European Union Aviation Safety Agency

Certification Specifications for European Technical Standard Orders (CS-ETSO)

Amendment 18

8 September 2025[1]

[1] For the date of entry into force of this Amendment, kindly refer to ED Decision 2025/017/R at the Official Publication of EASA.

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PREAMBLE

CS-ETSO Amendment 18 **Effective: See Decision 2025/017/R**

The following is a list of paragraphs affected by this amendment:

Subpart A	
Paragraphs 2.2, 2.3, 2.4, 2.6	Amended (NPA 2024-03)
INDEX 1	
ETSO-C30d A1	Amended (NPA 2024-03)
ETSO-C90e	Amended (NPA 2024-03)
ETSO-C96c A1	Amended (NPA 2024-03)
ETSO-C112f	Amended (NPA 2024-03)
ETSO-C132b	Amended (NPA 2024-03)
ETSO-C159e	Amended (NPA 2024-03)
ETSO-C164a	Amended (NPA 2024-03)
ETSO-C166c	Amended (NPA 2024-03)
ETSO-C219a	Created (NPA 2023-04)
ETSO-C220	Created (NPA 2024-03)
INDEX 2	
ETSO-2C169b	Amended (NPA 2024-03)
ETSO-2C502a	Amended (NPA 2024-03)
ETSO-2C503a	Amended (NPA 2024-03)
ETSO-2C504a	Amended (NPA 2024-03)
ETSO-2C505a	Amended (NPA 2024-03)
ETSO-2C519a	Amended (NPA 2024-03)
ETSO-2C521 A1	Amended (NPA 2024-03)

SUBPART A — GENERAL

1. APPLICABILITY

1.1 The requirements for the issue of European Technical Standard Order (ETSO) authorisations are found in Part 21, Section A, Subpart O.

1.2 The marking requirements for the issue of European Technical Standard Order (ETSO) authorisations are found in Part 21, Section A, Subpart Q

2. STANDARDS TO MEET TECHNICAL CONDITIONS

2.1 Environmental standards

Unless otherwise stated in 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, ED 14E/DO-160E dated March 2005, ED-14F/DO-160F dated March 2008, ED 14G/DO-160G dated December 2010, or ED-14G Change 1/DO-160G Change 1 dated January 2015.

Compliance shall be demonstrated entirely with one of the above versions of the applicable environmental standards.

2.2 Software

If the ETSO article includes software, the software shall be developed with development assurance. The accepted means of compliance for the development assurance of airborne software is contained in the revision of AMC 20-115, titled 'Airborne Software Development Assurance using EUROCAE ED-12 and RTCA document DO-178', which is current at the time of the application, or in any later revision. The use of any other means of compliance shall be subject to a deviation request.

The software level, also known as the 'item development assurance level (IDAL)', shall be determined by using the guidance provided in Section 2.4.1. The applicant must declare the software level(s) to which the software has been developed and verified.

If the ETSO article embeds a multi-core processor (MCP) with two or more activated cores, the software shall be developed in accordance with the acceptable means of compliance contained in AMC 20-193, titled 'Use of multi-core processors'. The use of any other means of compliance shall be subject to a deviation request.

2.3 Airborne electronic hardware (AEH)

If the ETSO article includes airborne electronic hardware, the airborne electronic hardware shall be developed with development assurance. The accepted means of compliance for the development of airborne electronic hardware is contained in the revision of AMC 20-152, titled 'Development Assurance for Airborne Electronic Hardware' that is current at the time of the application, or in any later revision. The use of any other means of compliance shall be subject to a deviation request.

The hardware development assurance level (DAL), also known as the 'item development assurance level (IDAL)', shall be determined by using the guidance provided in Section 2.4.1. The applicant must declare the hardware DAL(s) to which the item has been developed and verified.

If the ETSO article embeds a multi-core processor (MCP) with two or more activated cores, the airborne electronic hardware shall be developed in accordance with the acceptable means of compliance contained in AMC 20-193, titled 'Use of multi-core processors'. The use of any other means of compliance shall be subject to a deviation request.

2.4 Failure condition classification and ETSO article development assurance

When the ETSO article incorporates software or airborne electronic hardware, the following subparagraphs shall apply.

2.4.1 Failure condition classification

During the development of an ETSO article, consideration should be given to failure conditions, and the ETSO article should then be developed in accordance with the possible effects of those failure conditions at the system and aircraft levels (see, for instance, AMC CS xx.1309 or AMC CS 23.2500/2510 for further guidance).

If the effects at the system or aircraft level are not known, due to the non-availability of aircraft or system design data, the applicant should make and declare an assumption for the failure classification in the intended installation. The assumed failure classification should be at least as high as the minimum hazard classification level required in the ETSO standard (when the ETSO standard requires a minimum level for a failure condition).

The classification of failure conditions at the level of the ETSO article may change as a result of particular aircraft installation architectures and characteristics.

Depending on the intended aircraft installation, EUROCAE/SAE Document ED-135/ARP4761A, 'Guidelines for Conducting the Safety Assessment Process on Civil Aircraft, Systems, and Equipment', dated 20 December 2023, or ASTM Document F3061M-17, 'Standard Specification for Systems and Equipment in Small Aircraft', dated November 2017, provide guidance to assign the development assurance levels of the ETSO article, software and airborne electronic hardware.

The ETSO article shall be developed according to at least the development assurance level that is appropriate to the failure condition classifications that are expected for the intended installation.

2.4.2 Development assurance of the ETSO article

The ETSO article should be developed in accordance with at least the development assurance level that is assigned corresponding to the most critical failure condition classification determined as per Section 2.4.1.

Depending on the intended aircraft installation, the applicant may opt to apply an ETSO article development assurance process. In that case, the EUROCAE/SAE Document ED-79B/ARP4754B, 'Guidelines for Development of Civil Aircraft and Systems', dated 20 December 2023, may be the accepted means of compliance to ensure that a proper development assurance process is followed for the ETSO article and its functional requirements.

When the ETSO applicant is seeking a single ETSO authorisation for a group of equipment (e.g. a processing unit plus a remote sensor required to perform the intended functions, an integrated modular avionics (IMA) system), development assurance shall be applied on each piece of equipment implementing software or airborne electronic hardware.

2.5 ETSO article using an ETSO-C153()-authorised IMA platform or module

If the ETSO article implements one (or several) ETSO-C153()-authorised integrated modular avionics (IMA) platforms/modules and the applicant seeks compliance credit from this (these) ETSOA authorisation(s) to demonstrate compliance with one or several functional ETSO standard(s), the applicant shall apply for authorisation to the ETSO-C214 standard, together with the intended functional ETSO standard(s).

Note: A functional ETSO standard is any ETSO standard of CS-ETSO that describes an 'aircraft' function, i.e. typically any ETSO standard, except ETSO-C153() and ETSO-C214.

2.6 Information security protection

The ETSO article may be developed in accordance with at least the security assurance level (SAL) that is appropriate for the threat condition classification assumed for the intended installation.

Depending on the intended aircraft installation, the applicant may opt to apply an Information Security assurance process. In that case, AMC 20-42 (latest revision), titled 'Airworthiness information security risk assessment' may be the acceptable means of compliance to ensure that proper security assurance process is followed for the ETSO article.

2.7 Open problem reports (OPRs)

Problem reports that are related to ETSO articles that contain software or airborne electronic hardware shall be identified and managed. The accepted means of compliance for the management of OPRs is contained in the revision of AMC 20-189[1] 'Management of Open Problem Reports' that is current at the time of application, or in any later revision. The use of any other means of compliance shall be subject to a deviation request.

2.8 Embedded batteries

If an ETSO article embeds a lithium battery whose energy is equal to or greater than 2 Wh, the battery shall be approved in accordance with the applicable battery ETSO. Additionally, when the battery ETSO covers the article embedding the battery, the article shall also be approved in accordance with the applicable battery ETSO.

For rechargeable lithium batteries whose energy is less than 2 Wh, the battery shall comply with the UN Recommendations on the Transport of Dangerous Goods - Model Regulations and shall be certified to UL 1642, UL 2054 or IEC 62133, unless it is shown to meet the requirements of RTCA document DO-311A Energy Category 2.

For non-rechargeable lithium batteries whose energy is less than 2 Wh, the battery shall be certified to UL 1642 and shall comply with the UN Recommendations on the Transport of Dangerous Goods - Model Regulations.

If there is no ETSO that is applicable to a particular battery that an applicant intends to use in an ETSO article, the applicant should contact EASA.

[1] Refer to ED Decision 2020/010/R (https://www.easa.europa.eu/document-library/agency-decisions).

3. ADITIONAL INFORMATION

3.1 In some ETSOs, reference is made to an associated FAA standard. In these cases, the corresponding FAA technical standard order (TSO) can be consulted on http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgTSO.nsf/Frameset?OpenPage.

3.2 The standards documents referred to in this CS-ETSO may be purchased or obtained from the following organisations:

— ASD-STAN documents:

AeroSpace and Defence Industries Association of Europe – Standardization

Rue Montoyer 10 - 1000 Brussels

(Email: sales@asd-stan.org, website: www.asd-stan.org)

— ASTM documents:

American Society for Testing and Materials, ASTM International,

100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania

19428-2959, USA

(Website: www.astm.org)

— ETSI European Telecommunications Standards Institute

650, Route des Lucioles

06560 Valbonne - Sophia Antipolis

FRANCE

Telephone: +33 4 92 94 42 00

(https://www.etsi.org/standards#Pre-defined Collections)

— EUROCAE documents:

European Organisation for Civil Aviation Equipment

9-23 rue Paul Lafargue, ‘‘Le Triangle’’ building, 93200 Saint-Denis, France

Telephone: +33 1 49 46 19 65

(Email: eurocae@eurocae.net, website: www.eurocae.net)

— EUROCONTROL Surveillance Document Library:

https://www.eurocontrol.int/articles/surveillance-library

— FAA standards:

Superintendent of Documents, Government Printing Office

732N Capitol Street NW, Washington DC 20401, USA

(Website: www.gpoaccess.gov)

— FCC Documents:

http://www.fcc.gov

— Global System, Inc., documents:

Global Systems, Inc., 2144 Michelson Drive, Irvine, California 92715, USA

Telephone: (714) 851-0119

— International Electrotechnical Commission

https://webstore.iec.ch

— MIL specifications:

DODSSP, Standardization Documents Order Desk

Building 4D, 700 Robbins Avenue, PHILADELPHIA, PA 19111-5094, USA

or from the ASSIST Customer Service Desk, telephone (215) 697-6396

(Website: http://quicksearch.dla.mil/)

— NAS specifications:

Aerospace Industries Association (AIA)

1327 Jones Drive, Ann Arbor, MI 48105, USA

(Website: www.techstreet.com)

— RTCA documents:

Radio Technical Commission for Aeronautics, Inc.

1828 L Street NW, Suite 805, Washington DC 20036, USA

(Website: www.rtca.org)

— RTCM documents:

Radio Technical Commission for Maritime Services

1621 N. Kent St., Suite 705

Arlington, Virginia 22209 USA

(Website: https://www.rtcm.org

— SAE documents

SAE International

400 Commonwealth Drive, WARRENDALE, PA 15096-001, USA

(Website: www.sae.org)

— UN United Nations Economic Commission for Europe transport regulations:

United Nations Bookshop

GA-1B-103

New York, NY 10017

USA

Tel: +1-212-963-7680

Email: bookshop@un.org

(Website:
https://www.unece.org/trans/danger/publi/unrec/rev13/13nature_e.html)

— UL Underwriters Laboratory standards:

(website: https://standardscatalog.ul.co

[Amdt ETSO/3]

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[Amdt ETSO/8]

[Amdt ETSO/12]

[Amdt ETSO/14]

[Amdt ETSO/15]

[Amdt ETSO/16]

[Amdt ETSO/17]

[Amdt ETSO/18]

SUBPART B — LIST OF ETSOs

This Subpart contains two Indexes:

1 INDEX 1

1.1 Index 1 lists all those ETSOs which are technically similar to FAA-TSOs.

1.2 When an article has been approved by the Agency to an ETSO listed in Index 1 the article is to be permanently marked with the appropriate ETSO number. Also, all documentation associated with Certification and Release for installation on an aircraft must record this ETSO number. The 'E' Symbol signifies that the article has been certified to the relevant ETSO by the Agency.

1.3 Index 1 lists all those ETSOs whose functional requirements are equivalent to those of the corresponding FAA TSOs that have the same identification numbers.

1.4 Reserved

1.5 The ETSO numbering system is explained as follows:

— ETSO-C5e means: European TSO-Number and revision letter, and so

— ETSO-C95 with no revision letter means initial issue.

NOTE: Copies of ETSOs are listed in Index 1.

2 INDEX 2

2.1 Index 2 lists all those ETSOs which are not technically similar to the FAA-TSOs. Index 2 ETSOs are identified by '2C' prefixes, and numbered as follows:

(a) An ETSO with significant differences in the MOPS in comparison with the corresponding FAA TSO is identified by the same number as the corresponding FAA TSO (related to the same type of equipment) with a number in the range from ETSO-2C1 to ETSO-2C499; or

(b) An ETSO for which there is no corresponding FAA TSO (related to the same type of equipment) is identified by a number in sequence from ETSO-2C500 upwards.

Index 1

EASA ETSO ref.	Title	Last amended by
ETSO-C1e	Cargo Compartment Fire Detection Instruments	CS-ETSO/13
ETSO-C2d	Airspeed Instruments	CS-ETSO/Initial Issue
ETSO-C3e	Turn and Slip Instruments	CS-ETSO/11
ETSO-C4c	Bank and Pitch Instruments	CS-ETSO/Initial Issue
ETSO-C5f	Direction Instrument, Non-Magnetic (Gyroscopically Stabilized)	CS-ETSO/11
ETSO-C6e	Direction Instrument, Magnetic (Gyroscopically Stabilized)	CS-ETSO/6
ETSO-C7d	Direction Instrument, Magnetic Non-Stabilized Type (Magnetic Compass)	CS-ETSO/Initial Issue
ETSO-C8e	Vertical Velocity Instrument (Rate-of-Climb)	CS-ETSO/6
ETSO-C10c	Pressure Altimeter System	CS-ETSO/16
ETSO-C13g	Life preservers	CS-ETSO/16
ETSO-C14b	Aircraft Fabric, Intermediate Grade; External Covering Material	CS-ETSO/Initial Issue
ETSO-C15d	Aircraft Fabric, Grade A; External Covering Material	CS-ETSO/Initial Issue
ETSO-C16b	Electrically Heated Pitot and Pitot-Static Tubes	CS-ETSO/13
ETSO-C20a	Combustion Heaters and Accessories	CS-ETSO/16
ETSO-C21b	Aircraft Turnbuckle Assemblies and/or Turnbuckle Safetying Devices	CS-ETSO/Initial Issue
ETSO-C22g	Safety Belts	CS-ETSO/Initial Issue
ETSO-C23f	Personal Parachute Assemblies and Components	CS-ETSO/13
ETSO-C25a	Aircraft Seats and Berths (Type I Transport 6g Forward Load)	CS-ETSO/Initial Issue
ETSO-C26d	Aircraft Wheels and Wheel-Brake Assemblies (CS-23, 27 and 29 aircraft)	CS-ETSO/12
ETSO-C27a	Twin Seaplane Floats	CS-ETSO/16
ETSO-C28	Aircraft Skis	CS-ETSO/Initial Issue
ETSO-C30d A1	Aircraft Position Lights	CS-ETSO/18
ETSO-C39c	Aircraft Seats and Berths Certified by Static Testing only	CS-ETSO/6
ETSO-C42	Propeller Feathering Hose Assemblies	CS-ETSO/Initial Issue
ETSO-C43d	Temperature Instruments	CS-ETSO/16

EASA ETSO ref.	Title	Last amended by
ETSO-C44c A1	Fuel Flowmeters	CS-ETSO/8
ETSO-C45b A1	Manifold Pressure Instruments	CS-ETSO/8
ETSO-C46a	Maximum Allowable Airspeed Indicator System	CS-ETSO/Initial Issue
ETSO-C47a A1	Pressure Instruments — Fuel, Oil, and Hydraulic (Reciprocating Engine-Powered Aircraft)	CS-ETSO/8
ETSO-C49b	Electric Tachometer: Magnetic Drag (Indicator and Generator)	CS-ETSO/Initial Issue
ETSO-C53a	Fuel and Engine Oil System Hose Assemblies	CS-ETSO/Initial Issue
ETSO-C54	Stall Warning Instruments	CS-ETSO/Initial Issue
ETSO-C55a A1	Fuel and Oil Quantity Instruments	CS-ETSO/17
ETSO-C56b A1	Engine-Driven Direct Current Generators/Starter Generators	CS-ETSO/8
ETSO-C59b	Airborne Selective Calling Equipment	CS-ETSO/13
ETSO-C62e	Aircraft Tyres	CS-ETSO/7
ETSO-C63f	Airborne Weather Radar Equipment	CS-ETSO/17
ETSO-C64b	Oxygen Mask Assembly, Continuous Flow, Passenger	CS-ETSO/12
ETSO-C69c	Emergency Evacuation Slides, Ramps and Slide/Rafts Combinations	CS-ETSO/Initial Issue
ETSO-C70b	Life Rafts	CS-ETSO/11
ETSO-C71	Airborne Static ('DC to DC') Electrical Power Converter (for Air Carrier Aircraft)	CS-ETSO/Initial Issue
ETSO-C72c	Individual Flotation Devices	CS-ETSO/Initial Issue
ETSO-C73	Static Electrical Power Inverter	CS-ETSO/Initial Issue
ETSO-C76b	Fuel Drain Valves	CS-ETSO/11
ETSO-C78a	Crewmember Demand Oxygen Mask	CS-ETSO/13
ETSO-C79	Fire Detectors (Radiation Sensing Types)	CS-ETSO/Initial Issue
ETSO-C80	Flexible Fuel and Oil Cell Material	CS-ETSO/Initial Issue
ETSO-C85b	Survivor Locator Lights	CS-ETSO/12
ETSO-C87a	Airborne Low-Range Radio Altimeter	CS-ETSO/8
ETSO-C88b	Automatic Pressure Altitude Reporting Code Generating Equipment	CS-ETSO/11
ETSO-C89a	Crew Member Oxygen Regulators, Demand	CS-ETSO/11

EASA ETSO ref.	Title	Last amended by
ETSO-C90e	Cargo Pallets, Nets and Containers (Unit Load Devices)	CS-ETSO/18
ETSO-C92c	Ground Proximity Warning, Glide Slope Deviation Alerting Equipment	CS-ETSO/Initial Issue
ETSO-C95a	Mach Meters	CS-ETSO/7
ETSO-C96c A1	Anticollision Light Systems	CS-ETSO/18
ETSO-C99a	Flight Deck (Sedentary) Crew Member Protective Breathing Equipment	CS-ETSO/11
ETSO-C100c	Aviation Child Safety Device (ACDS)	CS-ETSO/11
ETSO-C101	Overspeed Warning Instruments	CS-ETSO/Initial Issue
ETSO-C102	Airborne Radar Approach and Beacon Systems for Helicopters	CS-ETSO/Initial Issue
ETSO-C103	Continuous Flow Oxygen Mask Assembly (for Non-Transport Category Aircraft)	CS-ETSO/Initial Issue
ETSO-C105	Optional Display Equipment for Weather and Ground Mapping Radar Indicators	CS-ETSO/Initial Issue
ETSO-C106a	Air Data Computer	CS-ETSO/17
ETSO-C109	Airborne Navigation Data Storage System	CS-ETSO/Initial Issue
ETSO-C110a	Airborne Passive Thunderstorm Detection Systems	CS-ETSO/Initial Issue
ETSO-C112f	Secondary Surveillance Radar Mode S Transponder	CS-ETSO/18
ETSO-C113b	Airborne Multipurpose Electronic Displays	CS-ETSO/16
ETSO-C114 A1	Torso Restraint Systems	CS-ETSO/8
ETSO-C115d	Required Navigation Performance (RNP) Equipment using Multi-Sensor Inputs	CS-ETSO/13
ETSO-C116a	Crew Member Portable Protective Breathing Equipment	CS-ETSO/11
ETSO-C117b	Airborne Wind Shear Warning and Escape Guidance Systems (Reactive Type) for Transport Aeroplanes	CS-ETSO/16
ETSO-C118a	Traffic Alert and Collision Avoidance System I (TCAS I)	CS-ETSO/13
ETSO-C119e	Airborne Collision Avoidance System II (ACAS II) Version 7.1 with Hybrid Surveillance	CS-ETSO/17
ETSO-C121b	Underwater Locating Device	CS-ETSO/8
ETSO-C126c	Emergency Locator Transmitter	CS-ETSO/16
ETSO-C127c	Rotorcraft, Transport Aeroplane, and Small Aeroplane Seating Systems	CS-ETSO/17
ETSO-C132b	Geosynchronous Orbit Aeronautical Mobile Satellite Services Aircraft Earth Station Equipment	CS-ETSO/18

