlated TIS-B target (i.e., *track(i).TISB_correlation_tag = 1*), the correlation status in the track file is modified (*track(i).TISB_correlation_status(j) = 1*), and a six bit FIFO queue detection pattern is updated (i.e., *track(i).TISB_correlation_patterns(j) = [1]*) upon the first comparison and successful correlation).

If a matching ICAO address cannot be found in the ADS-B/ADS-R track file database, ASSAP attempts to correlate the TIS-B track with any ADS-B/ADS-R targets that have not been marked invalid for correlation as described in the next section. Since all non-matching ICAO address ADS-B/ADS-R tracks will have been marked invalid for correlation, only ADS-B/ADS-R tracks which do not have an ICAO address will be examined further.

1.49 Page L-1, replace Table L-1 with:

9. Table L-1 ADS-B *Ownship* Data Lifetime Requirements

	Input Data Elements	**Date Lifetime (Seconds)**
1	ICAO 24-bit Address	n/a
2	Address Selection (ICAO vs. Temporary)	60
3	Latitude	2
4	Longitude	2
5	Altitude Type Selection (Barometric vs. Geometric)	60
6	Barometric Pressure Altitude	2
7	Geometric Altitude	2
8	NIC	2
9	Automatic Airborne / On-Ground Indication	2
10	North Velocity	2
11	East Velocity	2
12	Ground Speed	2
13	Track Angle	2
14	Heading	2
15	Barometric Vertical Rate	2
16	Geometric Vertical Rate	2
17	A/V Length and Width, *with GPS Antenna Offset and Position Offset Applied by Sensor Indication*	n/a
19	Emitter Category	n/a
20	Call Sign	60
21	Emergency / Priority Status Selection	60
22	SIL	60
23	NAC_P	2
24	NAC_V	2
25	NIC_{BARO}	2
26	TCAS Installed and Operational	60
27	TCAS/ACAS Resolution Advisory Flag	18
28	"True/Magnetic Indicator" Flag	60
29	*Geometric Vertical Accuracy*	*60*
30	*System Design Assurance*	*60*
31	*SIL Supplement*	*60*
32	*NIC Supplement*	*2*

APPENDIX 2. ETSO REQUIREMENTS FOR FUNCTIONAL CLASSES OF ASA AVIONICS BY APPLICATION

The following table identifies the performance requirements for each application that is supported by one of the three classes (i.e., CDTI (Surface Only), CDTI, ASSAP) of ASAS avionics identified in this ETSO. All requirements in a given paragraph and all underlying subparagraphs apply unless the subparagraphs are listed separately or an exception is noted.

ASAS avionics that integrate ASSAP and CDTI classes may allocate the requirements to either class of avionics.

If an optional information or display element (as described in DO-317) is implemented, then those performance requirements and verification sections would apply. For example, if the traffic horizontal velocity vector is implemented, then the CDTI should meet the requirements of 2.3.5.11 and be verified using the guidance in 2.6.2.4.8.

Avionics / Application	CDTI (Surface Only) (A)	CDTI (B)	ASSAP (C)
Requirements Common to All Applications	2.1; 2.3.1; 2.3.2 (except 2.3.2.4.2 and 2.3.2.4.4); 2.3.3; 2.3.4 (except 2.3.4.2.3.2.9); 2.3.5.2; 2.3.5.3; 2.3.5.5; 2.3.5.6; 2.3.5.7 2.3.5.12; 2.3.5.13; 2.3.6.2; 2.3.6.3; 2.3.6.4; 2.3.7; 2.3.8; 2.3.10; 2.3.11; 2.4; 2.6 (only); All of 2.6.1 except the following: {Table 2-10 requirements for 2.3.2.4.2; 2.3.2.4.4; 2.3.4.2.3.2.9; 2.3.5.4}; All of 2.6.2 except the following: {2.6.2.4.6 for 2.3.5.8; 2.6.2.4.8 for 2.3.5.11; 2.6.2.4.9 for 2.3.5.9; 2.6.2.5 for 2.3.5.4; 2.6.2.6 & 2.6.2.7 for 2.3.9.3(a) (3141); 2.6.2.7 and 2.6.2.7.1 for 2.3.4.2.3.2.9; 2.6.2.8 for 2.3.2.4.2, 2.3.2.4.4 and 2.3.9.1; 2.6.2.16 for 2.3.6.5; 2.6.2.17 for 2.3.9.1; 2.6.2.18 and 2.6.2.22 for 2.3.9.2;	2.1; 2.3.1; 2.3.2 (except 2.3.2.4.2 and 2.3.2.4.4); 2.3.3; 2.3.4 except 2.3.4.2.3.9); 2.3.5.2; 2.3.5.3; 2.3.5.5; 2.3.5.6; 2.3.5.7 2.3.5.12; 2.3.5.13; 2.3.6.2; 2.3.6.3; 2.3.6.4; 2.3.7; 2.3.8; 2.3.10; 2.3.11; 2.4; 2.6 (only); All of 2.6.1 except the following: {Table 2-10 requirements for 2.3.2.4.2; 2.3.2.4.4; 2.3.4.2.3.2.9; 2.3.5.4}; All of 2.6.2 except the following: {2.6.2.4.6 for 2.3.5.8; 2.6.2.4.8 for 2.3.5.11; 2.6.2.4.9 for 2.3.5.9; 2.6.2.5 for 2.3.5.4; 2.6.2.6 & 2.6.2.7 for 2.3.9.3(a) (3141); 2.6.2.7 and 2.6.2.7.1 for 2.3.4.2.3.2.9; 2.6.2.8 for 2.3.2.4.2, 2.3.2.4.4 and 2.3.9.1; 2.6.2.16 for 2.3.6.5; 2.6.2.17 for 2.3.9.1; 2.6.2.18 and 2.6.2.22 for 2.3.9.2;	2.1; 2.2.1; 2.2.2.1; 2.2.2.2; 2.2.2.3; 2.2.2.3.1(a)-(d), (f)-(i), (k)-(m); 2.2.2.3.2; 2.2.2.4; 2.2.2.5(only); 2.2.2.5.1 (except 17.1); 2.2.2.5.2 (except 2.2.2.5.2.2); 2.2.2.5.3; 2.2.2.5.4; 2.2.2.6; 2.2.3 (except 2.2.3.1.2(b) and 2.2.3.1.3.3); 2.2.5; 2.2.6; 2.4; All of 2.5 except the following: {2.5.2.3.1 for 2.2.2.3.1(e), (j), (n); 2.5.2.3.3; 2.2.2.5.1.17.1; 2.5.2.5.2.2; 2.5.3.1.2 for 2.2.3.1.2(b)};