EASA ETSO ref.	Title	Last amended by
ETSO-C135a	Large Aeroplane Wheels, and Wheels and Brake Assemblies	CS-ETSO/6
ETSO-C137a	Aircraft Portable Megaphones	CS-ETSO/17
ETSO-C139a A1	Aircraft Audio Systems and Equipment	CS-ETSO/17
ETSO-C141	Aircraft Fluorescent Lighting Ballast/Fixture Equipment	CS-ETSO/Initial Issue
ETSO-C142b	Non-Rechargeable Lithium Cells and Batteries	CS-ETSO/16
ETSO-C144a	Passive Airborne Global Navigation Satellite System (GNSS) Antenna	CS-ETSO/6
ETSO-C145e A1	Airborne Navigation Sensors Using the Global Positioning System Augmented by the Satellite-Based Augmentation System	CS-ETSO/16
ETSO-C146e A1	Stand-Alone Airborne Navigation Equipment Using the Global Positioning System Augmented by the Satellite-Based Augmentation System	CS-ETSO/16
ETSO-C147a	Traffic Advisory System (TAS) Airborne Equipment	CS-ETSO/12
ETSO-C151d	Terrain Awareness and Warning System (TAWS)	CS-ETSO/16
ETSO-C153a	Integrated Modular Avionics (IMA) Platform and Modules	CS-ETSO/16
ETSO-C154c	Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment	CS-ETSO/7
ETSO-C155b	Recorder Independent Power Supply	CS-ETSO/13
ETSO-C157c	Flight Information Services-Broadcast (FIS-B) Equipment	CS-ETSO/17
ETSO-C158	Aeronautical Mobile High Frequency Data Link (HFDL) Equipment	CS-ETSO/7
ETSO-C159e	Next Generation Satellite Systems (NGSS) Equipment	CS-ETSO/18
ETSO-C160a A1	VDL Mode 2 Communications Equipment	CS-ETSO/16
ETSO-C161b	Ground-Based Augmentation System Positioning and Navigation Equipment	CS-ETSO/17
ETSO-C162b	Ground-Based Augmentation System Very High Frequency Data Broadcast Equipment	CS-ETSO/17
ETSO-C164a	Night Vision Goggles	CS-ETSO/18
ETSO-C165b	Electronic Map Systems for Graphical Depiction of Aircraft Position	CS-ETSO/16
ETSO-C166c	Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)	CS-ETSO/18
ETSO-C170	High-Frequency (HF) Radio Communication Transceiver Equipment Operating Within the Radio Frequency 1.5 to 30 Megahertz	CS-ETSO/7
ETSO-C172a	Cargo Restraint Strap Assemblies	CS-ETSO/12

EASA ETSO ref.	Title	Last amended by
ETSO-C173a	Nickel-Cadmium, Nickel Metal-Hydride, and Lead-Acid Batteries	CS-ETSO/11
ETSO-C174 A1	Battery-Based Emergency Power Unit (BEPU)	CS-ETSO/8
ETSO-C175	Galley Cart, Containers and Associated Components	CS-ETSO/3
ETSO-C178a	Aircraft Circuit Breakers	CS-ETSO/17
ETSO-C179b	Rechargeable Lithium Cells, Batteries, and Battery Systems	CS-ETSO/16
ETSO-C184	Galley Equipment	CS-ETSO/7
ETSO-C190	Active Airborne Global Navigation Satellite System (GNSS) Antenna	CS-ETSO/6
ETSO-C194	Helicopter Terrain Awareness and Warning System (HTAWS)	CS-ETSO/7
ETSO-C195b	Avionics Supporting Automatic Dependent Surveillance-Broadcast (ADS-B) Aircraft Surveillance	CS-ETSO/12
ETSO-C196b	Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation	CS-ETSO/16
ETSO-C198	Automatic Flight Guidance and Control System (AFGCS) Equipment	CS-ETSO/8
ETSO-C199 A1	Traffic Awareness Beacon System (TABS)	CS-ETSO/16
ETSO-C200a	Low-Frequency Underwater Locating Device (ULD)	CS-ETSO/12
ETSO-C201	Attitude and Heading Reference Systems (AHRS)	CS-ETSO/11
ETSO-C202	Cargo Stopper Devices	CS-ETSO/11
ETSO-C203 A1	Fire containment covers (FCC)	CS-ETSO/13
ETSO-C207a	Aeronautical Mobile Airport Communication System (AeroMACS)	CS-ETSO/16
ETSO-C209	Electronic Flight Instrument System (EFIS) Display	CS-ETSO/13
ETSO-C210	Airborne Head-Up Display	CS-ETSO/13
ETSO-C214 A1	Functional ETSO equipment using an ETSO-C153a-authorised IMA platform or module	CS-ETSO/16
ETSO-C219a	Airborne Collision Avoidance System (ACAS) Xa/Xo	CS-ETSO/18
ETSO-C220	GNSS-Aided Inertial System	CS-ETSO/18

Index 2

EASA ETSO ref.	Title	Last amended by
ETSO-2C11e	Power Plant Fire Detection Instruments (Thermal and Flame Contact Types)	CS-ETSO/Initial Issue
ETSO-2C19c A1	Portable Water-Solution Type Hand Fire Extinguishers	CS-ETSO/16
ETSO-2C34f	ILS Glide Slope Receiving Equipment Operating within the Radio Frequency Range of 328.6–335.4 Megahertz (MHz)	CS-ETSO/Initial Issue
ETSO-2C35d	Radar Marker Receiving Equipment	CS-ETSO/Initial Issue
ETSO-2C36f	Airborne ILS Localizer Receiving Equipment Operating within the Radio Frequency Range 108–112 Megahertz	CS-ETSO/Initial Issue
ETSO-2C40c	VOR Receiving Equipment Operating within the Radio Frequency Range of 108–117.95 Megahertz	CS-ETSO/Initial Issue
ETSO-2C41d	Airborne Automatic Direction Finding (ADF) Equipment	CS-ETSO/Initial Issue
ETSO-2C48a	Carbon Monoxide Detector Instruments	CS-ETSO/6
ETSO-2C66b	Distance Measuring Equipment (DME) Operating within the Radio Frequency Range 960–1215 Megahertz	CS-ETSO/Initial Issue
ETSO-2C75	Hydraulic Hose Assembly	CS-ETSO/Initial Issue
ETSO-2C93b	Airborne Interim Standard Microwave Landing System Converter Equipment	CS-ETSO/Initial Issue
ETSO-2C104a	Microwave Landing System (MLS) Airborne Receiving Equipment	CS-ETSO/Initial Issue
ETSO-2C122	Devices That Prevent Blocked Channels Used in Two-Way Radio Communications Due to Simultaneous Transmissions	CS-ETSO/Initial Issue
ETSO-2C123c	Cockpit Voice Recorder Systems	CS-ETSO/16
ETSO-2C124c	Flight Data Recorder Systems	CS-ETSO/16
ETSO-2C128	Devices That Prevent Blocked Channels Used in Two-Way Radio Communications Due to Unintentional Transmissions	CS-ETSO/Initial Issue
ETSO-2C168a	Aviation Visual Distress Signals	CS-ETSO/17
ETSO-2C169b	VHF Radio Communications Transceiver Equipment Operating within the Radio Frequency Range 117.975 to 137.000 Megahertz	CS-ETSO/18
ETSO-2C176a	Aircraft Cockpit Image Recorder Systems	CS-ETSO/16
ETSO-2C177a	Data Link Recorder Equipment	CS-ETSO/16
ETSO-2C197 A1	Information Collection and Monitoring Systems	CS-ETSO/16

EASA ETSO ref.	Title	Last amended by
ETSO-2C204a	Circuit Card Assembly (CCA) Functional Sensors Using the Satellite-Based Augmentation System (SBAS) for Navigation and Non-Navigation Position/Velocity/Time (PVT) Output	CS-ETSO/16
ETSO-2C205a	Circuit Card Assembly (CCA) Functional Class Delta Equipment Using the Satellite-Based Augmentation System (SBAS) for Navigation Applications	CS-ETSO/16
ETSO-2C206	Circuit Card Assembly (CCA) Functional Sensors Using Aircraft-Based Augmentation for Navigation and Non-Navigation Position/Velocity/Time (PVT) Output	CS-ETSO/16
ETSO-2C208	Electrical Hoist Equipment	CS-ETSO/17
ETSO-2C500a	Combined ILS/MLS Airborne Receiving Equipment	CS-ETSO/Initial Issue
ETSO-2C501	Mode S Aircraft Data Link Processor	CS-ETSO/Initial Issue
ETSO-2C502a	Rotorcraft Integrated Immersion Suits	CS-ETSO/18
ETSO-2C503a	Rotorcraft Immersion Suits for Operations to or from Helidecks Located in a Hostile Sea Area	CS-ETSO/18
ETSO-2C504a	Rotorcraft Constant-Wear Life Jackets for Operations to or from Helidecks Located in a Hostile Sea Area	CS-ETSO/18
ETSO-2C505a	Rotorcraft Life Rafts for Operations to or from Helidecks Located in a Hostile Sea Area	CS-ETSO/18
ETSO-2C509	Light Aviation Secondary Surveillance Transponders (LAST)	CS-ETSO/2
ETSO-2C512	Portable Gaseous Oxygen Supply (PGOS)	CS-ETSO/3
ETSO-2C513	Tow Release	CS-ETSO/3
ETSO-2C514a	Airborne Systems for Non-Required Telecommunication Services (in Non-Aeronautical Frequency Bands) (ASNRT)	CS-ETSO/13
ETSO-2C515 A1	Aircraft Halocarbon Clean Agent Hand-Held Fire Extinguishers	CS-ETSO/16
ETSO-2C516	Reserved	N/A
ETSO-2C517	Automatic Deployable Flight Recorder (ADFR) Systems for Large Aeroplanes	CS-ETSO/16
ETSO-2C518	Runway Overrun Awareness and Alerting Systems	CS-ETSO/16
ETSO-2C519a	Emergency Breathing Systems (EBSs)	CS-ETSO/18
ETSO-2C520	406-MHz Satellite Personal Locator Beacon	CS-ETSO/17
ETSO-2C521 A1	Electronic Flight Bag (EFB) Software Applications Approval	CS-ETSO/18
ETSO-2C522	Helicopter Terrain Awareness and Warning System (HTAWS) Advanced Features	CS-ETSO/17

[Amdt ETSO/1]
[Amdt ETSO/2]
[Amdt ETSO/3]
[Amdt ETSO/4]
[Amdt ETSO/5]
[Amdt ETSO/6]
[Amdt ETSO/7]
[Amdt ETSO/8]
[Amdt ETSO/9]
[Amdt ETSO/10]
[Amdt ETSO/11]
[Amdt ETSO/12]
[Amdt ETSO/13]
[Amdt ETSO/14]
[Amdt ETSO/16]
[Amdt ETSO/17]
[Amdt ETSO/18]

ETSO-C30d A1

AIRCRAFT POSITION LIGHTS

1 Applicability

This ETSO provides the requirements which aircraft position lights that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 Procedures

2.1 General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 Specific

None.

3 Technical Conditions

3.1 Basic

3.1.1 Minimum Performance Standard

Standards set forth in the SAE Aerospace Standard (AS) Document AS8037C 'Minimum Performance Standard for Aircraft Position Lights' dated July 2013, as modified by Appendix 1 to this ETSO.

3.1.2 Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.3 Airborne Electronic Hardware

See CS-ETSO Subpart A paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4.

4 Marking

4.1 General

In lieu of the marking detailed in CS-ETSO Subpart A paragraph 1.2, the minimum lamp candle power or lamp part number shall be shown.

4.2 Specific

None.

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/13]
[Amdt ETSO/18]

Appendix 1 to ETSO-C30d A1 — AIRCRAFT POSITION LIGHTS

In Section 3.2.2 of SAE AS8037C, 'Minimum Performance Standard for Aircraft Position Lights', dated July 2013, add below Figure 4 the following new paragraph.

The minimum intensity shall not be less than 75 % of its maximum value within the area defined by 'x' less than or equal to 10°, as per Figure 4. The minimum intensity shall not be less than 75 % of its maximum value within the area defined by 'x' greater than 10° and 'x' less than or equal to 20°, as per Figure 4. The minimum intensity shall not be less than 75 % of its maximum value within the area defined by 'x' greater than or equal to 110°, as per Figure 4.

[Amdt ETSO/18]

ETSO-C90e

CARGO PALLETS, NETS AND CONTAINERS (UNIT LOAD DEVICES)

1 Applicability

This ETSO provides the requirements which Cargo Unit Load Devices (ULDs) that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking. This ETSO also provides the requirements to enable a ULD to be additionally classified as a Fire-Resistant Container (FRC).

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 (MPS)

For new models of Type I ULDs, the standards 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 modified by Appendix 1 to this ETSO, are to be used when applicable.

For new models of Type II ULDs, the standards set forth in the SAE Aerospace Standard (AS) 36100, 'Air Cargo Unit Load Devices - Performance Requirements and Test Parameters', Revision C, dated September 2020, as modified by Appendix 2 to this ETSO, are to be used when applicable.

Note: Refer to paragraph 3.1 of SAE AS36100C for definitions of Type 1 and Type 2 ULDs, and paragraph 2.2 of the same standard for general definitions.

For Type I and II ULDs, the standards set forth in SAE AS36102B, 'Air Cargo Unit Load Devices - Testing Methods', dated March 2017, as modified by Appendix 3 to this ETSO, are applicable.

For FRCs, all above-mentioned applicable ULD standards and the standards set forth in SAE AS8992, 'Fire Resistance Container Design, Performance and Testing Requirements', dated October 2020, as modified by Appendix 4 to this ETSO, are to be used when the ULD container integrates fire containment functionality.

3.1.2 Environmental Standard

3.1.2.1 Generic

See CS-ETSO Subpart A, paragraph 2.1.

3.1.2.2 Specific

For ULDs and FRCs, environmental degradation due to ageing, ultra-violet (UV) exposure, weathering, etc., for any materials used in the construction of pallets, nets and containers must be considered. Where applicable, testing should take into account the requirements set forth in CS-ETSO, Subpart A, paragraph 2.1.

Textile Performance: See SAE Aerospace Information Report (AIR) 1490C, Environmental Degradation of Textiles, dated April 2019, for available data for textile performance when exposed to environmental factors. This 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 AS36100 Rev. C, paragraph 4.11.

Note: Environmental degradation data other than that documented in AIR1490C may be used if substantiated by the applicant and approved by EASA. A net must be able to meet the MPS of this ETSO at any time during its service life.

FRCs shall meet the additional environmental requirements set forth in AS8992, paragraphs 3.6 and 4.2.

The nominal weight of the article in kilograms and pounds in the format 'Weight: … kg (… lb)' shall be included in the relevant Declaration of Design and Performances document.

3.1.3 Software

None.

3.1.4 Airborne Electronic Hardware

None.

3.2 Flammability Requirements

The materials used in the construction of ULDs must meet the applicable requirements set forth in CS-25, Appendix F, Part I:

— paragraph (a)(1)(ii): 12-second vertical test;
— paragraph (a)(2)(ii): 45-degree test;
— paragraph (a)(1)(iv): horizontal test with 2.5 inch-per-minute burn rate criterion.

These tests are applicable as prescribed in Table 1 below. ULDs additionally classified as FRCs shall meet the flammability requirements of AS8992, Section 4.

ULD pallets and nets used with Fire Containment Covers (FCCs) should be marked with 'FIRE CONTAINMENT COMPATIBLE' as per paragraph 4.2 of this ETSO if the article meets the performance and testing requirements of the latest version of AS6453, 'Fire Containment Cover – Design, Performance, and Testing Requirements'. Table 1 summarises these flammability requirements; however, refer to the most recent version of AS6453 for additional information and the order of testing required.

Note: The applicable requirements can also be found in Chapters 1, 2 and 3 of the FAA *Aircraft Materials Fire Test Handbook*, available at https://www.fire.tc.faa.gov/Handbook.

Table 1: Summary of Flammability Requirements for ULDs and FRCs

Article/Component:	Vertical Bunsen Burner Test *(12-second test)*	45-degree Bunsen Burner Test	Horizontal Bunsen Burner Test *(2.5-inch/minute burn rate criteria)*
ULD side panels, rigid doors, non-metallic pallets and ceilings	X	X	
ULD curtain-style doors	X		
ULD nets			X
ULD nets compatible with FCCs	X		
Non-metallic ULD pallets compatible with FCCs	X	X	

3.3 Failure Condition Classification

N/A

4 Marking

4.1 General

Marking is detailed in CS-ETSO Subpart A, paragraph 1.2. Marking shall be done in an area that will typically remain visible after the ULD is loaded with cargo.

4.2 Specific

The following list applies to all ULDs.

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

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 AS36100, Revision C, paragraph 3.5, for Type 2 ULDs.
2. If the article is not omnidirectional, the words ‘FORWARD’, ‘AFT’, and ‘SIDE’ must be conspicuously and appropriately placed.
3. The manufacturer’s serial number of the article, with the option to add the date of manufacture.
4. If applicable, the expiry date in the format ‘EXP YYYY-MM’ must be marked on the ULD.

ULDs additionally classified as FRCs: FRCs must also be marked as per the requirements in paragraphs 5.1.a, 5.1.c, and 5.2 to 5.4 of AS8992.

Nets and Pallets Compatible for Use with Fire Containment Covers: refer to AS6453, 'Fire Containment Cover – Design, Performance, and Testing Requirements', which describes testing requirements for pallets and nets that are operationally suited for use with an Fire Containment Cover (FCC) approved under ETSO-C203 A1 and SAE AS6453. If the pallet or net meets the testing requirements given in that standard, it may be marked under this ETSO as follows:

1. Net: 'FIRE CONTAINMENT COMPATIBLE WITH SAE AS6453 CERTIFIED FIRE COVER' in bold characters at least 40 mm (1.6 in) high;
   Note: Include the revision number of SAE AS6453 in the marking.
2. Pallets (non-metallic): 'FIRE CONTAINMENT COMPATIBLE' in legible characters.

5 Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]
[Amdt ETSO/18]

Appendix 1 to ETSO-C90e — CARGO PALLETS, NETS AND CONTAINERS (UNIT LOAD DEVICES)

Purpose: This Appendix prescribes the MPS for Type I ULDs. The applicable standard is AIA NAS 3610, Revision 10, 'Specifications for Cargo Unit Load Devices, dated 1 November 1990, as modified by this Appendix.

When reading NAS 3610, Revision 10 …	Do the following
Paragraph 3.5	Replace with Section 4 of this ETSO for marking requirements
Paragraph 3.7	Replace with paragraph 3.2 of this ETSO
Sheet 87, Figure 31	Use the revised Figure 31 from sheet 88
Figure 32 (missing from NAS 3610, Revision 10)	Use Figure 32 of NAS 3610, Revision 9, dated November 1987, or NAS 3610, Revision 8, dated September 1987

[Amdt ETSO/18]

Appendix 2 to ETSO-C90e — CARGO PALLETS, NETS AND CONTAINERS (UNIT LOAD DEVICES)

Purpose: This Appendix prescribes the MPS for Type 2 ULDs. The applicable standard is SAE AS36100, 'Air Cargo Unit Load Devices – Performance Requirements and Test Parameters', Revision C, dated September 2020, as modified by this Appendix.

When reading AS36100C …	Do the following
Paragraphs 1.1–1.2	Disregard
Paragraph 4.5	Replace with Section 4 of this ETSO for marking requirements
Paragraph 4.6	Disregard
Paragraph 4.7	Replace with paragraph 3.2 of this ETSO
Section 6	Disregard

[Amdt ETSO/18]

Appendix 3 to ETSO-C90e — CARGO PALLETS, NETS AND CONTAINERS (UNIT LOAD DEVICES)

Purpose: This Appendix prescribes the MPS for Type 1 and Type 2 ULDs, including those classified as FRCs. The applicable standard is SAE AS36102B, 'Air Cargo Unit Load Devices — Testing Methods', dated March 2017, as modified by this Appendix.

When reading AS36102B …	Do the following
Paragraph 4.1.2	Replace the word 'should' with 'shall'
Paragraph 4.2.5	
Paragraph 4.3.5	
Paragraph 4.4.7	
Paragraph 6.2	
Paragraph 6.2.6	Replace the wording of the paragraph with the following: 6.2.6 Test r*esults* A description of the results of each of the tests performed, with actual load, the location of CG and how long the ULD was held clear of support, supported by exhaustive photographic and video proof, evidence of any deformations and damage, and references to any drawings and/or pictures of test arrangements.

[Amdt ETSO/18]

Appendix 4 to ETSO-C90e — CARGO PALLETS, NETS AND CONTAINERS (UNIT LOAD DEVICES)

Purpose: This Appendix prescribes the MPS for FRCs. The applicable standard is SAE AS8992, 'Fire Resistant Container Design, Performance, and Testing Requirements', dated October 2020, as modified by this Appendix.

When reading AS8992 …	Do the following
Note to paragraph 3.1.2	Disregard
Paragraph 3.3.4	Disregard
Paragraph 3.3.5	Disregard
Paragraph 3.4	Disregard
Section 5	ULDs classified as FRCs must meet the marking requirements of this section in addition to those of paragraphs 4.1 and 4.2 of this ETSO. Disregard paragraph 5.1.b of AS8992, as it duplicates paragraphs 4.1 and 4.2 of this ETSO.

[Amdt ETSO/18]

ETSO-C96c A1

ANTICOLLISION LIGHT SYSTEMS

1 Applicability

This ETSO provides the requirements that anticollision light systems that are designed and 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

The 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

The applicable standard is that provided in Society of Automotive Engineers, Inc., (SAE) Aerospace Standard AS8017D 'Minimum Performance Standard for Anticollision Light Systems', dated August 2017, as modified by Appendix 1 to this ETSO.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

3.2.2 Others

Note: AS8017D does not reflect the impact of updates to Certification Specifications published after 15 August 2017, such as CS-23 Amendment 5.

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

The following information shall be legibly and permanently marked on the major equipment components:

(a) Class I, II, III or IV (refer to SAE AS8017D and Appendix 1 to this ETSO).

(b) Nominal power input rating.

5 Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3

[Amdt ETSO/13]
[Amdt ETSO/17]
[Amdt ETSO/18]

Appendix 1 to ETSO-C96c A1 — ANTICOLLISION LIGHT SYSTEMS

A.1 In Section 1.2 of SAE Aerospace Standard AS8017D 'Minimum Performance Standard for Anticollision Light Systems', dated August 2017, below the row defining Class III, add a new row defining Class IV:

'Class IV — Fixed Wing Aircraft 400 Candelas with reduced elevation angle.'

Below the lines defining the different classes in Section 1.2 of SAE AS8017D 'Minimum Performance Standard for Anticollision Light Systems', dated August 2017, add the following:

'The requirements for a Class IV anticollision light system are as for a Class II anticollision light system, except that there is no intensity requirement for angles above or below the horizontal plane which are greater than 30°.'

A.2 In Section 1.2.1 of SAE Aerospace Standard AS8017D 'Minimum Performance Standard for Anticollision Light Systems', dated August 2017, remove the statement:

'Anticollision lights for fixed wing aircraft must meet requirements for Class III lights if certificated prior to August 11, 1971, and the requirements for Class II lights if certificated after that date.'

A.3 In Section 3.1, add a new Section 3.1.4, 'Effective Intensity Variation', containing the following text: 'For any angle (up to 30°) above or below the horizontal plane, the difference between the minimum and maximum effective intensity for different azimuths shall be less than 25 % of the maximum intensity.'

A.4 In Section 3.2, add a new Section 3.2.4, 'Effective Intensity Variation', containing the following text: 'For any angle (up to 75°) above or below the horizontal plane, the difference between the minimum and maximum effective intensity for different azimuths shall be less than 25 % of the maximum intensity.'

A.5 In Section 3.3, add a new Section 3.3.4, 'Effective Intensity Variation', containing the following text: 'For any angle (up to 30°) above or below the horizontal plane, the difference between the minimum and maximum effective intensity for different azimuths shall be less than 25 % of the maximum intensity.'

A.6 In Section 3.4 of SAE Aerospace Standard AS8017D 'Minimum Performance Standard for Anticollision Light Systems', dated August 2017, replace the statement:

'Caution: compliance only to the alternate colour definitions detailed in Section 3.4.1 (without compliance to the CFR requirements) will require an Equivalent Level of Safety Finding by the Federal Aviation Administration in order to allow installation of the lights on certified aircraft.'

With the following revised statement:

'Caution: compliance only to the alternate colour definitions detailed in Section 3.4.1 (without compliance to the CS requirements) may require an Equivalent Level of Safety Finding in order to approve the installation of the lights on certified aircraft.'

[Amdt ETSO/17]
[Amdt ETSO/18]

ETSO-C112f

SECONDARY SURVEILLANCE RADAR MODE S TRANSPONDER

1 Applicability

This ETSO provides the requirements which Secondary Surveillance Radar Mode S Transponder that are designed and 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-73F / RTCA DO-181F, 'Minimum Operational Performance Standards for Secondary Surveillance Radar Mode S Transponders', dated December 2020, as modified by Change 1, dated January 2022, and as amended by Appendix 1 to this ETSO.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

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 resulting in misleading information is a major failure condition.

Failure of the function defined in paragraph 3.1.1 of this ETSO resulting in a lack of responses to valid interrogations to a degree sufficient to create potential for a missing resolution advisory (RA) is a major failure condition.

Failure of the function defined in paragraph 3.1.1 of this ETSO resulting in any of the below is a major failure condition:

- replies sent with incorrect timing;
- replies sent with an incorrect altitude;
- transmission of incorrect information to a connected collision avoidance system.

Failure of the function defined in paragraph 3.1.1 of this ETSO resulting in annunciated loss of function is a minor failure condition.

4 Marking

4.1 General

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

4.2 Specific

The marking must also include the transponder's functional level and optional additional features as provided in ED-73F, Section 1.4.2.2, as well as minimum peak output power identified by the transponder class as defined in ED-73F, Section 1.4.2.4.

5 Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]
[Amdt ETSO/18]

Appendix 1 to ETSO-C112f — Secondary Surveillance Radar Mode S Transponder Amendment to EUROCAE ED-73F / RTCA DO-181F requirements

Purpose

This Appendix lists the modifications to EUROCAE ED-73F / RTCA DO-181F, 'Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment', as modified by Change 1. To enhance readability, sections of EUROCAE ED-73F / RTCA DO-181F that are modified by Change 1 are shown with the modifications implemented as the baseline text. Text added to modify EUROCAE ED-73F / RTCA DO-181F is underlined. Text to be removed is struck through. In between the sections an ellipsis, '[…]', is introduced to indicate that the rest of the text is unchanged. For easy reading, all cross references are provided to EUROCAE ED-73F sections. Due to the extensive modifications, Section 5.5.8.36 is included as a complete change.

[…]

3.23.1.12.e.(3) Updating of the Data Link Capability Report

The maximum update interval at which Register 10_{16} shall be reloaded with valid data is ≤ 1.0 seconds.

NOTE: *Effectively, Register 10_{16} must be updated every 1.0 seconds or sooner.*

If a particular data field in Register 10_{16} cannot be updated within 8.0 seconds, the data field shall be set to ZERO, with the exception of the following CAS version and capability fields: CAS Extended Version Number (Bit # 43 – 46 or MB Bit # 11 – 14), Hybrid Surveillance Capability (Bit # 69 or MB Bit # 37), CAS RA Capability Enabled (Bit # 70 or MB Bit # 38), and CAS Version (Bit # 71 – 72 or MB Bit # 39 – 40).

At intervals not exceeding four seconds, the transponder compares the current basic data link capability status with that last reported and if a difference is noted, initiates a revised basic data link capability report by Comm-B broadcast for BDS1=1 and BDS2=0.

The transponder shall initiate, generate and announce the revised basic data link capability report even if the aircraft data link capability is degraded or lost. To support this requirement, the transponder shall set the BDS for the basic data link capability report.

NOTE: *The setting of the BDS code by the transponder ensures that a broadcast change of the capability report will contain the BDS code for all cases of data link failure (e.g. the loss of the transponder data link interface).*

[…]

3.27.1.2 b.(1) Data Link Capability Codes in MB for All Transponder/CAS Systems

The following bits of the Data Link Capability report are allocated to providing information about the CAS system on the aircraft.

Bit #	MB #	Field	Notes
43	11	CAS Extended Version Number	1
44	12		
45	13		
46	14		
48	16	CAS Out of Standby	2
69	37	Hybrid Surveillance Capability	3
70	38	CAS RA Capability Enabled	4
71	39	CAS Version	5
72	40		

Notes:

1. *CAS Extended Version Number will be 0000 for all versions of TCAS. The definition of this field is as follows:*

Bits 43 – 46 'MB' Bits 11 – 14	Meaning
0000	Non-extended version
0001	ACAS Xa version 1
0010	ACAS Xu version 1
0011 – 1111	Reserved for future versions

2. *CAS Out of Standby, Bit 48 ('MB' bit 16), set to ONE (1) indicates that the both the transponder & CAS functions are operational and the transponder is receiving RI=1, 2, or 3 from the CAS unit. Transponders will only receive RI=1 from CAS that are Active CAS of junior status or passive CAS, i.e. CAS with reduced capability that are limited when interacting with other CAS.*

3. *Hybrid Surveillance Capability, Bit 69 ('MB' bit 37), set to ONE (1) indicates capability of Hybrid Surveillance, and set to ZERO (0) indicates that there is no Hybrid Surveillance capability.*

4. *CAS RA Capability Enabled, Bit 70 ('MB' bit 38), is only relevant if CAS Out of Standby is a ONE (1). This field set to ONE (1) indicates that the CAS is currently capable of generating RAs. This field set to ZERO (0) indicates that CAS is not currently capable of generating RAs. In some systems, such as TCAS and ACAS Xa, this means that the system is currently only able to generate TAs. For other systems, such as ACAS Xu, this means that the system is not currently capable of generating Remain Well Clear (RWC) alerting and guidance.*

5. *CAS Version, Bits 71, 72 ('MB' bits 39, 40), are encoded in accordance with the following table. Note that unlike most other fields in a BDS Register, the MSB of this field is the higher numbered bit.*

Bit 72 'MB' Bit 40	Bit 71 'MB' Bit 39	Meaning
0	0	DO-185 (TCAS 6.04A) (ETSO-C119a)
0	1	DO-185A (TCAS 7.0) (ETSO-C119b)
1	0	EUROCAE ED-143 (TCAS 7.1) (ETSO-C119c – TSO-C119e)
1	1	See CAS Extended Version Number

If the transponder / CAS are no longer communicating or if a failure of the CAS system is detected by the transponder, the transponder **shall** set ~~all CAS related bits in the Data Link Capability report~~ CAS Out of Standby (Bit # ~~43, 44, 45, 46,~~ 48~~, 69, 70, 71, & 72~~ or MB Bit # ~~11, 12, 13, 14,~~ 16~~, 37, 38, 39, & 40~~) to ZERO (0).

Interrogators, such as ground based Mode S sensors, learn of the specific data link capabilities on board the aircraft by using the Data Link Capability Report protocol specified in §3.23.1.12 e.

The data bits discussed here reside in the MB field of the Data Link Capability Report. The transponder inserts these bits such that the data appears appropriately in response to a request for Data Link Capability Report when BDS1=1 and BDS2=0. As such, these data bits comprise only a small fraction of the entire Data Link Capability Report which may collate data from multiple sources for transfer in the downlink. Care must be taken to ensure that the data fields discussed in the following paragraphs are not compromised when other sources attempt to update the Data Link Capability Report, and that updating of these bits does not compromise other parts of the Data Link Capability Report.

3.27.1.2 b.(2) Data Link Capability Codes in MB for Systems Loaded Directly by CAS

The following guidance applies to all 'loaded directly by CAS' (as defined in §3.27.f) transponder/CAS.

In this system, the CAS unit will directly provide the data necessary to set all of the CAS related bits in the Data Link Capability Report (Bit # 43, 44, 45, 46, 48, 69, 70, 71, & 72 or MB Bit # 11, 12, 13, 14, 16, 37, 38, 39, & 40). The transponder **shall** set the bits in the Data Link Capability Report as provided by the CAS, except when a failure is detected as specified in §3.27.2.3. None of the other bits in this register are to be affected by the loading of these bits by CAS.

[…]

3.27.2.3 CAS Failure Data Handling

When a CAS failure is detected, the transponder shall perform the following:

- Set RI (see §3.27.1.5) to ZERO.
- Set SL (see §3.18.4.35) to ZERO.
- Set BDS 1,0 bit~~s 11-14,~~ 16~~, 37-40~~ to ZERO.
- Set BDS 0,F and 3,2 through 3,F to ZERO.
- ~~Set BDS E,5 and E,6 to ZERO.~~
- Set BDS 3,0 and 3,1 to zero when the RAT field (§3.27.1.2 ~~c~~a) is ~~ZERO~~ONE.

Notes:

1. *Ways in which the transponder detects a CAS failure include, but are not limited to~~: (a) non-operational CAS (§3.27.1.5); (b)~~ a failure of the CAS/transponder interface (§3.27.2.2). The reception of RI=0 with SL=1 indicates that the CAS is in standby and is not considered to be a failure condition.*

2. *A CAS failure during an active RA will trigger RA termination (RAT=1). The frozen RA report will be retained while RAT=1 and set to ZERO upon RAT expiration.*

[…]

3.31.3 Update Interval

a. The maximum update interval at which a data field in a Register will be reloaded with valid data is defined for each register in Table B-2-1 in Appendix B.

b. The transponder will load valid data into the related transponder Register as soon as it becomes available at the Mode S Specific Services Entity.

c. The time between availability of data that causes a change in a data field of a Register and the time that the change is made to the Register will be less than the maximum update interval specified in Table B-2-1 in Appendix B.

d. If a data field cannot be updated with valid data within twice the specified maximum update interval defined for the Register or 2.6 seconds (whichever is the greater), then Status Bit (if specified) of the field will be set to ZERO (~~'0'~~ (INVALID) and that data field will be ~~ZERO~~zeroed.

[…]

5.5.8.34 Procedure #30: Sensitivity Level Operation (§3.27.1.5)

This test verifies that the transponder receives sensitivity level information from the CAS unit and correctly reports this information in outgoing DF=0, 16 replies.

Note: *When the following tests are performed with a EUROCAE 143 (or later) transponder/CAS interface, bit=48 of the Data Link Capability Report must be set consistent with the RI field specified for the test (see §3.27.1.2.b).*

a. Send a status = 'Active CAS with resolution capability' and a sensitivity level=6 to the transponder via the transponder/CAS interface.

Interrogate the transponder with a UF=0 and a UF=16 non-acquisition interrogation.

Show that the transponder correctly reports the CAS status and sensitivity level in the RI and SL fields respectively.

b. Not used.

c. Not used.

d. Send a sensitivity level=4 to the transponder via the transponder/CAS interface. Interrogate the transponder with a UF=0 and a UF=16 non-acquisition interrogation.

Show that the transponder correctly reports the CAS status and sensitivity level in the RI and SL fields respectively.

e. Send a status = 'CAS with resolution capability inhibited' and a sensitivity level=2 to the transponder via the transponder/CAS interface.

Interrogate the transponder with a UF=0 and a UF=16 non-acquisition interrogation.

Show that the transponder correctly reports the CAS status and sensitivity level in the RI and SL fields respectively.

f. Send a status = 'No operating CAS' and a sensitivity level=1 to the transponder via the transponder/CAS interface.

Interrogate the transponder with a UF=0 and a UF=16 non-acquisition interrogation.

Show that the transponder correctly reports the CAS status and sensitivity level in the RI and SL fields respectively (RI=0, SL=1).

g. Send a status = 'Active CAS of junior status with resolution capability or Passive CAS with resolution capability' and a sensitivity level=3 to the transponder via the transponder/CAS interface.

Interrogate the transponder with a UF=0 and a UF=16 non-acquisition interrogation.

Show that the transponder correctly reports the CAS status and sensitivity level in the RI and SL fields respectively.

[…]

5.5.8.36.2 Procedure #32: Transmission of CAS Capability Information to a Mode S Sensor (§3.27.g, §3.27.1.2.b, §3.27.1.2.b.1, and §3.27.1.2.b.2) and to other CAS Aircraft (§3.27.1.5) for a Transponder Capable of Being Loaded Directly by CAS

a. Enable the transponder only (i.e. establish the state where the transponder/CAS interface is not operational).

b. Interrogate the transponder with a non-acquisition UF=0 interrogation.

Show that the transponder replies with the correct capability information in the DF=0 reply (i.e. RI=0).

c. Interrogate the transponder with the following four interrogations:

UF=4 with RR=17 and DI≠7;

UF=5 with RR=17 and DI≠7;

UF=20 with RR=17, DI=7, and RRS=0;

UF=21 with RR=17, DI=7, and RRS=0.

Show, in each of the four cases, that the transponder replies with the correct capability information in the DF=20, 21 replies (i.e. BDS1=1, BDS2=0, bits 43 – 46 = 0000, bit 48=0, ~~bits 69, 70, 71 and 72 =0000~~ and bits 69 – 72 = 0000). ~~Additionally show that in each of the four cases bits 43, 44, 45 and 46 = 0000.~~

d. Establish the transponder/CAS interface. Repeat the procedures in steps b and c above for each of the following ~~32~~ cases ~~in substep (1a), (1b), (2a), (2b), (3a), (3b), (4a), and (4b) below~~. For each case use the following values for validating that the CAS version is correctly reported in the Data Link Capability Report:

DO-185A TCAS:	Bits 43 – 46: 0000, Bits 71, 72: 10
DO-185B / ED-143 TCAS:	Bits 43 – 46: 0000, Bits 71, 72: 01
DO-385 / ED-256 ACAS Xa:	Bits 43 – 46: 0001, Bits 71, 72: 11
DO-386 / ED-275 ACAS Xu:	Bits 43 – 46: 0010, Bits 71, 72: 11

(1) CAS reports (RI=2) and reports bit 48=1, bit 69=1 and bit 70=0 in its Data Link Capability Report information to the transponder via the transponder/CAS interface.

Show that the transponder replies with RI=2 in the DF=0 reply.

Show that the transponder replies with bits 43 – 46, 71 and 72 reporting the correct CAS version, bit 48=1, bit 69=1 and bit 70=0 in the DF=20, 21 replies.

(2) CAS reports (RI=3) and reports bit 48=1, bit 69=0 and bit 70=1 in its Data Link Capability Report information to the transponder via the transponder/CAS interface.

Show that the transponder replies with RI=3 in the DF=0 reply.

Show that the transponder replies with bits 43 – 46, 71 and 72 reporting the correct CAS version, bit 48=1, bit 69=0 and bit 70=1 in the DF=20, 21 replies.

(3) CAS reports RI=0 and reports bit 48=0, bit 69=1, and bit 70=0 in its Data Link Capability Report information to the transponder via the transponder/CAS interface.

Show that the transponder replies with RI=0 in the DF=0 reply.

Show that the transponder replies with bits 43 – 46, 71 and 72 reporting the correct CAS version, bit 48=0, bit 69=1 and bit 70=0 in the DF=20, 21 replies.

[…]

5.5.8.37.1 Procedure #33: CAS or transponder/CAS Interface Failure During Transmission of RA Report and Data Link Capability Report to a Mode S Sensor (§3.27.1.2 a (2) and §3.27.1.2 b (2) for a Transponder Operating with an RTCA DO-185A or EUROCAE ED-143 or EUROCAE ED-256 compatible CAS

For each of the CAS versions use the following values to validate that the CAS version is correctly reported in the Data Link Capability Report:

DO-185A TCAS: Bits 43 – 46: 0000 , Bits 71, 72: 10

DO-185B TCAS: Bits 43 – 46: 0000 , Bits 71, 72: 01

ED-256 ACAS Xa: Bits 43 – 46: 0001 , Bits 71, 72: 11

a. Send the following content for the RA report to the transponder via the transponder/CAS interface once per second for 5 seconds.

BDS	Bits 41 – 58	RAI	Bits 60 – 88
48	0101010101010101	0	11001100110011001100110011001

During the 5th second, cause the CAS unit to report a CAS failure to the transponder ~~(i.e. RI=0 and SL=1)~~.

Interrogate the transponder once per second during the 5 seconds described above and for an additional 25 seconds (30 seconds total) with UF=4 interrogations with RR=19, DI=7, and RRS=0 and with UF=4 interrogations with RR=19, DI=7, and RRS=1.

Show that in the DF=20 RA report replies:

For the first 23 ±1 seconds, the ~~'ACAS Resolution report available code'~~ 'TCAS bit' is set in the DR field. Thereafter, it is cleared.

For the first 5 seconds, the RA Report has the following content:

BDS	Bits 41 – 58	RAT	Bits 60 – 88
48	Same as input	0	Same as input

BDS	Bits 41 – 88
49	0

For the next 18 ±1 seconds, the content is:

BDS	Bits 41 – 58	RAT	Bits 60 – 88
48	Same as input	1	Same as input

BDS	Bits 41 – 88
49	0

For the remaining 7 ±1 seconds, the values are:

BDS	Bits 41 – 58	RAT	Bits 60 – 88
48	000000000000000000	0	0000000000000000000000000000

BDS	Bits 41 – 88
49	0

b. Repeat the steps in step 'a', except during the 5th second, cause the transponder to recognize a failure on the transponder/CAS interface (i.e. disconnect or otherwise interrupt the interface). The results should be the same as in step 'a'.

c. Send 'Active CAS with resolution capability' (RI=3), CA operational = 1, hybrid surveillance capability, and the CAS version to the transponder via the transponder/CAS interface for 5 seconds.