Avionics / Application	CDTI (Surface Only) (A)	CDTI (B)	ASSAP (C)
Unique ASAS Requirements for Airborne Application	**Not Permitted**	**2.3.9 (excluding subparagraphs)**	**2.2.4.1;** **2.5.4.1;**
Unique ASAS Requirements for Surface (Runways Only) Application	**2.3.9.2 (except c and f);** **2.6.2.18 for 2.3.9.2 except for 2.3.9.2(c) (3135);** **2.6.2.22 for 2.3.9.2(g) (3140);**	**2.3.9.2 (except c and f);** **2.6.2.18 for 2.3.9.2 except for 2.3.9.2(c) (3135);** **2.6.2.22 for 2.3.9.2(g) (3140);**	**2.2.2.3.1(e), (j); 2.2.2.3.3; 2.2.4.2;** **2.5.2.3.1 for 2.2.2.3.1(e), (j); 2.5.2.3.3; 2.5.4.2;**
Unique ASAS Requirements for Surface (Runways & Taxiways) Application	**2.3.9.2 (except c and g);** **2.6.2.18 for 2.3.9.2 except for {2.3.9.2(c) (3135);** **2.6.22 for 2.3.9.2(f) (3139);**	**2.3.9.2 (except c and g);** **2.6.2.18 for 2.3.9.2 except for {2.3.9.2(c) (3135);** **2.6.22 for 2.3.9.2(f) (3139);**	**2.2.2.3.1(e), (j), (n); 2.2.2.3.3; 2.2.4.2;** **2.5.2.3.1 for 2.2.2.3.1(e), (j), (n); 2.5.2.3.3; 2.5.4.2;**
Unique ASAS Requirements for Enhanced Visual Approach Application	**Not Permitted**	**2.3.2.4.2; 2.3.4.2.3.2.9; 2.3.9.3(a); 2.6.2.7 & 2.6.2.6 for 2.3.9.3(a);**	**2.2.2.5.1.4; 2.2.2.5.1.5, 2.2.2.5.1.8; 2.2.2.5.1.9; 2.2.2.5.2.2; 2.2.4.4;** **2.5.2.5.1.4; 2.5.2.5.1.5; 2.5.2.5.1.8; 2.5.2.5.1.9; 2.5.2.5.2.2; 2.5.4.4;**

Table 1: Requirements for Functional Classes of ASA Avionics by Application

European Aviation Safety Agency

European Technical Standard Order

Subject: Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation

1 - Applicability

This ETSO gives the requirements which Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation 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-316, Minimum Operational Performance Standards (MOPS) for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment, dated 14/04/2009.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

None

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition for malfunction of oceanic/remote, en route and terminal navigation and lateral navigation (LNAV) approaches.

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a minor failure condition for loss of navigation of oceanic/remote, en route and terminal navigation and lateral navigation (LNAV) approaches.

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.

ETSO-2C197

Date: xx.xx.2011

European Aviation Safety Agency

European Technical Standard Order

Subject: Information Collection and Monitoring Systems

1 - Applicability

This ETSO gives the requirements which Information Collection and Monitoring Systems that record cockpit audio, aircraft data, airborne images, or data link communications and 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-155, Minimum Operational Performance Specification for Lightweight Flight Recording Systems, dated July 2009.

All ICMS must meet the requirements in ED-155 Chapters 2-1, 2-2, 2-3 and 2-4 of Section 2. All deployable ICMS must also meet the requirements in ED-155 Chapters 3-1, 3-2, 3-3 and 3-4 of Section 3. Additionally, each Type of ICMS must meet the requirements of ED-155 listed in the table below.

ICMS	*Your design must also meet the following requirements in ED-155*	*Your design does not need to meet the following requirements in ED-155*
I	*Part I, Cockpit Audio Recording System*	*I-2.1.7 and I-6*
II	*Part II, Aircraft Data Recording System*	*II-2.1.7, II-2.1.9, II-2.1.12, and II-6*
III	*Part III, Airborne Image Recording System*	*III-2.2 and III-6*
IV	*Part IV, Data-link Recording System*	*IV-2.1.6, IV-2.1.11, and IV-6*

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3

3.2 - Specific

The lowest of the height (a), width (b), and depth (c) of the crash enclosure must be 4 cm (1.5 inches) or greater.

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. 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.