During the 5th second, cause the ~~transponder to recognize a failure on the transponder/CAS interface (i.e. disconnect or otherwise interrupt the interface)~~ CAS unit to report a CAS failure to the transponder.

Interrogate the transponder once per second for 30 seconds with UF=4 interrogations with RR=17, DI 7 and RRS=0.

Show that in the DF=20 Data Capability Report replies:

For the first 5 seconds, bits 43, 44, 45, 46, 71 and 72 indicate the correct CAS version, bit 48=1, bit 69=1, and bit 70=1.

For the next 25 seconds, ~~bits 43, 44, 45, 46, 48, 69, 70, 71, and 72 all = 0~~ bits 43 – 46, 71 and 72 indicate the correct CAS version, bit 48=0, bit 69=1 and bit 70=1.

d. Repeat steps a., b. and c., this time using the following content as input:

BDS	Bits 41 – 58	RAI	Bits 60 – 88
48	101010101010101010	0	00110011001100110011001100110

The results should be the same as in test steps a., b. and c.

5.5.8.37.2 Procedure #33: CAS or transponder/CAS Interface Failure During Transmission of RA Report and Data Link Capability Report to a Mode S Sensor (§3.27.1.2 a (2) and §3.27.1.2 b (2)) for a Transponder Operating with an EUROCAE ED-275/RTCA DO-386 Compatible ACAS Xu

a. Send the following content for the RA report to the transponder via the transponder/CAS interface once per second for 5 seconds:

Part 1 of RA report: Content for BDS register 30_{16}

BDS	Bits 41 – 58	RAI	Bits 60 – 88
48	010101010101010101	0	11001100110011001100110011001

Part 2 of RA report: Content for BDS register 31_{16}

BDS	Bits 41 – 88
49	000111000111000111000111000111000111000111000111

During the 5th second, cause the CAS unit to report a CAS failure to the transponder ~~(i.e. RI=0 and SL=1)~~.

Interrogate the transponder once per second during the 5 seconds described above and for an additional 25 seconds (30 seconds total) with UF=4 interrogations with RR=19, DI=7, and RRS=0 and with UF=4 interrogations with RR=19, DI=7, and RRS=1.

Show that in the DF=20 RA report replies:

For the first 23 ±1 seconds, the ~~'ACAS Resolution report available code'~~ 'TCAS bit' is set in the DR field. Thereafter, it is cleared.

For the first 5 seconds, the RA Report has the following content:

BDS	Bits 41 – 58	RAT	Bits 60 – 88
48	Same as input	0	Same as input

BDS	Bits 41 – 88
49	Same as input

For the next 18 ±1 seconds, the content is:

BDS	Bits 41 – 58	RAT	Bits 60 – 88
48	Same as input	1	Same as input

BDS	Bits 41 – 88
49	Same as input

For the remaining 7 ±1 seconds, the values are:

BDS	Bits 41 – 58	RAT	Bits 60 – 88
48	00000000000000000	0	00000000000000000000000000000

BDS	Bits 41 – 88
49	00000000000000000000000000000000000000000000000

b. Repeat the steps in step 'a', except during the 5th second, cause the transponder to recognize a failure on the transponder/CAS interface (i.e. disconnect or otherwise interrupt the interface). The results should be the same as in step 'a'.

c. Send 'Active CAS with resolution capability' (RI=3), CA operational = 1, ~~no~~ hybrid surveillance capability, and CAS of ACAS Xu version 1 to the transponder via the transponder/CAS interface for 5 seconds.

During the 5th second, cause the ~~transponder to recognize a failure on the transponder/CAS interface (i.e. disconnect or otherwise interrupt the interface)~~ CAS unit to report a CAS failure to the transponder.

Interrogate the transponder once per second for 30 seconds with UF=4 interrogations with RR=17 and DI=7.

Show that in the DF=20 Data Capability Report replies:

For the first 5 seconds, bits 43, 44, 45, and 46 ~~are~~ ='0010', bit 48=1, and bits 69, 70, 71, and 72='1111'.

For the next 25 seconds, ~~bits 43, 44, 45, 46, 48, 69, 70, 71, and 72 all = 0~~ bits 43 – 46='0010', bit 48=0, and bits 69 – 72='1111'.

d. Repeat steps a., b. and c., this time using the following content as input:

Part 1 of RA report: Content for BDS register 30_{16}

BDS	Bits 41 – 58	RAI	Bits 60 – 88
48	101010101010101010	0	0011001100110011001100110011

Part 2 of RA report: Content for BDS register 31_{16}

BDS	Bits 41 – 88
49	111000111000111000111000111000111000111000111000

The results should be the same as in test steps a., b. and c.

[…]

5.8 Generic Register XX Test Procedures (§3.31)

Introduction:

The following general test procedure is intended to provide guidelines for minimal verification that newly implemented GICB registers are properly being serviced. This test procedure is not intended for Extended Squitter registers; tests for Extended Squitter are included in EUROCAE ED-102B as modified by Change 1.

5.8.1 Purpose and Definition (§3.31.1)

NOTE: *In the following subsections, '**ddd**' means the decimal equivalent to **XX**$_{16}$. For instance, for 40_{16}, '**ddd**' = 64_{10} = 64.*

For any newly added given Register **XX**$_{16}$, refer to Appendix B, Table B-3-**ddd** for appropriate format and definition of the register.

5.8.2 Data Requirement (§3.31.2)

a. Ensure that no data is being provided to the transponder that could be used to fill any field in the Register **XX**$_{16}$ that is being tested.

b. Interrogate the transponder using GICB protocols as specified in §3.23.1.12.

NOTE 1: *See §5.7.7.1.a and b as example interrogations used to extract Register 60_{16}.*

c. Verify that the transponder replies with a DF=20 reply with all externally provided data in Bits 33 through 88 (bits 1 through 56 of the 'MB' field) set to ALL ZERO (0).

NOTE 2: *Some registers are required to fill bits 1 through 8 with the Register Number, e.g. **XX**$_{16}$. In such cases, bits 1 through 8 of the 'MB' field will contain the Register number **XX**$_{16}$ and the remaining bits (9 through 56) of the 'MB' field will be set to ZERO (0).*

5.8.2.1 Data Field 'y' (§3.31.2.1)

a. Via an appropriate interface, provide the transponder with appropriate valid data for each parameter '**y**' in Register **XX**$_{16}$ that is to be tested.

b. Interrogate the transponder using GICB protocols as ~~specified~~ described in §3.23.1.12.

NOTE: *See §5.7.7.1.a and b as example interrogations used to extract Register 60_{16}.*

c. For each '**y**' parameter, verify that the transponder replies with an 'MB' field having:

(1). Each '**y**' parameter encoded in the proper register location.

(2). Each '**y**' parameter encoded in two's complement arithmetic unless otherwise specified.

(3). Each '**y**' parameter value properly rounded to preserve accuracy of ±½ LSB.

(4). Status bit for each applicable '**y**' parameter set to ONE (1) if data is valid and set to ZERO (0) if data is invalid.

5.8.3 Update Rate (§3.31.3)

Change the data provided to the transponder and repeat the interrogation given in §5.8.2.1.b as necessary to complete the following steps:

a. For each '**y**' parameter, verify that the data changes to the appropriate value required in §5.8.2.1.c within the maximum update interval time specified in Appendix B, Table B-2-1 for the given Register **XX_{16}** being tested.

b. If the appropriate value required in 'a' above cannot be realized within twice the maximum update interval time specified or ~~2~~ 2.6 seconds (whichever is greater), verify that the parameter '**y**' subfield and its associated status bit is set to ALL ZERO (0).

5.8.4 Service Reporting (§3.31.4)

Change the data provided to the transponder and repeat the interrogation given in §5.8.2.1.b as necessary to complete the following steps:

a. Verify that the servicing of Register **XX_{16}** during the power-on cycle of the transponder is properly reported in Registers 18_{16} through $1C_{16}$ as required in Appendix B, Table B-3-24 to Table B-3-28.

b. Verify that the real-time (not just since power-on) servicing of Register **XX_{16}** is properly reported in Register 17_{16} (see Appendix B, Table B-3-23) if such reporting is required for Register **XX_{16}**.

c. Verify that an appropriate Comm. – B Broadcast is initiated if a change to Register **XX_{16}** forces a change to Register 10_{16}.

Note: *See §5.7.7.2.b.(2) as an example of validating presence of the Broadcast using Register 60_{16}.*

d. Extract the Broadcast and verify that the contents of Register 10_{16} have been changed in accordance with the change action affecting Register **XX_{16}** under test.

Note: *See §5.7.7.2.g as an example of validating the Broadcast using Register 60_{16} as the register forcing the change to Register 10_{16}.*

5.8.5 Register XX_{16} – Repeat §5.8.1 through §5.8.4 using Extended Data Source Extraction with 'DI' = 3 (§3.31)

Note: *The following procedure uses XY to define the register as opposed to XX used in §5.8.*

Repeat all of §5.8.1 through §5.8.4 using the following interrogation.

Register XY_{16} GICB extraction Extended data source interrogation setup using DI=3							
1 ---- 5	6 ---- 8	9 --- 13	14 - 16	17 -- 22	23	24 – 27	28 – 32
				'SD'			

'UF' =	'PC' =	'RR' =	'DI' =	'SIS' =	'LSS' =	'RRS' =	Not Assigned =
4	**0**	**16 + X** (1X HEX)	**3**	**1**	**1**	**Y** (Y HEX)	**0**

[…]

APPENDIX B

[…]

Table B-2-1: GICB Register Number Assignments

Transponder Register Number	***Assignment***	***Implementation Reference***	***Maximum update interval*** *(Note 1)*
00_{16}	Not valid	Not defined as a specific register, however corresponding protocol used to extract AICB and Comm-B Broadcast on Level 2	N/A
01_{16}	Reserved		N/A
02_{16}	Linked Comm-B, segment 2	Level 2 with AICB Capability	N/A
03_{16}	Linked Comm-B, segment 3	Level 2 with AICB Capability	N/A
04_{16}	Linked Comm-B, segment 4	Level 2 with AICB Capability	N/A
05_{16}	Extended Squitter Airborne Position	ADS-B ([6])	0.2s
06_{16}	Extended Squitter Surface Position	ADS-B (6)	0.2s
07_{16}	Reserved (Removed from subnetwork version number 6)	ADS-B v0 – v2 (6)	N/A
08_{16}	Extended Squitter Identification and Category	ADS-B (3, 6)	15.0s
09_{16}	Extended Squitter Airborne Velocity	ADS-B (6)	1.3s
$0A_{16}$	Reserved (Removed from ADS-B v3)	ADS-B v1 and v2 (6) transmission of 61_{16}. Not for direct reading (2).	N/A
$0B_{16}$ – $0C_{16}$	Reserved (Removed from subnetwork version number 6)		N/A
$0D_{16}$ – $0E_{16}$	Reserved		N/A
$0F_{16}$	Reserved for CAS		N/A
10_{16}	Data Link Capability Report	Level 2	≤4.0s (7)
11_{16}	Data Link Capability Report (extension)	Level 2 with Basic Dataflash	5.0s
12_{16} – 16_{16}	Reserved for extension to datalink capability reports		5.0s
17_{16}	Common usage GICB Capability Report	Level 2	5.0s

Transponder Register Number	***Assignment***	***Implementation Reference***	***Maximum update interval*** *(Note 1)*
18_{16} – $1C_{16}$	Mode S Specific Services Capability Reports (GICB Capability)	Level 2	5.0s
$1D_{16}$ – $1F_{16}$	Mode S Specific Services Capability Reports (MSP Capability)	Level 2	5.0s
20_{16}	Aircraft Identification	Level 2	5.0s
21_{16}	Aircraft and airline registration markings		15.0s
22_{16}	Reserved (Removed from subnetwork version number 6)		N/A
23_{16} – 24_{16}	Reserved		N/A
25_{16}	Aircraft type		15.0s
26_{16} – $2F_{16}$	Reserved		N/A
30_{16}	CAS Active Resolution Advisory	Level 2 with CAS	1.0s (when RA active)
31_{16}	CAS Active Resolution Advisory (Part 2)		1.0s
32_{16}	Reserved for CAS		N/A
33_{16} – 37_{16}	Extended Squitter Operational Coordination Message		1.0s (when RA active)
38_{16} – $3F_{16}$	Reserved for CAS		N/A
40_{16}	Selected vertical intention	EHS (5)	1.0s
41_{16}	Next waypoint identifier		1.0s
42_{16}	Next waypoint position		1.0s
43_{16}	Next waypoint information		0.5s
44_{16} – 45_{16}	Reserved (Removed from subnetwork version number 6)		N/A
46_{16} – 47_{16}	Reserved		N/A
48_{16}	VHF channel report		5.0s
49_{16} – $4F_{16}$	Reserved		N/A
50_{16}	Track and turn report	EHS (5)	1.3s
51_{16}	Position report coarse		1.3s
52_{16}	Position report fine		1.3s
53_{16}	Air-referenced state vector		1.3s
54_{16}	Waypoint 1		5.0s
55_{16}	Waypoint 2		5.0s
56_{16}	Waypoint 3		5.0s
57_{16} – $5E_{16}$	Reserved		N/A
$5F_{16}$	Reserved (Removed from subnetwork version number 6)		N/A
60_{16}	Heading and speed report	EHS (5)	1.3s
61_{16}	Extended Squitter Aircraft Status (Subtype 1: Emergency/Priority Status)	ADS-B v1 – v3 (6)	15.0s
62_{16}	Extended Squitter Target State and Status Information	ADS-B v1 – v3 (6)	0.5
63_{16}	Extended Squitter Aircraft Status (Subtype 4: UAS/RPAS Lost Link, Current TCP)	ADS-B v3 (6)	1.0s

Transponder Register Number	***Assignment***	***Implementation Reference***	***Maximum update interval*** *(Note 1)*
64_{16}	Extended Squitter Aircraft Status (Subtype 4: UAS/RPAS Lost Link, Next TCP)	ADS-B v3 (6)	1.0s
65_{16}	Extended Squitter Aircraft Operational Status	ADS-B v1 – v3 (6)	2.5 s
66_{16}	IRM – Interrogation Rate Monitor	ADS-B v3 (6)	5.0s
67_{16}	IRM – Reply Rate Monitor	ADS-B v3 (6)	5.0s
68_{16}	ADS-B Wx AIREP (Subtype 0: Aircraft State)	ADS-B v3 (6)	60 s
69_{16}	ADS-B Wx AIREP (Subtype 1: Weather State)	ADS-B v3 (6)	5.0 s
$6A_{16}$	ADS-B Wx AIREP (Subtype 2: Alternate Weather State)	EHS (5) and ADS-B v3 (6)	5.0 s
$6B_{16}$	ADS-B Wx PIREP (Subtype 0: Flight Weather)	ADS-B v3 (6)	Indefinite
$6C_{16}$	ADS-B Wx PIREP (Subtype 1: Temp, Wind & Turbulence)	ADS-B v3 (6)	Indefinite
$6D_{16}$	ADS-B Wx PIREP (Subtype 2: Hazardous Weather)	ADS-B v3 (6)	Indefinite
$6E_{16}$	High Velocity and/or Altitude (Subtype 0: Position)	ADS-B v3 (6)	0.2s
$6F_{16}$	High Velocity and/or Altitude (Subtype 1: Velocity)	ADS-B v3 (6)	0.2s
70_{16}	Reserved		N/A
71_{16}	Interval Management Report	EHS (5) and IM (4)	10 s
72_{16} — DD_{16}	Reserved		N/A
DE_{16} – DF_{16}	Mode S BITE	ICAO Doc 9871 and Doc 9924	N/A
$E0_{16}$	Reserved		N/A
$E1_{16}$ – $E2_{16}$	Mode S BITE	ICAO Doc 9871 and Doc 9924	N/A
$E3_{16}$	Transponder type/part number	Recommended in European CS-ACNS AMC1 ACNS.D.ELS.015	15 s
$E4_{16}$	Transponder software revision number	Recommended in European CS-ACNS AMC1 ACNS.D.ELS.015	15 s
$E5_{16}$	CAS unit part number	Level 2 with CAS	~~15 s~~ Indefinite
$E6_{16}$	CAS unit software revision number	Level 2 with CAS	~~15 s~~ Indefinite
$E7_{16}$	Transponder Status and Diagnostics		15 s
$E8_{16}$ – $E9_{16}$	Reserved		N/A
EA_{16}	Vendor Specific Status and Diagnostics		15 s
EB_{16} – $F0_{16}$	Reserved		N/A
$F1_{16}$ – $F2_{16}$	Reserved (Removed from subnetwork version number 6)		N/A
$F3_{16}$ – FF_{16}	Reserved		N/A

NOTES *for Table B-2-1:*

1 *The term 'minimum update rate' is used in this document. The minimum update rate is obtained when data is loaded in one Register field once every maximum update interval.*

2 *Register $0A_{16}$ is not to be used for GICB or ACAS crosslink readout.*

3 *If Extended Squitter is implemented, then Register 08_{16} is not cleared or ZEROed once either Flight Identification or Aircraft Registration data has been loaded into the Register during the current power-on cycle. Register 08_{16} is not cleared since it provides information that is fundamental to track file management in the ADS-B environment. (See §2.2.5.1.11.c in RTCA DO-260C / EUROCAE ED-102B).*

4 *The maximum update interval of register 71_{16} is used to determine if new IM data is provided and when the IM data has to be reset. An empty message will be sent every 10s by the Flight-deck Interval Management (FIM) application, the reception of this message is sufficient for the transponder to declare support for the Interval Management Report in BDS 1,A and 1,7. When an IM clearance is active the FIM application will send the data every 1s for a limited period of time, as defined in DO-361A/ED-236A.*

5 *The EHS (Enhanced Surveillance) parameters are defined in European Union regulation and in ICAO Doc 7030. ~~EU 1207/2011~~Commission Implementing Regulation (EU) 2023/1770 requires the transmission of parameters. CS-ACNS indicates which registers shall or should be transmitted. ~~EU 1207/2011 requires that any information transmitted must be tested.~~*

6 *ADS-B requirements are defined by state regulations including but not limited to U.S. 14 CFR 91.225 and 91.227, European Commission Implementing Regulation ~~(EU) 1207/2011, (EU) 1028/2014, (EU) 2017/386, (EU) 2020/587~~(EU) 2023/1770 and associated CS-ACNS, Canadian Operations Specifications 609 for domestic or 610 for foreign operators and Advisory Circular AC700-009 revision 2, Australian CAO 20.18, 82.1, 82.3, 83.5, and Advisory Circular AC-21-45(v2.2).*

7 *A CAS compatible transponder populates the following CAS version and capability fields of Register 10_{16} as corresponding data is received by the CAS: CAS Extended Version Number (Bit # 43 – 46 or MB Bit # 11 – 14), Hybrid Surveillance Capability (Bit # 69 or MB Bit # 37), CAS RA Capability Enabled (Bit # 70 or MB Bit # 38), and CAS Version (Bit # 71 – 72 or MB Bit # 39 – 40). Once populated with non-zero data, these fields are not cleared or ZEROed during the current power cycle.5 The EHS (Enhanced Surveillance) parameters are defined in European Union regulation and in ICAO Doc 7030. ~~EU 1207/2011~~Commission Implementing Regulation (EU) 2023/1770 requires the transmission of parameters. CS-ACNS indicates which registers shall or should be transmitted. ~~EU 1207/2011 requires that any information transmitted must be tested.~~*

[…]

Table B-3-17: BDS Code 1,1 — Data Link Capability Report (extension)

MB FIELD

1	MSB	**PURPOSE:** To extend the reporting of data link capability of the Mode S transponder/data link installation.
2		
3		
4		1) See Table B-3-16a (BDS 1,0) Note 7.
5	BDS Code 1,1 (11_{16})	
6		2) Encoding of Monitoring bits for each Basic Dataflash Register shall be encoded as follows:
7		
8	LSB	

9	Continuation flag (see 6)	
10	Reserved	
11	MSB	BDS 4,0 (40_{16}) Selected Vertical Intent change
12	LSB	(see 2)
13	MSB	Reserved for future Basic Dataflash Register Expansion
14	LSB	(see 2)
15	MSB	Reserved for future Basic Dataflash Register Expansion
16	LSB	(see 2)
17	MSB	Reserved for future Basic Dataflash Register Expansion
18	LSB	(see 2)
19	MSB	BDS 4,8 (48_{16}) VHF Channel Report change
20	LSB	(see 2)
21	MSB	Reserved for future Basic Dataflash Register Expansion
22	LSB	(see 2)
23	MSB	Reserved for future Basic Dataflash Register Expansion
24	LSB	(see 2)
25	MSB	Reserved for future Basic Dataflash Register Expansion
26	LSB	(see 2)
27	MSB	BDS 7,1 (71_{16}) Interval Management Report
28	LSB	(see 2)
29	MSB	Reserved for future Basic Dataflash Register Expansion
30	LSB	(see 2)
31	MSB	Reserved for future Basic Dataflash Register Expansion
32	LSB	(see 2)
33	MSB	Reserved for future Basic Dataflash Register Expansion
34	LSB	(see 2)
35	MSB	Reserved for future Basic Dataflash Register Expansion
36	LSB	(see 2)
37 38 39 40	Reserved (see 3)	
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56	MSB Bit array indicating the support status of DTE 48 Sub-addresses 0 to 15 (see 4 and 5) LSB	

Monitoring Bit Encoding		
MSB	**LSB**	**Meaning**
0	0	Register is NOT monitored. (see §3.32.3.a and §3.32.4.f).
0	1	Register is monitored but there has been no update change in the register contents ~~since the last time that the register was included in a Basic Dataflash Broadcast~~. (see §3.32.3.b).
1	0	Register is monitored and data contents are changing such that the Monitoring Bits shall be toggled '10', '11', '10', etc., each time the contents change in accordance with §3.32.4.b. through §3.32.4.e.
1	1	

3) These bits remain reserved for future system expansion needs.

4) Starting from the MSB, each subsequent bit position **shall** represent the DTE sub-address in the range of 0 to 15.

5) The current status of the on-board DTE **shall** be periodically reported to the GDLP by on-board sources. Since a change in this field results in a broadcast of the capability report, status inputs **shall** be sampled at approximately one minute intervals.

6) In order to determine the extent of any continuation of the data link capability report (into those registers reserved for this purpose: register 11_{16} to register 16_{16}), bit 9 **shall** be reserved as a continuation flag to indicate if the subsequent register can be extracted by the interrogator. For example: upon detection of bit 9 = 1 in register 10_{16}, then register 11_{16} can be extracted by the interrogator. If bit 9 = 1, in register 11_{16}, then register 12_{16} can be extracted by the interrogator, and so on (up to register 16_{16}). Note that if bit 9 = 1 in register 16_{16}, then this is considered as an error condition

[Amdt ETSO/11]
[Amdt ETSO/18]

ETSO-C132b

GEOSYNCHRONOUS ORBIT AERONAUTICAL MOBILE SATELLITE SERVICES AIRCRAFT EARTH STATION EQUIPMENT

1 Applicability

This ETSO gives the requirements which Geosynchronous Orbit Aeronautical Mobile Satellite Services (AMSS) aircraft earth station equipment that is designed and 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 RTCA document DO 210D 'MOPS for Geosynchronous Orbit Aeronautical Mobile Satellite Services (AMSS) avionics' Section 2.0 dated April 19, 2000 including Change 1, dated December 14, 2000, Change 2, dated November 28, 2001, Change 3 dated September 19, 2006; Change 4, dated March 24, 2015; and Change 5, dated 26 March 2020.

AMSS aircraft earth station (AES) equipment manufactured under ETSO-C132a can be upgraded to this ETSO by replacing the Diplexer Low Noise Amplifier (DLNA) with one identified and manufactured using this ETSO.

Functionality. This ETSO's standards apply to AMSS AES equipment that provides direct worldwide communications between aircraft subnetworks and ground subnetworks using aeronautical mobile satellites in geosynchronous orbit and their ground earth stations. AMSS will support both data and voice communications between aircraft users and ground-based users, such as air route traffic control centres (ARTCC) and aircraft operators. Communication services with AMSS functions include four categories: air traffic services (ATS), aircraft operational control (AOC), aeronautical administrative communications (AAC), and aeronautical passenger communications (APC).

3.1.2 Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4.

(1) Failure of the function defined in paragraph 3.1.1 is a minor failure condition.

(2) Loss of the function defined in paragraph 3.1.1 of this ETSO is a minor failure condition. Satellite communication is a supplemental service operation, with high frequency (HF) radio required for primary communication. The loss of satellite communication is mitigated by availability of HF communications.

(3) AMSS equipment is intended for procedural airspace area operations. FAA determined the failure condition specified in paragraph 3.2.1 of this ETSO based on AMSS equipment operating as an approved long-range communication system (LRCS) in oceanic airspace area environments. Use of AMSS equipment in other operating environments (for example, high-density terminal/en-route domestic airspace) may impact equipment performance and safety considerations.

Note: Equipment authorised in accordance with this ETSO may not be approved for use in dual satellite communications (SATCOM) or dual-dissimilar SATCOM configurations if the failure condition classification for the design was ‘minor’.

4 Marking

4.1 General

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

4.2 Specific

In addition, mark the DLNA subassemblies permanently and legibly, with at least the manufacturer’s name, the subassembly part number and this ETSO number.

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/3]
[Amdt ETSO/12]
[Amdt ETSO/18]

ETSO-C159e

NEXT GENERATION SATELLITE SYSTEMS (NGSS) EQUIPMENT

1 Applicability

This ETSO provides the requirements which next generation satellite systems (NGSS) equipment that is designed and 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

The 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

The standards are those provided in EUROCAE ED-243C / RTCA DO-262F 'Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS)', dated June 2021, including Errata 1 published in September 2021, Change 1 published in September 2022 and Change 2 published in November 2023.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

The MPS allows for different equipment classes and subclasses as defined by EUROCAE ED-243C / RTCA DO-262F. There are 10 applicable equipment classes and 11 equipment subclass components identified as shown in Tables 1A, 1B and 1C and Tables 2A and 2B of this ETSO. Tables 1A and 2A show the requirements for SATCOM Short Burst Data (SBD) equipment classes and subclass components. Tables 1B and 2B show the requirements for SATCOM SwiftBroadband (SBB) equipment classes and subclass components. Table 1C shows the requirements for SATCOM Certus Broadband (CBB). The manufacturer must declare the equipment class requirements from those identified in the applicable table of this ETSO. The equipment configuration shall satisfy the relevant requirements of the EUROCAE ED-243C / RTCA DO-262F (as modified by Errata 1, Change 1 and Change 2) minimum operational performance standards (MOPS) as identified in Tables 1A, 1B and 1C, and Tables 2A and 2B of this ETSO.

Table 1A — Equipment Class Identifiers supporting SATCOM Short Burst Data (SBD)

Equipment Class Identifier	Description	Requirement
All SATCOM SBD equipment classes	All SATCOM SBD equipment produced under EUROCAE ED-243C / RTCA DO-262F, Appendix D, identified as Equipment Class AES1, AES2 or AES3	Appendix D, Sections D.2.1 and D.2.2, for requirements applicable to all SATCOM SBD equipment classes, and Section D.2.4 for the applicable test requirements
AES1	AES using a single channel Satellite Data Unit (SDU) that contains one SBD (96XX) transceiver for Aeronautical Mobile Satellite (Route) Services (AMS(R)S) data-only applications. AES1 is a Short Burst Data (SBD)-only transceiver and cannot support voice calling. A passive Low Gain Antenna (LGA) is required for use with the AES1. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix D, Figure D-13	Appendix D, Section D.2.2, for requirements specifically applicable to AES1 Appendix D, Section D.2.2.1.1 and Section D.2.4 for the applicable test requirements
AES2	AES using a single- or dual-channel SDU that contains one or two LBT (95XX) transceivers for voice and/or data applications. A passive LGA is part of the AES2 system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix D, Figure D-14	Appendix D, Section D.2.2, for requirements specifically applicable to AES2 Appendix D, Section D.2.2.1.2 and Section D.2.4 for the applicable test requirements
AES3	AES using two or more LBT (95XX) and/or SBD (96XX) transceivers for multiple-channel data and/or voice applications. A passive LGA is part of the AES3 system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix D, Figure D-15	Appendix D, Section D.2.2, for requirements specifically applicable to AES3 Appendix D, Section D.2.2.1.3 and Section D.2.4 for the applicable test requirements

Table 1B — Equipment Class Identifiers supporting SATCOM SwiftBroadband (SBB)

Equipment Class Identifier	Description	Requirement
All SATCOM SBB equipment classes	All SATCOM SBB equipment produced under EUROCAE ED-243C / RTCA DO-262F, Appendix E, identified as Equipment Class AES4, AES6 or AES7	Appendix E, Sections E.2.1 and E.2.2, for requirements applicable to all SATCOM SBB equipment classes, and Section E.2.4 for the applicable test requirements
AES4	AES using an enhanced Low Gain Antenna (ELGA). AES4 configured as a complete system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix E, Figure E-8	Appendix E, Section E.2.2, for requirements specifically applicable to AES4, including Section 2.2.1.1.1 and Section E.2.4 for the applicable test requirements

AES6	AES using a High Gain Antenna (HGA) transceiver and Diplexer Low Noise Amplifier (DLNA). AES6 is defined as an entire system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix E, Figure E-9	Appendix E, Section E.2.2, for requirements specifically applicable to AES6, including Section 2.2.1.1.2 and Section E.2.4 for the applicable test requirements
AES7	AES using an Intermediate Gain Antenna (IGA) transceiver and DLNA. AES7 is defined as an entire system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix E, Figure E-10	Appendix E, Section E.2.2, for requirements specifically applicable to AES7, including Section 2.2.1.1.3 and Section E.2.4 for the applicable test requirements

Table 1C – Equipment Class Identifiers Supporting SATCOM Certus Broadband (CBB)

Equipment Class Identifier	Description	Requirement
All SATCOM CBB equipment classes	All SATCOM CBB equipment produced under EUROCAE ED-243C / RTCA DO-262F, Appendix F, identified as Equipment Class AES8, AES9, AES10 or AES11	Appendix F, Sections F.2.1 and F.2.2, for requirements applicable to all SATCOM CBB equipment classes, and Section F.2.4 for the applicable test requirements
AES8	AES using either an omni L-Class (ALGA) or steered M-class antenna (MGA) for one carrier uplink. AES8 is configured as a complete system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix F, Table F-9	Appendix F, Section F.2.2, for requirements specifically applicable to AES8, and Section F.2.4 for the applicable test requirements
AES9	AES using either an omni L-Class (ALGA) or a steered M-Class antenna (MGA) for two sub-carrier uplinks. AES9 is configured as a complete system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix F, Table F-9	Appendix F, Section F.2.2, for requirements specifically applicable to AES9, and Section F.2.4 for the applicable test requirements
AES10	AES using a steered H-Class antenna (HGA) for one carrier uplink. AES10 is configured as a complete system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix F, Table F-9.	Appendix F, Section F.2.2, for requirements specifically applicable to AES10, and Section F.2.4 for the applicable test requirements
AES11	AES using a steered H-Class antenna (HGA) for two sub-carrier uplinks. AES11 is configured as a complete system. Also see EUROCAE ED-243C / RTCA DO-262F, Appendix F, Table F-9	Appendix F, Section F.2.2, for requirements specifically applicable to AES11, and Section F.2.4 for the applicable test requirements

Table 2A — Equipment Subclass Identifiers supporting SATCOM Short Burst Data (SBD)

Subclass Identifier	Description	Requirement

LGA	Passive LGA for use with AES1, AES2 or AES3	Appendix D, Section D.2.1, for requirements that apply to LGAs. Appendix D, Section D.2.2, for requirements applicable to all SATCOM SBD equipment Appendix D, Section D.2.2, for requirements specifically applicable to LGAs, including Section D.2.2.3.1.1

Table 2B — Equipment Subclass Identifiers supporting SATCOM SwiftBroadband (SBB)

Subclass Identifier	Description	Requirement
All SATCOM SBB equipment subclasses	All SATCOM SBB system components produced under EUROCAE ED-243C / RTCA DO-262F, Appendix E, identified as Equipment Subclass HGA, IGA, 6J, 6F, 7J, 7F, 6D, 7D, DJ or DFL.	Appendix E, Section E.2.1, for requirements applicable to equipment subclass Appendix E, Section E.2.2, for requirements applicable to all SATCOM SBB equipment Appendix E, Section E.2.2, for requirements specifically applicable to the equipment subclass, including the sections listed for each subclass in the rows below
HGA	HGA for AES6.	Appendix E, Section E.2.2.3.1.2
IGA	IGA for AES7.	Appendix E, Section E.2.2.3.1.2
6J	Transceiver for AES6, using a DJ (or, in certain conditions, DFL) DLNA and an HGA	Appendix E, Section E.2.2.1.1.4, as modified by RTCA DO-262F Errata 1
6F	Transceiver for AES6, using a DFL DLNA and an HGA	Appendix E, Section E.2.2.1.1.5
7J	Transceiver for AES7, using a DJ (or, in certain conditions, DFL) DLNA and an IGA	Appendix E, Section E.2.2.1.1.6, as modified by RTCA DO-262F Errata 1
7F	Transceiver for AES7, using a DFL DLNA and an IGA	Appendix E, Section E.2.2.1.1.7
6D	Transceiver with integrated DLNA for AES6, using an HGA	Appendix E, Section E.2.2.1.1.8
7D	Transceiver with integrated DLNA for AES7, using an IGA	Appendix E, Section E.2.2.1.1.9
DJ	Type J diplexer (DLNA) as described in ARINC-781. Configures with a 6J transceiver and an HGA for use with AES6, or a 7J transceiver and an IGA for use with AES7	Appendix E, Section E.2.2.1.1.10
DFL	Type F LTE diplexer (DLNA) as described in ARINC-781. Configures with 6F (and, under certain conditions, 6J) transceiver	Appendix E, Section E.2.2.1.1.11

Subclass Identifier	Description	Requirement
	and HGA for use with AES6, or with 7F (and, under certain conditions, 7J) transceiver and IGA for use with AES7	

This ETSO standard applies to equipment intended for long-range communication services, procedural and continental communication services, aeronautical mobile satellite (route) services (AMS(R)S) by means of satellite communications between AES, corresponding satellites, and ground earth stations (GES). The NGSS supports voice and data communications between aircraft users and ground-based users, such as air navigation service providers (ANSPs) and aircraft operators.

The functionality of an NGSS supports four categories of communication service in the aircraft control domain (ACD) and/or aircraft information services domain (AISD). Two are safety of flight communication used for air traffic services (ATS) and aeronautical operational control (AOC) communication. The other two are aeronautical administrative communication (AAC) and special-purpose aeronautical passenger communication (APC) under the physical or virtual access control of the flight crew.

EUROCAE ED-243C / RTCA DO-262F, Normative Appendix E (as modified by Errata 1) and Appendix F (as modified by Changes 1 and 2), also contain provisions for supporting a non-priority and non-safety of flight communications service known as passenger information and entertainment services (PIES). EUROCAE ED-243, Normative Appendix E, states that non-priority services are outside the scope of that Appendix. However, PIES communications, if supported, must be partitioned from communications in the ACD and AISD for security reasons. Therefore, PIES communications are non-ETSO functions, and equipment that supports shared ACD and PIES communications must provide security partitioning of the PIES functionality from priority communications services in the ACD and AISD in accordance with this ETSO.

See paragraphs 3.1.3, 3.1.4, 3.2.1 and 3.2.2 of this ETSO for specific additional data, design/security assurance and verification requirements related to the required security partitioning for equipment intended to support shared ACD/AISD and PIES communications.

NGSS equipment is intended for procedural/continental airspace area operations. The failure conditions specified in paragraph 3.2.1 of this ETSO have been determined based on NGSS equipment that supplements or complements primary HF/VHF voice or data communications in procedural/continental airspace area operations, and on equipment that provides ‘Segregation & arbitration’ as described in EUROCAE ED-243, Appendix E, Section 1.3.4, or the equivalent functionality. Use of NGSS equipment in other operating environments (for example, high-density terminal/en route airspace) may impact equipment performance and safety considerations.

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

A loss or malfunction of the functions defined in paragraph 3.1.1 of this ETSO is a minor failure condition.

A loss or malfunction of the partitioning function required by paragraph 3.2 of this ETSO is a major failure condition.

Note: The use of NGSS equipment as the sole means of routine ATS communication may change the classification of the failure conditions.

3.2.2 Threat Condition Classification

Failure of the AES, described in paragraph 3.2 of this ETSO, that enables unauthorised or inadvertent access to the ACD from outside the ACD partition is a major threat condition.

ETSO applicants can develop a specific security assessment to demonstrate the possibility of reducing the threat condition classification based on the ACD services implemented.

See CS-ETSO, Subpart A, paragraph 2.6.

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

(1) For an article produced as a complete system according to Table 3 of this ETSO (AES1-1, AES2-3, AES3-5, AES4-101, AES6-106, AES7-111, AES8-1, AES8-2, AES9-3, AES9-4, AES10-5 or AES11-6), additionally mark at least one major component of the system with the applicable valid combination for the system according to Table 3 of this ETSO.

(2) For an article produced as an individual component, additionally mark the article with the applicable Subclass Identifier according to Table 2A or Table 2B of this ETSO; or, for SBD (96XX) or LBT (95XX) transceivers, with ‘SBD’ or ‘LBT’ as applicable.

For valid combinations of system component markings, see Table 3 below.

Table 3 — Valid Combinations of System Components

Valid Combinations		DO-262F Normative Appendix	Transceiver							Transceiver & DLNA		DLNA		Antenna					Complete System
			SBD (96XX)	LBT (95XX)	BCX	6J	6F	7J	7F	6D	7D	DJ	DFL	LGA (passive)	ALGA	MGA (Steered)	HGA (Steered)	IGA	
AES1	1	D																	X
	2	D	X											X					
AES2	3	D																	X
	4	D		X										X					
AES3	5	D																	X
	6	D	X	X										X					
AES4	101	E																	X
AES6	102	E				X						X					X		
	103	E					X						X [1]				X		
	104	E								X							X		
	105	E				X							X [1]				X		
	106	E																	X
AES7	107	E						X				X						X	
	108	E							X				X [1]					X	
	109	E									X							X	
	110	E						X					X [1]					X	
	111	E																	X
AES8	1	F																	X
	2	F																	X
AES9	3	F																	X
	4	F																	X
AES10	5	F																	X
AES11	6	F																	X

([1]) Systems with DLNA-type DFL do not have blocking immunity to interfering signals in the 1 526–1 536 MHz band. These may be used in regions where this blocker is not present due to local spectrum management. See EUROCAE ED-243C / RTCA DO-262F, Appendix E, Section E.2.2.1.1.11, for a description.

Note: Also see EUROCAE ED-243C / RTCA DO-262F, Tables D-6 and E-4, and Errata 1.

5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]
[Amdt ETSO/13]
[Amdt ETSO/16]
[Amdt ETSO/18]

ETSO-C164a

NIGHT VISION GOGGLES (NVG)

1 Applicability

This ETSO gives the requirements which Night Vision Goggle (NVG) equipment that is manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 Procedures

2.1 General

Applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

None.

3 Technical conditions

3.1 Basic

3.1.1 Minimum performance standard

Standards set forth in the applicable sections of RTCA DO-275, 'Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment', dated 12/10/2001, as modified by Appendix 1 to this ETSO.

Note that the equipment is portable (battery-powered only), and does not have an interface with aircraft systems. For details on batteries, see CS-ETSO, Subpart A, paragraph 2.8.

The NVG power source shall be designed to minimise the simultaneous loss of battery power to both tubes using one of the two following methods.

a. Provide separate and independent power sources to each tube.

b. Provide the user with a visual alert of pending power loss. The time available between the alert and the actual loss of power to the tubes must be at least 30 minutes. The performance of this alert requirement shall be demonstrated to not be affected when the NVGs are operated or stored within the environmental conditions for which the equipment is qualified.

3.1.2 Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

Failure of the function (i.e. a loss of image or an inaccurate image) defined in paragraph 3.1.1 of this ETSO has been determined to be not less than major condition.

3.2.2 Manuals

a. The installation and/or operational manual shall include operating instructions and equipment limitations sufficient to describe the equipment's operational capability. Include notes with the following statements.

- 'Night vision imaging systems (NVIS) are an aid to night VFR flight. NVIS systems consist of a set of night vision goggles (NVG) and NVG compatible aircraft lighting systems. NVG compatibility with aircraft lighting is not part of this ETSO authorisation and requires separate installation approval.'
- 'CAUTION: some light-emitting diode (LED) lighting systems that are clearly visible to the naked eye are not visible to NVGs, including some red LED obstruction lights.'

See EASA Safety Information Bulletin SIB 2019-04 for additional information.

b. The maintenance manual shall include instructions covering periodic maintenance, calibration and repair to ensure that the NVGs continue to meet the ETSO-approved design. Include recommended inspection intervals and service life, as appropriate. Inspection intervals must meet the minimum requirements of RTCA DO-275.

4 Marking

4.1 General

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

4.2 Specific

If the NVG ETSO article is compatible with a Heads-Up Display (HUD), mark it with 'Modified Class B' when it implements a modified Class B filter designed to allow its use with a HUD.

5 Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/8]
[Amdt ETSO/18]

Appendix 1 to ETSO-C164a — EASA MODIFICATIONS TO RTCA DO-275 MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR INTEGRATED NIGHT VISION IMAGING SYSTEM EQUIPMENT

The following sections of RTCA DO-275 are updated with these revised standards:

[DO-275] 2.2.1.1 System Resolution

The system resolution shall be a minimum of 1.3 cycles per milliradian (cy/mrad) on-axis under optimum light conditions using a nominal 100% contrast dark bar on white background resolution target chart. At 14 degrees off-axis, the resolution shall be not less than 0.81 cycles per milliradian. If each monocular has a variable focus objective lens, then it shall focus through infinity, and at the through-infinity mechanical stop shall maintain an on-axis resolution of not less than 0.49 cycles per milliradian. If each monocular has a fixed focus objective lens, then 1.0 cycle per milliradian will be maintained at infinity.

[DO-275] 2.2.1.2 System Luminance Gain

At 1×10^{-4} footlamberts input light level, the luminance gain shall not be less than 4,000 footlamberts (fL) per footlambert. The output luminance averaged across the full field of view shall not exceed 4 footlamberts. Output brightness uniformity shall be such that the ratio of the maximum to minimum brightness variation over the useful image area shall not exceed 3:1. The ratio of luminance gain between any two channels shall not exceed 1.5.

[DO-275] 2.2.1.8 Image Cosmetic Defects (Table 2-1 Spot Criteria)

Diameter of Spots [inches]	Quantity of spots allowed within 0.22 inch diameter circle	Quantity of spots allowed within annulus bounded by 2 circles 0.22 and 0.58 inch diameter circle	Quantity of spots allowed within the annulus bounded by 2 circles 0.58 inch diameter circle and total screen diameter
> 0.009	0	0	0
0.006 - 0.009	0	1	1
0.003 - 0.006	0	2	2

Note: *The circles on the image screen, defined in the table above, shall be concentric and centred on the optical axis of the assembly. Spots smaller than* .003 *inches shall be ignored.*

[DO-275] 2.2.1.10 Halo Size

Halos shall be no greater than 1.0 mm in diameter at the output of the image intensifier tube.

[DO-275] 5.2.1 Description of Maintenance Performed

Change second paragraph to read: '… preventative maintenance (Pilot/ Crew Member performed preventative maintenance exempt from record keeping except for Removing or Installing Helmet or Headband Mounting Assembly), and alteration …'.

[DO-275] 5.4 (Table 5-1 Authorised Preventative Maintenance Allocations)

Type	**Preventive Maintenance**					
	Functional / Pre-flight Check	Battery Replacement	Cleaning with no disassembly required	Cleaning of Powered Battery Contacts	Removing or Installing Helmet or Headband Mounting Assembly	Minor Adjustments for fit, focus or other adjustments required to complete functional check
*Pilot/ Crew Member	Yes	Yes	Yes	Yes	Yes	Yes
Airframe Mechanic	Yes	Yes	Yes	Yes	Yes	Yes
Repair Station	Yes	Yes	Yes	Yes	Yes	Yes

([1]) Preventative maintenance performed by a pilot / crew member is exempt from the record-keeping requirement of Section 5.2.1 except for removing or installing Helmet or Headband Mounting Assembly.

[DO-275] 5.4.1 (Table 5-2 Additional Maintenance Allocations)

Note: In the table, change 'Pilot' to read 'Pilot /Crew Member'.

[Amdt ETSO/18]

ETSO-C166c

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

1 Applicability

This ETSO provides 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 designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 Procedures

2.1 General

Applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

None.

3 Technical conditions

3.1 Basic

3.1.1 Minimum performance standard

Standards set forth in EUROCAE ED-102B / RTCA DO-260C, 'Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B)', as modified by Change 1, issued in January 2022, and as amended by Appendix 1 to this ETSO.

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

(a) Class A equipment, consisting of transmit and receive subsystems; and

(b) Class B equipment, containing a transmit subsystem only.

Class A equipment includes Classes A0, A1, A1S, A2 and A3 as defined in EUROCAE ED-102B. This standard requires 1090 MHz airborne Class A equipment to include the capability of receiving both ADS-B and TIS-B messages and delivering both ADS-B and TIS-B reports, as well as transmitting ADS-B messages. A receive-only Class of equipment is allowed.

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

3.1.2 Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1. The required performance under test conditions is defined in EUROCAE ED-102B, Section 2.3.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

Failure of the function defined in paragraph 3.1.1 of this ETSO resulting in misleading information is a major failure condition.

Failure of the function defined in paragraph 3.1.1 of this ETSO resulting in loss of function is a minor failure condition at equipment level.

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

4 Marking

4.1 General

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

4.2 Specific

Transmitting and receiving components must be permanently and legibly marked in accordance with EUROCAE ED-102B, Section 2.1.11, 'Equipage Class Definitions', the receiving equipment type in accordance with Section 2.2.6, 'ADS-B Receiving Device Message Processor Characteristics' and Section 1.3.6 'optional additional features'.

5 Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]
[Amdt ETSO/13]
[Amdt ETSO/18]

Appendix 1 to ETSO-C166c — EASA MODIFICATIONS TO EUROCAE ED-102B / RTCA DO-260C

Purpose
This appendix lists EASA modifications to EUROCAE ED-102B / RTCA DO-260C. Text added to modify EUROCAE ED-102B / RTCA DO-260C is underlined. Text to be removed is struck through. In between the sections an ellipsis, '[…]', is introduced to indicate that the rest of the text is unchanged. For easy reading, all cross-references are provided to EUROCAE ED-102B sections. Due to the extensive modifications, Section 2.4.5.2.12 is included as a complete change. Excerpts from EUROCAE ED-102B / RTCA DO-260C are reprinted with the permission of EUROCAE and RTCA Inc. All rights reserved.

[…]

2.4.3.2.7.6.4.4 Verification of 'Wind Speed' Subfield in ADS-B Wx Weather State Messages (§2.2.3.2.7.6.4.4)

This test procedure is used to verify that the ADS-B Transmitting Subsystem correctly encodes the 'Wind Speed' subfield in the Weather State Message as a dynamic value from a variable data input.

Table 2-240: 'Wind Speed' Subfield Encoding Test Values

Coding		Meaning
(Binary)	(Decimal)	
~~0000 0000~~	~~0~~	~~NO or INVALID data~~
0000 0001	1	0 ≤ Wind Speed [kts] < 1
0000 0010	2	1 ≤ Wind Speed [kts] < 2
0000 0100	4	3 ≤ Wind Speed [kts] < 4
0000 1000	8	7 ≤ Wind Speed [kts] < 8
0001 0000	16	15 ≤ Wind Speed [kts] < 16
0010 0000	32	31 ≤ Wind Speed [kts] < 32
0100 0000	64	63 ≤ Wind Speed [kts] < 64
1000 0000	128	127 ≤ Wind Speed [kts] < 128
1111 1110	254	253 ≤ Wind Speed [kts] < 254
1111 1111	255	254 ≤ Wind Speed [kts]

Measurement Procedure:

Step 1: Conduct variable data input tests

a. Configure the ADS-B system as for installed operation

b. Power on the ADS-B system and perform start-up procedures (§2.2.3.3.2.1)

c. Operate the ADS-B system so as to broadcast Airborne Position Messages (§2.2.3.3.2.2).

d. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Wind Speed' and 'Wind Direction' subfields.

e. For each 'Wind Speed' decimal value in Table 2-240, verify that the system generates Weather State Messages with the 'Wind Speed' subfield in each such message set equal to the binary coding value corresponding to the decimal value tested.

f. Provide an updated 'Wind Speed' subfield value to the ADS-B Transmitting Subsystem input interface. Verify that the 'Wind Speed' subfield for subsequent Weather State Messages is set to the updated value within 100 milliseconds of the data being made available to the input interface.

2.4.3.2.7.6.4.5 Verification of 'Wind Direction' Subfield in ADS-B Wx Weather State Messages (§2.2.3.2.7.6.4.5)

This test procedure is used to verify that the ADS-B Transmitting Subsystem correctly encodes the 'Wind Direction' subfield in the Weather State Message as a dynamic value from a variable data input.

Table 2-241: 'Wind Direction' Subfield Encoding

Coding		Meaning
(Binary)	(Decimal)	
~~00 0000 0000~~	~~0~~	~~NO or INVALID data~~
00 0000 0001	1	0.000 ≤ Wind Direction [degrees] < 0.352
00 0000 0010	2	0.352 ≤ Wind Direction [degrees] < 0.704
00 0000 0100	4	1.056 ≤ Wind Direction [degrees] < 1.408
00 0000 1000	8	2.463 ≤ Wind Direction [degrees] < 2.815
00 0001 0000	16	5.279 ≤ Wind Direction [degrees] < 5.630
00 0010 0000	32	10.909 ≤ Wind Direction [degrees] < 11.261
00 0100 0000	64	22.170 ≤ Wind Direction [degrees] < 22.522
00 1000 0000	128	44.692 ≤ Wind Direction [degrees] < 45.044
01 0000 0000	256	89.736 ≤ Wind Direction [degrees] < 90.088
10 0000 0000	512	179.824 ≤ Wind Direction [degrees] < 180.176
11 1111 1110	1022	359.296 ≤ Wind Direction [degrees] < 359.648
11 1111 1111	1023	359.648 ≤ Wind Direction [degrees] < 360.000

Measurement Procedure:

Step 1: Conduct variable data input tests

a. Configure the ADS-B system as for installed operation

b. Power on the ADS-B system and perform start-up procedures (§2.2.3.3.2.1)

c. Operate the ADS-B system so as to broadcast Airborne Position Messages (§2.2.3.3.2.2).

d. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Wind Speed' and 'Wind Direction' subfields.

e. For each 'Wind Direction' decimal value in Table 2-241, verify that the system generates Weather State Messages with the 'Wind Direction' subfield in each such message set equal to the binary coding value corresponding to the decimal value tested.

f. Provide an updated 'Wind Direction' subfield value to the ADS-B Transmitting Subsystem input interface. Verify that the 'Wind Direction' subfield for subsequent Weather State Messages is set to the updated value within 100 milliseconds of the data being made available to the input interface.

2.4.3.2.7.6.4.6 Verification of 'Air Temperature Type' Subfield in ADS-B Wx Weather State Messages (§2.2.3.2.7.6.4.6)

This test procedure is used to verify that the ADS-B Transmitting Subsystem correctly encodes the 'Air Temperature Type' subfield in the Weather State Message, as either a preconfigured, static value or as a dynamic value based on variable data input(s). It also verifies the encoding of 'Air Temperature Type' in the Alternate Weather State Message.

Note: *This test procedure assumes 'Air Temperature Type' may be preconfigured, provided explicitly, or may be determined from the provision of Total Air Temperature data or Static Air Temperature data. If one or more method is not supported, the test steps associated with that method may be omitted.*

Measurement Procedure:

Step 1: Conduct preconfigured data tests

a. Configure the ADS-B system as for installed operation, preconfiguring the Weather State Message, 'Air Temperature Type' subfield with decimal value '0' (binary 0) in Table 2-90, as appropriate per §2.2.3.2.7.6.4.6.

b. Power on the ADS-B system and perform start-up procedures (§2.2.3.3.2.1).

c. Operate the ADS-B system so as to broadcast Airborne Position Messages (§2.2.3.3.2.2).

d. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Wind Speed' and 'Wind Direction' subfields.

e. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Air Temperature Type' subfield set to the preconfigured value.

f. Perform Steps 1.a through 1.e, substituting the untested 'Air Temperature Type' decimal value '1' (binary 1) in Table 2-90 for the '0' in Step 1.a.

g. Perform Steps 1.a through 1.c.

h. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Roll Angle' subfield.

i. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Air Temperature Type' subfield set to the preconfigured value.

j. Perform Steps 1.a through 1.c and 1.h, substituting the untested 'Air Temperature Type' decimal value '1' (binary 1) in Table 2-90 for the '0' in Step 1.a.

k. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Air Temperature Type' subfield set to the preconfigured value.

Step 2: Conduct variable data input tests for dynamic, explicitly provided Air Temperature Type variable input

a. Perform Steps 1.b through 1.d

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature Type' subfield in the form of 'Air Temperature Type' data set to decimal '0' (binary 0)

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '0' (binary 0).

d. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature Type' subfield in the form of 'Air Temperature Type' data set to decimal '1' (binary 1).

e. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '1' (binary 1).

f. Provide an updated 'Air Temperature Type' subfield value to the ADS-B Transmitting Subsystem input interface. Verify that the 'Air Temperature Type' subfield for subsequent Weather State Messages is set to the updated value within 100 milliseconds of the data being made available to the input interface.

g. Perform Steps 1.b and 1.c and 1.h.

h. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature Type' subfield in the form of 'Air Temperature Type' data set to decimal '0' (binary 0).

i. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '0' (binary 0).

j. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature Type' subfield in the form of 'Air Temperature Type' data set to decimal '1' (binary 1).

k. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '1' (binary 1).

l. Provide an updated 'Air Temperature Type' subfield value to the ADS-B Transmitting Subsystem input interface. Verify that the 'Air Temperature Type' subfield for subsequent Alternate Weather State Messages is set to the updated value within 100 milliseconds of the data being made available to the input interface.

Step 3: Conduct variable data input tests for determining Air Temperature Type from variable input of Total Air Temperature data

a. Perform Steps 1.b through 1.d

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature' subfield in the form of 'Total Air Temperature' data only.

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '0' (binary 0).

d. Provide an updated 'Air Temperature' subfield value to the ADS-B Transmitting Subsystem input interface in the form of Static Air

Temperature. Verify that the 'Air Temperature Type' subfield for subsequent Weather State Messages is set to decimal '1' (binary 1) within 100 milliseconds of the data being made available to the input interface.

e. Perform Steps 1.b and 1.c.

f. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature' subfield in the form of 'Total Air Temperature' data only.

g. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '0' (binary 0).

h. Provide an updated 'Air Temperature' subfield value to the ADS-B Transmitting Subsystem input interface in the form of Static Air Temperature. Verify that the 'Air Temperature Type' subfield for subsequent Alternate Weather State Messages is set to decimal '1' (binary 1) within 100 milliseconds of the data being made available to the input interface.

Step 4: Conduct variable data input tests for determining Air Temperature Type from variable input of Static Air Temperature data

a. Perform Steps 1.b through 1.d.

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature' subfield in the form of 'Static Air Temperature' data only.

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '1' (binary 1).

d. Discontinue the input of Static Air Temperature. Provide an updated 'Air Temperature' subfield value to the ADS-B Transmitting Subsystem input interface in the form of Total Air Temperature. Verify that the 'Air Temperature Type' subfield for subsequent Weather State Messages is set to decimal '0' (binary 0) within 100 milliseconds of the data being made available to the input interface.

e. Perform Steps 1.b and 1.c.

f. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature' subfield in the form of 'Static Air Temperature' data only.

g. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '1' (binary 1).

h. Discontinue the input of Static Air Temperature. Provide an updated 'Air Temperature' subfield value to the ADS-B Transmitting Subsystem input interface in the form of Total Air Temperature. Verify that for Alternate Weather State messages sent within 2.0 seconds after discontinuing the input of Static Air Temperature, the 'Air Temperature Type' subfield is set to decimal '1' (binary 1), and that for Alternate Weather State messages sent more than 2.0 seconds after discontinuing the input of Static Air Temperature, the

'Air Temperature Type' subfield ~~for subsequent Alternate Weather State Messages~~ is set to decimal '0' (binary 0) ~~within 100 milliseconds of the data being made available to the input interface~~.

Step 5: Conduct variable data input tests for determining Air Temperature Type from variable input of both Total Air Temperature data and Static Air Temperature data

a. Perform Steps 1.b through 1.d

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature' subfield in the form of both 'Total Air Temperature' data, and 'Static Air Temperature'.

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '1' (binary 1).

d. Perform Steps 1.b and 1.c.

e. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Air Temperature' subfield in the form of both 'Total Air Temperature' data and 'Static Air Temperature' data.

f. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Air Temperature Type' subfield in each such message set to decimal '1' (binary 1).

[…]

2.4.3.2.7.6.4.8 Verification of 'Airspeed Type' Subfield in ADS-B Wx Weather State Messages (§2.2.3.2.7.6.4.8)

This test procedure is used to verify that the ADS-B Transmitting Subsystem correctly encodes the 'Airspeed Type' subfield in the Weather State Message, as either a preconfigured, static value or as a dynamic value based on variable data input(s). It also verifies the encoding of 'Airspeed Type' in the Alternate Weather State Message.

Note: *This test procedure assumes 'Airspeed Type' may be preconfigured, provided explicitly, or may be determined from the provision of Indicated Airspeed data or True Airspeed data. If one or more method is not available, the test steps associated with that method may be omitted.*

Measurement Procedure:

Step 1: Conduct preconfigured data tests

a. Configure the ADS-B system as for installed operation, preconfiguring the Weather State Message, 'Airspeed Type' subfield with decimal value '0' (binary 0) in Table 2-92, as appropriate per §2.2.3.2.7.6.4.8.

b. Power on the ADS-B system and perform start-up procedures (§2.2.3.3.2.1).

c. Operate the ADS-B system so as to broadcast Airborne Position Messages (§2.2.3.3.2.2).

d. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Wind Speed' and 'Wind Direction' subfields.

e. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Airspeed Type' subfield set to the preconfigured value.

f. Perform Steps 1.a through 1.e, substituting the untested 'Airspeed Type' decimal value '1' (binary 1) in Table 2-92 for the '0' in Step 1.a.

g. Perform Steps 1.a through 1.c.

h. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Roll Angle' subfield.

i. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield set to the preconfigured value.

j. Perform Steps 1.a through 1.c and 1.h, substituting the untested 'Airspeed Type' decimal value '1' (binary 1) in Table 2-92 for the '0' in Step 1.a.

k. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield set to the preconfigured value.

Step 2: Conduct variable data input tests for dynamic, explicitly provided Airspeed Type variable input

a. Perform Steps 1.b through 1.d.

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed Type' subfield in the form of 'Airspeed Type' data set to decimal '0' (binary 0).

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '0' (binary 0).

d. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed Type' subfield in the form of 'Airspeed Type' data set to decimal '1' (binary 1).

e. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '1' (binary 1).

f. Provide an updated 'Airspeed Type' subfield value to the ADS-B Transmitting Subsystem input interface. Verify that the 'Airspeed Type' subfield for subsequent Weather State Messages is set to the updated value within 100 milliseconds of the data being made available to the input interface.

g. Perform Steps 1.b and 1.c and 1.h

h. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed Type' subfield in the form of 'Airspeed Type' data set to decimal '0' (binary 0).

i. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '0' (binary 0).

j. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed Type' subfield in the form of 'Airspeed Type' data set to decimal '1' (binary 1).

k. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '1' (binary 1).

l. Provide an updated 'Airspeed Type' subfield value to the ADS-B Transmitting Subsystem input interface. Verify that the 'Airspeed Type' subfield for subsequent Alternate Weather State Messages is set to the updated value within 100 milliseconds of the data being made available to the input interface.

Step 3: Conduct variable data input tests for determining Airspeed Type from variable input of Indicated Airspeed data

a. Perform Steps 1.b through 1.d.

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed' subfield in the form of 'Indicated Airspeed' data only.

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '0' (binary 0).

d. Provide an updated 'Airspeed' subfield value to the ADS-B Transmitting Subsystem input interface in the form of True Airspeed. Verify that the 'Airspeed Type' subfield for subsequent Weather State Messages is set to decimal '1' (binary 1) within 100 milliseconds of the data being made available to the input interface.

e. Perform Steps 1.b and 1.c.

f. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed' subfield in the form of 'Indicated Airspeed' data only.

g. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '0' (binary 0).

h. Ensure that the 'Air Temperature Type' subfield is set to 'Static Air Temperature'. Provide an updated 'Airspeed' subfield value to the ADS-B Transmitting Subsystem input interface in the form of True Airspeed. Verify that the 'Airspeed Type' subfield for subsequent Alternate Weather State Messages is set to decimal '1' (binary 1) within 100 milliseconds of the data being made available to the input interface.

Step 4: Conduct variable data input tests for determining Airspeed Type from variable input of True Airspeed data

a. Perform Steps 1.b through 1.d.

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed' subfield in the form of 'True Airspeed' data only.

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '1' (binary 1).

d. Discontinue the input of True Airspeed. Provide an updated 'Airspeed' subfield value to the ADS-B Transmitting Subsystem input interface in the form of Indicated Airspeed. Verify that for Weather State messages sent within 2.0 seconds after discontinuing the input of True Airspeed, the 'Airspeed Type' subfield for subsequent Weather State Messages is set to decimal '1' (binary 1), and that for Weather State messages sent more than 2.0 seconds after discontinuing the input of True Airspeed, the 'Airspeed Type' subfield ~~for subsequent Weather State Messages~~ is set to decimal '0' (binary 0) ~~within 100 milliseconds of the data being made available to the input interface~~.

e. Perform Steps 1.b and 1.c

f. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed' subfield in the form of 'True Airspeed' data only.

g. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '1' (binary 1).

h. Discontinue the input of True Airspeed. Provide an updated 'Airspeed' subfield value to the ADS-B Transmitting Subsystem input interface in the form of Indicated Airspeed. Verify that for Weather State messages sent within 2.0 seconds after discontinuing the input of True Airspeed, the 'Airspeed Type' subfield for subsequent Weather State Messages is set to decimal '1' (binary 1), and that for Weather State messages sent more than 2.0 seconds after discontinuing the input of True Airspeed, the 'Airspeed Type' subfield ~~for subsequent Alternate Weather State Messages~~ is set to decimal '0' (binary 0) ~~within 100 milliseconds of the data being made available to the input interface~~.

Step 5: Conduct variable data input tests for determining Airspeed Type from variable input of both Indicated Airspeed data and True Airspeed data

a. Perform Steps 1.b through 1.d.

b. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed' subfield in the form of both 'Indicated Airspeed' data and 'True Airspeed' data.

c. Verify that the ADS-B Transmitting Subsystem transmits Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '1' (binary 1).

d. Perform Steps 1.b and 1.c.

e. Ensure that the 'Air Temperature Type' subfield is set to 'Static Air Temperature'. Provide variable input data to the ADS-B Transmitting

Subsystem at the nominal update rate for the 'Airspeed' subfield in the form of both 'Indicated Airspeed' data and 'True Airspeed' data.

f. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '1' (binary 1).

g. Ensure that the 'Air Temperature Type' subfield is set to 'Total Air Temperature'. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Airspeed' subfield in the form of both 'Indicated Airspeed' data and 'True Airspeed' data.

h. Verify that the ADS-B Transmitting Subsystem transmits Alternate Weather State Messages with the 'Airspeed Type' subfield in each such message set to decimal '0' (binary 0).

[…]

2.4.3.2.7.8.1.6 Verification of 'Peak EDR Offset' Subfield in Emergency / Priority Status Messages (§2.2.3.2.7.8.1.6)

Purpose/Introduction:

If supporting the ADS-B Wx AIREP option, this test procedure is used to verify that the ADS-B Transmitting Subsystem correctly encodes the 'Peak EDR Offset' subfield in the Emergency / Priority Status Message as a dynamic value from a variable data input. The test procedures in §2.4.3.3.2.6.3 verify that encodings other than 'NO or INVALID Data' occur only when Airborne Position Messages are being broadcast. If ADS-B Wx AIREPs are not supported, this test verifies that the 'Peak EDR Offset' subfield is set to ALL ZEROs.

Measurement Procedure:

If NOT implementing ADS-B Wx AIREP:

Configure the ADS-B Transmitting Subsystem to transmit Airborne Position Messages. Set the ADS-B Transmitting Subsystem to Airborne status. Produce valid Airborne Position Messages at the nominal rate with valid position and altitude data. Verify that the ADS-B Transmitting Subsystem begins to transmit Extended Squitter Aircraft Status Messages at the nominal rate with the TYPE Subfield set to 28 (binary 1 1100) and the Subtype Subfield set to ONE (binary 001). Verify that the 'Peak EDR Offset' subfield ('ME' bits 40 – 42; Message bits 72 – 74) is set to ALL ZEROs.

If implementing ADS-B Wx AIREP:

Conduct variable data input tests

a. Configure the ADS-B system as for installed operation
b. Power on the ADS-B system and perform start-up procedures (§2.2.3.3.2.1)
c. Operate the ADS-B system so as to broadcast Airborne Position Messages (§2.2.3.3.2.2).
d. Provide variable input data to the ADS-B Transmitting Subsystem at the nominal update rate for the 'Peak EDR Offset' subfield.
e. For each valid 'Peak EDR Offset' decimal value in Table 2-102, verify that the system generates Emergency / Priority Status Messages with the 'Peak EDR Offset' subfield in each such message set equal to the binary coding value corresponding to the decimal value tested.
~~f. For variable input values greater than the 'Peak EDR Offset' subfield range maximum~~

~~in Table 2-102, verify that the system generates Emergency / Priority Status Messages with the 'Peak EDR Offset' subfield coding in each such message is set to decimal '7' (binary 111).~~

g. Provide an updated 'Peak EDR Offset' subfield value to the ADS-B Transmitting Subsystem input interface. Verify that the 'Peak EDR Offset' subfield for subsequent Emergency/Priority Status Messages is set to the updated value within 100 milliseconds of the data being made available to the input interface.

[…]

2.4.3.3.2.3 Verification of ADS-B Surface Position Message Broadcast Rate (§2.2.3.3.2.3)

Purpose/Introduction:

This test verifies the Surface Position broadcast rates. Broadcast rates for 1090 MHz Extended Squitter ADS-B Messages are summarized in Table 2-128.

Equipment Required:

Provide a method of loading valid data for broadcasting ADS-B Messages into the ADS-B equipment under test. Provide a method of monitoring the transmitted ADS-B Messages and measuring the rate at which they are output.

Measurement Procedure:

Step 1: Broadcast Rate (§2.2.3.3.2.3.a, b and c)

Ensure that the equipment is set to the 'On-Ground' condition and that the appropriate valid ADS-B Surface Position data are available such that the position data is initiated and changes such that the position reflects an increased displacement from the initial position of 1 meter each second.

After 15 seconds, verify that the ADS-B Surface Position Messages are broadcast at random intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.3.b.

Provide position and movement data to the ADS-B equipment such that the position is stationary. Note the initial time that the position data is no longer changing. After 15 minutes and 10 seconds from the start of the input of stationary position data, verify that the ADS-B Surface Position Messages are broadcast at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.3.c.

Provide position data such that the position is moving 10 meters per minute and note the time the input changes from stationary to moving. After 61 seconds from the change from stationary position to moving, verify that the ADS-B Surface Position Messages are broadcast at random intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds.

Step 2: Initiation, Timeout, and Termination (§2.2.3.3.2.1.2, §2.2.3.3.2.11.b, §2.2.3.3.2.12.b)

Ensure that the equipment is set to the 'On-Ground' condition. Input Movement and Heading / Ground Track, but do not input position. Verify that Surface Position Messages are not broadcast.

Cease input of Movement and Heading / Ground Track. Input position with a simulated movement at a rate high enough to result in a 'High' broadcast rate. Verify that Surface Position messages are initiated.

Input all data for the Surface Position Messages. Stop the input of position data, but continue with data sufficient to populate the Movement and Heading / Ground Track subfields.

Verify that the Surface Position Messages broadcast within 2.6 seconds after stopping the data input have all data bits set to the last reported valid value. Verify that Surface Position Messages broadcast more than 2.6 seconds after stopping the data input have all data bits set to ZERO. Verify that the ADS-B Surface Position Messages cease to be broadcast 60 seconds from stopping the position input.

Note: *The 60 second termination does not apply to Non-Transponder Devices.*

Resume input of position data and stop the input of Movement data. Verify that the Surface Position Messages broadcast within 2.6 seconds after stopping the data input have the Movement subfield set to the last reported valid value. Verify that Surface Position Messages broadcast more than 2.6 seconds after stopping the data input have the Movement subfield set to ZERO with all other subfields correctly populated.

Resume input of Movement data and stop the input of Heading / Ground Track data. Verify that the Surface Position Messages broadcast within 2.6 seconds after stopping the data input have the Heading / Ground Track subfield set to the last reported valid value. Verify that Surface Position Messages broadcast more than 2.6 seconds after stopping the data input have the Heading / Ground Track subfield set to ZERO with all other subfields correctly populated.

Note: *It is acceptable to validate the data in the subsequent Surface Position Message received after the indicated time has elapsed.*

~~Step 3: Switching between High Rate and Low Rate (§2.2.3.3.2.3.a)~~

~~Ensure that the equipment is set to the 'On-Ground' condition and that the appropriate valid ADS-B Surface Position data are provided such that the position is changing at a rate of 10.1 meters in any 15 minute interval. After the initial data input, verify that the ADS-B Surface Position Messages are broadcast at a low rate. 15 minutes and 10 seconds after the start of the data input, verify that the ADS-B Surface Position Messages are the high rate.~~

~~Input new ADS-B Surface Position data with the position data changing at a rate of 9.9 meters in any 15 minute interval. Verify that high rate broadcasts are maintained for at least 14 minutes and 50 seconds. 15 minutes and 10 seconds after the inputting of the new data, verify that the ADS-B Surface Position Messages are broadcast at the low rate.~~

~~***Note:*** *It is acceptable to validate the data in the subsequent Surface Position Message received after the indicated time has elapsed.*~~

2.4.3.3.2.4 Verification of ADS-B Aircraft Identification and Category Message Broadcast Rate (§2.2.3.3.2.4)

Purpose/Introduction:

This test verifies the Aircraft Identification and Category broadcast rates. Broadcast rates for 1090 MHz Extended Squitter ADS-B Messages are summarized in Table 2-128.

Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of monitoring the transmitted ADS-B Messages and measuring the rate at which they are output.

Measurement Procedure:

Step 1: Broadcast Rate (§2.2.3.3.2.4)

Ensure that the equipment is set to the 'Airborne' condition and that the appropriate valid Aircraft Identification and Category data are available. Verify that the Aircraft Identification and Category Messages are broadcast at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.4.a.

Ensure that the equipment is set to the 'On-Ground' condition, the appropriate valid ADS-B Surface Position data are provided such that the position is stationary, the Surface Position Message is transmitting at the 'Low' rate, and the appropriate valid ADS-B Aircraft Identification and Category data are available. Verify that the ADS-B Aircraft Identification and Category Messages are broadcast at random intervals that are uniformly distributed over the range of 9.8 to 10.2 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.4.b.

Discontinue input of position data and wait 60 seconds. Verify that the ADS-B Aircraft Identification and Category Messages are broadcast at intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.4.c.

Resume input of ~~Input new~~ ADS-B Surface Position data such that the position is changing at a rate of 5 m/s. Two (2) seconds after inputting the new data, verify that the ADS-B Aircraft Identification and Category Messages are broadcast at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.4.a.

Note: *It is acceptable to validate the data in the subsequent Aircraft Identification and Category Message received after the indicated time has elapsed.*

Step 2: Initiation, Timeout, and Termination (§2.2.3.3.2.1.2, §2.2.3.3.2.11.d, §2.2.3.3.2.12.c)

Reset the ADS-B device. Input only ADS-B Emitter Category data. Verify that the Aircraft Identification and Category Messages are initiated.

Stop the input of data. At least 60 seconds later, verify that the Aircraft Identification and Category Messages continue to be broadcast with the same data that existed prior to stopping the data input.

Reset the ADS-B system. Input only Aircraft Identification data. Verify that the Aircraft Identification and Category Messages are initiated.

Stop the input of data. At least 60 seconds later, verify that the Aircraft Identification and Category Messages continue to be broadcast with the same data that existed prior to stopping the data input.

[…]

2.4.3.3.2.6.1 Verification of ADS-B Target State and Status Message Broadcast Rates (§2.2.3.3.2.6.1)

Purpose/Introduction:

This test verifies the Target State and Status broadcast rates. Broadcast rates for 1090 MHz Extended Squitter ADS-B Messages are summarized in Table 2-128.

Equipment Required:

Provide a Method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of monitoring the transmitted ADS-B Messages and measuring the rate at which they are output.

Measurement Procedure:

Step 1: Broadcast Rate (§2.2.3.3.2.6.1)

Ensure that the equipment is set to the ‘Airborne’ condition and that the appropriate valid Target State and Status data are available. Verify that the Target State and Status Messages are broadcast at random intervals that are uniformly distributed over the range of 1.2 to 1.3 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.6.1.

Step 2: Initiation, Timeout, and Termination (§2.2.3.3.2.1.2, §2.2.3.3.2.11.e, §2.2.3.3.2.12.e)

Provide the ADS-B Transmitting Subsystem with valid data necessary for the generation of Target State and Status Messages and Surface Position Messages. Ensure that the equipment is set to the ‘On-Ground’ condition. Verify that Target State and Status Messages are not broadcast.

Discontinue the input of Selected Altitude, Selected Heading, and BPS data. Ensure that the equipment is set to the ‘Airborne’ condition. Generate Airborne Position messages. Verify that Target State and Status Messages are not broadcast.

Input valid Selected Altitude data. Verify that Target State and Status Messages are initiated.

Discontinue input of Selected Altitude data. Verify that the Target State and Status Messages cease to be broadcast 2.6 seconds after stopping the data input.

Input valid Selected Heading data. Verify that the Target State and Status Messages are initiated.

Discontinue input of Selected Heading data. Verify that the Target State and Status Messages cease to be broadcast 2.6 seconds after stopping the data input.

Input valid BPS data. Verify that the Target State and Status Messages are initiated. Discontinue input of BPS data. Verify that the Target State and Status Messages cease to be broadcast 2.6 seconds after stopping the data input.

Input valid Target State and Status data, and discontinue Airborne Position Message broadcast (e.g. no position or altitude data provided to the system). Verify that the ADS-B Transmitting Subsystem is not broadcasting any ADS-B Target State and Status Messages.

Input valid Target State and Status data and Airborne Position data. Discontinue input of Selected Altitude. Verify that the Target State and Status Messages broadcast within ~~2.0~~ 2.6 seconds after stopping the data input have the Selected Altitude subfield set to the last reported valid value. Verify that Target State and Status Messages broadcast more than ~~2.0~~ 2.6 seconds after stopping the data input have the Selected Altitude subfield set to ALL ZEROs with all other subfields correctly populated.

Resume input of Selected Altitude and discontinue input of Selected Heading. Verify that the Target State and Status Messages broadcast within ~~2.0~~ 2.6 seconds after stopping the data input have the Selected Heading subfield set to the last reported valid value. Verify that Target State and Status Messages broadcast more than ~~2.0~~ 2.6 seconds after stopping the data input have the Selected Heading subfield set to ALL ZEROs with all other subfields correctly populated.

Resume input of Selected Heading and discontinue input of BPS. Verify that the Target State and Status Messages broadcast within ~~2.0~~ 2.6 seconds after stopping the data input have the BPS subfield set to the last reported valid value. Verify that Target State and Status Messages broadcast more than ~~2.0~~ 2.6 seconds after stopping the data input have the BPS subfield set to ALL ZEROs with all other subfields correctly populated.

Note: It is acceptable to validate the data in the subsequent Target State and Status Message received after the indicated time has elapsed.

[...]

2.4.3.3.2.6.3 Verification of ADS-B Emergency/Priority Status Message Broadcast Rate (§2.2.3.3.2.6.3)

Purpose/Introduction:

This test verifies the Emergency/Priority Status Message broadcast rates. Broadcast rates for 1090 MHz Extended Squitter ADS-B Messages are summarized in Table 2-128.

Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of monitoring the transmitted ADS-B Messages and measuring the rate at which they are output.

Measurement Procedure:

Step 1: Broadcast Rate (§2.2.3.3.2.6.3)

Ensure that appropriate valid Emergency/Priority Status Message data are available. Verify that the Emergency/Priority Status Messages are broadcast at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization no greater than 15 milliseconds as specified in §2.2.3.3.2.6.3.b.

Input a Mode A Code of 1000. Verify that the Emergency/Priority Status Messages are broadcast at random intervals that are uniformly distributed over the range of 0.7 to 0.9 seconds using a time quantization no greater than 15 milliseconds seconds as specified in §2.2.3.3.2.6.3.a. Verify that the Emergency/Priority Status Messages return to the nominal rate 24 ±1 seconds after changing the data.

Input a Mode A Code of 7400. Verify that the Emergency/Priority Status Messages are broadcast at random intervals that are uniformly distributed over the range of 0.7 to 0.9 seconds using a time quantization no greater than 15 milliseconds seconds as specified in §2.2.3.3.2.6.3.a. At least 60 seconds after changing the Mode A Code, verify that the Emergency/Priority Status Messages remain at the higher rate.

Input a Mode A Code of 1000. After the Emergency/Priority Status Message reverts to the low broadcast rate, input a Mode A Code of 7500. At least 60 seconds after changing the Mode A Code to 7500, verify that the Emergency/Priority Status Messages are broadcast at the higher rate.

Input a Mode A Code of 1000. After the Emergency/Priority Status Message reverts to the low broadcast rate, input a Mode A Code of 7600. At least 60 seconds after changing the Mode A Code to 7600, verify that the Emergency/Priority Status Messages are broadcast at the higher rate.

Input a Mode A Code of 1000. After the Emergency/Priority Status Message reverts to the low broadcast rate, input a Mode A Code of 7700. At least 60 seconds after changing the Mode A Code to 7700, verify that the Emergency/Priority Status Messages are broadcast at the higher rate.

Input a Mode A Code of 1000. After the Emergency/Priority Status Message reverts to the low broadcast rate, input an Emergency/Priority Status of decimal 6. At least 60 seconds after changing the Emergency/Priority Status, verify that the Emergency/Priority Status Messages are broadcast at the higher rate.

Step 2: Initiation, Timeout, and Termination (§2.2.3.3.2.1.2, §2.2.3.3.2.11.i, §2.2.3.3.2.12.g)

Provide the ADS-B Transmitting Subsystem with only Emergency/Priority Status data. Verify that the Emergency/Priority Status Message is initiated.

Discontinue input of Emergency/Priority Status data. At least 60 seconds later, verify that the Emergency/Priority Status Messages continue to be broadcast.

Reset the ADS-B Transmitting Subsystem. Provide the ADS-B Transmitting Subsystem with only Mode A Code data. Verify that the Emergency/Priority Status Message is initiated.

Reset the ADS-B Transmitting Subsystem. Provide the ADS-B Transmitting Subsystem with Mode A Code data and with Manned/Unmanned Operation data setting the subfield to ONE (binary 1). Verify that the Emergency/Priority Status Message is initiated.

Discontinue input of Mode A Code and Manned/Unmanned Operation data. At least 60 seconds later, verify that the Emergency/Priority Status Messages continue to be broadcast with the same Mode A Code data as was previously input and with the Manned/Unmanned Operation subfield set to ONE (binary 1).

If implementing support for the optional ADS-B Wx AIREP Messages, the following additional tests apply:

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Surface Position Messages (§2.2.3.3.2.2). Provide the ADS-B Transmitting Subsystem, additionally, with Mean EDR data only. Verify that the Emergency/Priority Status Message is not initiated. Provide the ADS-B Transmitting Subsystem with Mode A Code data in addition to Mean EDR data. Verify that the Emergency/Priority Status Message is initiated and that the Mean EDR subfield is set to ALL ZEROs in the Emergency/Priority Status Messages generated.

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Airborne Position Messages. Provide the ADS-B Transmitting Subsystem, additionally, with Mean EDR data only. Verify that the Emergency/Priority Status Message is initiated.

Discontinue input of Mean EDR data. Verify that the Emergency/Priority Status Messages broadcast within 15 seconds after stopping the data input have the Mean EDR subfield set to the last reported valid value and that any Emergency/Priority Status Messages broadcast more than 15 seconds after stopping the data input have the Mean EDR subfield set to ALL ZEROs. At least 60 seconds later, verify that the Emergency/Priority Status Messages continue to be broadcast.

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Surface Position Messages. Provide the ADS-B Transmitting Subsystem, additionally, with Peak EDR data only. Verify that the Emergency/Priority Status Message is not initiated. Provide the ADS-B Transmitting Subsystem with Mode A Code data in addition to Peak EDR data. Verify that the Emergency/Priority Status Message is initiated and that

the Peak EDR subfield is set to ALL ZEROs in the Emergency/Priority Status Messages generated.

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Airborne Position Messages. Provide the ADS-B Transmitting Subsystem, additionally, with Peak EDR data only. Verify that the Emergency/Priority Status Message is initiated.

Discontinue input of Peak EDR data. Verify that the Emergency/Priority Status Messages broadcast within 15 seconds after stopping the data input have the Peak EDR subfield set to the last reported valid value and that any Emergency/Priority Status Messages broadcast more than 15 seconds after stopping the data input have the Peak EDR and Peak EDR Offset subfields set to ALL ZEROs. At least 60 seconds later, verify that the Emergency/Priority Status Messages continue to be broadcast.

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Surface Position Messages. Provide the ADS-B Transmitting Subsystem, additionally, with Peak EDR Offset data only. Verify that the Emergency/Priority Status Message is not initiated. Provide the ADS-B Transmitting Subsystem with Mode A Code data in addition to Peak EDR Offset data. Verify that the Emergency/Priority Status Message is initiated and that the Peak EDR Offset subfields are set to ALL ZEROs in the Emergency/Priority Status Messages generated.

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Airborne Position Messages. Provide the ADS-B Transmitting Subsystem, additionally, with Peak EDR Offset data only. Verify that the Emergency/Priority Status Message is not initiated. Provide the ADS-B Transmitting Subsystem with Peak EDR data in addition to Peak EDR Offset data. Verify that the Emergency/Priority Status Message is initiated.

Discontinue the input of Peak EDR Offset data. Verify that the Emergency/Priority Status Messages broadcast within 15 seconds after stopping the data input have the Peak EDR Offset subfield set to the last reported valid value and that any Emergency/Priority Status Messages broadcast more than 15 seconds after stopping the data input have the Peak EDR Offset subfield set to ALL ZEROs. At least 60 seconds later, verify that the Emergency/Priority Status Messages continue to be broadcast.

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Surface Position Messages. Provide the ADS-B Transmitting Subsystem, additionally, with Water Vapor data only. Verify that the Emergency/Priority Status Message is not initiated. Provide the ADS-B Transmitting Subsystem with Mode A Code data in addition to Water Vapor data. Verify that the Emergency/Priority Status Message is initiated and that the Water Vapor subfield is set to ALL ZEROs in the Emergency/Priority Status Messages generated.

Reset the ADS-B Transmitting Subsystem. Operate the ADS-B system so as to broadcast Airborne Position Messages. Provide the ADS-B Transmitting Subsystem, additionally, with Water Vapor data only. Verify that the Emergency/Priority Status Message is initiated.

Discontinue input of Water Vapor data. Verify that the Emergency/Priority Status Messages broadcast within 6 seconds after stopping the data input have the Water Vapor subfield set to the last reported valid value and that any Emergency/Priority Status Messages broadcast more than 6 seconds after stopping the data input have the Water Vapor subfield set to ALL ZEROs. At least 60 seconds later, verify that the Emergency/Priority Status Messages continue to be broadcast.

Note: *It is acceptable to validate the data in the subsequent Emergency/Priority Status Message received after the indicated time has elapsed.*

[…]

2.4.5.2.4 Verification of Airborne Velocity Message – Subtype=1 Latency (§2.2.5.2.4, §2.2.3.2.6.1)

Purpose/Introduction:

This test verifies the latency of the Airborne Velocity Message – Subtype=1. ~~The following test procedures are used to test Airborne Velocity Messages – Subtype=1 transmitted by Airborne ADS-B Transmitting Subsystems when the transmitting device is installed in an environment having NON-supersonic airspeed capabilities. These test procedures verify that any changes in the data used to structure the subfields of the Airborne Velocity Message - Subtype=1 are reflected in the affected subfield of the next scheduled Airborne Velocity Message - Subtype=1 provided that the change occurs at least 100 milliseconds prior to the next scheduled Airborne Velocity Message - Subtype=1 transmission.~~

Measurement Procedure:

Step 1: Airborne Velocity Message - Subtype=1 – ‘TYPE’ Subfield (§2.2.3.2.6.1.1 and §2.2.5.2.4)

Configure the ADS-B Transmitting Subsystem to transmit Airborne Velocity Messages – Subtype=1 by providing subsonic velocity information at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set the ADS-B Transmitting Subsystem to Airborne status. Provide valid non-zero subsonic velocity data to the ADS-B System. Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Verify that the TYPE subfield in the Airborne Velocity Message – Subtype=1 equals 19, which is the only TYPE value assigned to Airborne Velocity Messages.

Step 2: Airborne Velocity Message - Subtype=1 – ‘Subtype’ Subfield (§2.2.3.2.6.1.2 and §2.2.5.2.4)

Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Increase the velocity data input to the ADS-B System to a supersonic value so that the change occurs at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the ‘Subtype’ subfield value has changed to TWO (2) in the next transmitted Airborne Velocity Message.

Step 3: Airborne Velocity Message - Subtype=1 – 'NAC_V' Subfield (§2.2.3.2.6.1.5 and §2.2.5.2.4)

Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Verify that the NAC_V value equals Zero (0). Insert changed data to the ADS-B System to cause a change to occur in the NAC_V value and so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the NAC_V subfield value has changed to the correct value in the next transmitted Airborne Velocity Message.

Step 4: Airborne Velocity Message - Subtype=1 – 'East/West Direction Bit' Subfield (§2.2.3.2.6.1.6 and §2.2.5.2.4)

Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Verify that the East/West Direction Bit equals Zero (0). Insert changed data to the ADS-B System to cause a change to occur in the East/West Direction Bit so that the direction will become 'West' and so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the East/West Direction Bit subfield value has changed to ONE (1) in the next transmitted Airborne Velocity Message.

Step 5: Airborne Velocity Message - Subtype=1 – 'East/West Velocity' Subfield (§2.2.3.2.6.1.7 and §2.2.5.2.4)

Configure the ADS-B Transmitting Subsystem to transmit Airborne Velocity Messages – Subtype=1 by providing subsonic velocity information at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set the ADS-B Transmitting Subsystem to Airborne status. Provide valid non-zero subsonic East/West Velocity data to the ADS-B System. Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged.

Insert changed data to the ADS-B System to cause a change to occur in the East/West Velocity so that it is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the East/West Velocity subfield value has changed in the next transmitted Airborne Velocity Message and that the value in the subfield is correct.

Step 6: Airborne Velocity Message - Subtype=1 – 'North/South Direction Bit' Subfield (§2.2.3.2.6.1.8 and §2.2.5.2.4)

Repeat the tests in Step ~~6~~4 above changing the word 'East' to 'North' and the word 'West' to 'South'.

Step 7: Airborne Velocity Message - Subtype=1 – 'North/South Velocity' Subfield (§2.2.3.2.6.1.9 and §2.2.5.2.4)

Repeat the tests in Step 5 ~~7~~ above changing the word 'East' to 'North' and the word 'West' to 'South'.

Step 8: Airborne Velocity Message - Subtype=1 – 'Vertical Rate Source Bit' Subfield (§2.2.3.2.6.1.10 and §2.2.5.2.4)

a. Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Verify that the Source Bit for Vertical Rate equals Zero (0), indicating receipt of Vertical Rate information from a Non-Barometric Source. Insert changed data to the ADS-B System to cause a change to occur in the Source Bit for Vertical Rate so that the Vertical Rate information will come from a Barometric Source or Barometric Source blended with another Source~~, and so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission~~. Wait for 2.6 seconds. Verify that the 'Source Bit for Vertical Rate' subfield value has changed to ONE (1) in the next transmitted Airborne Velocity Message.

b. Continue transmitting Airborne Velocity Messages – Subtype=1 at the nominal rate with all parameters unchanged and verify that the Source Bit for Vertical Rate contains the value ONE (1). Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Insert changed data to the ADS-B System to cause a change to occur in the Source Bit for Vertical Rate so that the Vertical rate information will come from a Non-Barometric Source~~, and so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission~~. Wait for 2.6 seconds. Verify that the 'Source Bit for Vertical Rate' subfield value has changed to ZERO (0) in the next transmitted Airborne Velocity Message.

Step 9: Airborne Velocity Message - Subtype=1 – 'Sign Bit for Vertical Rate' Subfield (§2.2.3.2.6.1.11 and §2.2.5.2.4)

a. Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Verify that the 'Sign Bit for Vertical Rate' subfield equals ZERO (0), indicating Vertical Rate information in the UP Direction. Insert changed data to the ADS-B System to cause a change to occur in the 'Sign Bit for Vertical Rate' so that the Vertical Direction information will be DOWN, and so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the 'Sign Bit for Vertical Rate' subfield value has changed to ONE (1) in the next transmitted Airborne Velocity Message.

b. Continue transmitting Airborne Velocity Messages – Subtype=1 at the nominal rate with all parameters unchanged and verify that the 'Sign Bit for Vertical Rate' subfield contains the value of ONE (1). Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged. Insert changed data to the ADS-B System to cause a change to occur in the 'Sign Bit for Vertical Rate' so that the Vertical Direction information will be UP, and so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the

'Sign Bit for Vertical Rate' subfield value has changed to ZERO (0) in the next transmitted Airborne Velocity Message.

Step 10: Airborne Velocity Message - Subtype=1 – 'Vertical Rate' Subfield (§2.2.3.2.6.1.12 and §2.2.5.2.4)

Configure the ADS-B Transmitting Subsystem to transmit Airborne Velocity Messages – Subtype=1 by providing subsonic velocity information at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set the ADS-B Transmitting Subsystem to Airborne status. Provide valid non zero Vertical Rate data to the ADS-B System. Continue transmitting Airborne Velocity Messages - Subtype=1 at the nominal rate with all parameters unchanged.

Insert changed data to the ADS-B System to cause a change to occur in the Vertical Rate so that it is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the Vertical Rate subfield value has changed in the next transmitted Airborne Velocity Message and that the value in the subfield is correct.

Step 11: Airborne Velocity Message - Subtype=1 – 'Extended Difference From Barometric Altitude Sign Bit' Subfield (§2.2.3.2.6.1.14 and §2.2.5.2.4)

Configure the ADS-B Transmitting Subsystem to transmit Airborne Velocity Messages - Subtype=1 by providing subsonic velocity information at the nominal update rate, including non-zero Barometric and Geometric Altitude data. Provide the data externally at the interface to the ADS-B system. Ensure that the 'Extended Difference From Barometric Altitude Sign Bit' subfield equals ZERO (0), indicating geometric altitude source data is greater than or equal to barometric. Insert changed data to the ADS-B System to cause a change to occur in the 'Extended Difference From Barometric Altitude Sign Bit' so that the geometric altitude source data is less than barometric, and so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the 'Extended Difference From Barometric Altitude Sign Bit' subfield value has changed to ONE (1) in the next transmitted Airborne Velocity Message.

Step 12: Airborne Velocity Message - Subtype=1 – 'Extended Difference From Barometric Altitude' Subfield (§2.2.3.2.6.1.15 and §2.2.5.2.4)

Configure the ADS-B Transmitting Subsystem to transmit Airborne Velocity Messages – Subtype=1 at the nominal rate with all parameters unchanged. Insert data to the ADS-B System to cause a change to occur in the Extended Difference From Barometric Altitude so that it is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the Extended Difference From Barometric Altitude subfield value has changed in the next transmitted Airborne Velocity Message and that the value in the subfield is correct.

Step 13: Airborne Velocity Message - Subtype=1 – 'NIC Supplement-D' Subfield (§2.2.3.2.6.1.16 and §2.2.5.2.4)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Airborne Velocity Messages – Subtype=1 at the nominal rate.

For Type Codes=20 & 22, insert changed data to the ADS-B System to cause a change to occur in the NIC Supplement-D subfield, so that the change is detected at least 100 milliseconds prior to the next scheduled Airborne Velocity Message transmission. Verify that the value in the NIC Supplement-D subfield equals the corresponding value in the NIC Supplement-D column in the applicable row of Table 2-28.

[…]

2.4.5.2.12 Verification of Aircraft Operational Status Message Latency (§2.2.3.2.7.2, §2.2.5.2.12)

Purpose/Introduction:

This test verifies the latency of the Aircraft Operational Status Message.

Measurement Procedure:

Step 1: Aircraft Operational Status Message - 'TYPE' Subfield (§2.2.3.2.7.2.1 and §2.2.5.2.12)

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing data at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with all parameters unchanged. Verify that the TYPE subfield in the Aircraft Operational Status Message equals 31, which is the only TYPE value assigned to Aircraft Operational Status Messages.

Step 2: Aircraft Operational Status Message - 'Subtype' Subfield (§2.2.3.2.7.2.2 and §2.2.5.2.12)

Continue transmitting Aircraft Operational Status Messages at the nominal rate with all parameters unchanged. Verify that the Subtype subfield in the Aircraft Operational Status Messages equals ZERO (0).

Insert data to the ADS-B System to simulate an On-Ground status, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the Subtype subfield is set to ONE (1).

Step 3: Aircraft Operational Status Message - 'Capability Class' (CC) Subfield (§2.2.3.2.7.2.3 and §2.2.5.2.12)

a. Capability Class Code for 'CA Operational' (§2.2.3.2.7.2.3.2)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with CA Operational indicated. Verify that 'ME' bit 11 is set to ONE (1). Insert data to the ADS-B System to cause a change to occur in the Capability Class subfield with Collision Avoidance System is NOT operational indicated, and so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 11 is set to ZERO (0).

b. Capability Class Code for '1090ES IN' (§2.2.3.2.7.2.3.3)

This test is only applicable to systems setting the 1090ES IN subfield via data received from an external interface.

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with ADS-R and/or TIS-B 1090ES reception capability indicated. Verify that 'ME' bit 12 is set to ONE (1). Insert data to the ADS-B System to cause a change to occur in the Capability Class subfield which indicates that there is no ADS-R and/or TIS-B 1090ES reception capability available, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 12 is set to ZERO (0).

Set the ADS-B Transmitting Subsystem to On-Ground Status. Rerun this procedure and verify that the Subtype is set to ONE (1) and that 'ME' bit 12 is set to the appropriate state.

c. Capability Class Code for 'UAT IN' (§2.2.3.2.7.2.3.9)

This test is only applicable to systems setting the UAT IN subfield via data received from an external interface.

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with ADS-R and/or TIS-B UAT reception capability indicated. Verify that 'ME' bit 19 is set to ONE (1). Insert data to the ADS-B System to cause a change to occur in the Capability Class subfield which indicates that there is no ADS-R and/or TIS-B UAT reception capability available, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 19 is set to ZERO (0).

Set the ADS-B Transmitting Subsystem to On-Ground Status. Rerun this procedure and verify that the Subtype is set to ONE (1) and that 'ME' bit 19 is set to the appropriate state.

d. Capability Class Code for 'Transponder Side Indication' (§2.2.3.2.7.2.3.4)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with unknown transponder side data. Verify that 'ME' bits 15 – 16 are set to ALL ZEROs (binary 00). Insert data to the ADS-B System to cause a change to occur in the Capability Class subfield with Transponder #1 indicated, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bits 15 – 16 are set to ONE (binary 01).

e. Capability Class Code for 'Tx Power' (§2.2.3.2.7.2.3.6)

Tx Power is a static parameter that is verified in §2.4.3.2.7.2.3.6.

f. Capability Class Code for 'B2 Low' (§2.2.3.2.7.2.3.7)

B2 Low is a static parameter that is verified in §2.4.3.2.7.2.3.7.

g. Capability Class Code for 'NAC_V' (§2.2.3.2.7.2.3.8)

Set the ADS-B Transmitting Subsystem to On-Ground Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with unknown horizontal velocity error data. Verify that 'ME' bits 17 – 19 are set to ALL ZEROs (binary 000). Insert data to the ADS-B System to cause a change to occur in the Capability Class subfield with a horizontal velocity error < 10 m/s indicated, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bits 17 – 19 are set to ONE (binary 001).

h. Capability Class Code for 'NIC Supplement-C' (§2.2.3.2.7.2.3.10)

Continue transmitting Aircraft Operational Status Messages at the nominal rate with NIC Supplement-C set to ZERO. Verify that 'ME' bit 20 is set to ZERO. Insert data to the ADS-B System to cause a change to occur in the Capability Class subfield with NIC Supplement-C set to ONE, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 20 is set to ONE.

i. Capability Class Code for 'RCE' (§2.2.3.2.7.2.3.11)

RCE is a static parameter that is verified in §2.4.3.2.7.2.3.11.

j. Capability Class Code for 'DAA' (§2.2.3.2.7.2.3.12)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with no RWC capability indicated. Verify that 'ME' bits 23 – 24 are set to ALL ZEROs (binary 00). Insert data to the ADS-B System to cause a change to occur in the Capability Class subfield to indicate an RWC function capable of receiving TCAS Resolution messages and ADS-B OCMs, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bits 23 – 24 are set to ONE (binary 01).

Step 4: Aircraft Operational Status Message – Subtype 0/1 - 'Operational Mode' (OM) Subfield (§2.2.3.2.7.2.4 and §2.2.5.2.12)

a. Operational Mode Code for 'CA Resolution Advisory Active' (§2.2.3.2.7.2.4.2)

Configure the ADS-B Transmitting Subsystem to transmit Aircraft Operational Status Messages by providing data at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with no CA Resolution Advisory Active indicated. Verify that 'ME' bit 27 is set to ZERO (0). Insert data to the ADS-B System to cause a change to occur in the Operational Mode subfield with a CA Resolution Advisory Active indicated, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 27 is set to ONE (1).

Set the ADS-B Transmitting Subsystem to On-Ground Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with no CA Resolution Advisory Active indicated. Verify that 'ME' bit 27 is set to ZERO (0) when the OM subfield format code is equal to ZERO (binary 00). Insert changed data to the ADS-B System to cause a change to occur in the Operational Mode subfield with a CA Resolution Advisory Active indicated, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 27 is set to ONE (1) when the OM subfield format code is equal to ZERO (binary 00).

b. Operational Mode Code for 'IDENT Switch Active' (§2.2.3.2.7.2.4.3)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with IDENT switch not active indicated. Verify that 'ME' bit 28 is set to ZERO (0). Insert data to the ADS-B System to cause a change to occur in the Operational Mode subfield with IDENT switch active indicated, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 28 is set to ONE (1).

Set the ADS-B Transmitting Subsystem to On-Ground Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with IDENT switch not active indicated. Verify that 'ME' bit 28 is set to ZERO (0) when the OM subfield format code is equal to ZERO (binary 00). Insert data to the ADS-B System to cause a change to occur in the Operational Mode subfield with IDENT switch active indicated, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 28 is set to ONE (1) when the OM subfield format code is equal to ZERO (binary 00).

c. Operational Mode Code for 'Single Antenna Flag' (§2.2.3.2.7.2.4.5)

The Single Antenna Flag (SAF) is a static parameter that is configured at the aircraft level to indicate whether the aircraft is equipped with Diversity or Non-Diversity antenna. The stimulus required to specify this will be implementation dependent.

Provide stimulus to indicate that the aircraft has a single antenna and, if required, reset the ADS-B System for this stimulus to take effect. Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate. Verify that 'ME' bit 30 is set to ONE (1).

Provide stimulus to indicate that the aircraft has multiple antennas and, if required, reset the ADS-B System for this stimulus to take effect. Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate. Verify that 'ME' bit 30 is set to ZERO (0).

Reset the ADS-B Transmitting Subsystem to On-Ground Status and rerun the above tests and verify 'ME' bit 30 is set appropriately.

d. Operational Mode Code for 'System Design Assurance' (§2.2.3.2.7.2.4.6)

Continue transmitting Aircraft Operational Status Messages at the nominal rate with unknown SDA data. Verify that the SDA subfield ('ME' bits 31 – 32) equals ZERO (binary 00). Insert data to the ADS-B System to cause a change to occur in the SDA subfield to indicate 1×10^{-3} per flight hour, and so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the SDA subfield equals ONE (binary 01).

Set the ADS-B Transmitting Subsystem to On-Ground Status. Rerun this procedure and verify that the Subtype is set to ONE (1) and that 'ME' bits 31 – 32 are set to the appropriate values.

e. Operational Mode Code for 'GPS Antenna Offset' (§2.2.3.2.7.2.4.7)

Set the ADS-B Transmitting Subsystem to On-Ground Status. Via the appropriate input interface provide the ADS-B Transmitting Subsystem with no GPS Antenna Offset data. Transmit Aircraft Operational Status Messages at the nominal rate. Verify that 'ME' bits 33 – 40 (Message bits 65 – 72) are set to All ZEROs in the Surface Aircraft Operational Status Messages when the OM subfield format code is equal to ZERO (binary 00). Change the Lateral and Longitudinal GPS Antenna Offset inputs such that both the Lateral and Longitudinal Offsets are non-zero. Make the change such that it is detected at least 100 milliseconds prior to the next scheduled Surface Aircraft Operational Status Message transmission. Verify that the Lateral and Longitudinal Offsets are properly reported in the next transmitted Surface Aircraft Operational Status Message when the OM subfield format code is equal to ZERO (binary 00).

f. Operational Mode Code for 'Mode S Reply Rate Limiting Status' (§2.2.3.2.7.2.4.4)

The Mode S Reply Rate Limiting Status is verified in §2.4.3.2.7.2.4.4.

g. Operational Mode Code for 'CCCB' (§2.2.3.2.7.2.4.8, §2.2.3.2.7.2.4.9, §2.2.3.2.7.2.4.10)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with CCCB data set to ZERO. Verify that the Sense: Vertical and Horizontal and Aircraft CAS Type/Capability ('ME' bits 33 – 39) are set to ZERO. Insert data to the ADS-B System to cause a change to occur in the CCCB subfield, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the Sense: Vertical and Horizontal and Aircraft CAS Type/Capability are set to the updated values.

h. Operational Mode Code for 'RWC Active' (§2.2.3.2.7.2.4.12)

Continue transmitting Aircraft Operational Status Messages at the nominal rate with no active RWC corrective alert. Verify that RWC Active ('ME' bit 40) is set to ZERO. Insert data to the ADS-B System to cause an RWC corrective alert to be active, so that the change is

detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that RWC Active ('ME' bit 40) is set to ONE.

i. Operational Mode Code for 'Transponder Antenna Offset' (§2.2.3.2.7.2.4.13)

Set the ADS-B Transmitting Subsystem to On-Ground Status. Via the appropriate input interface provide the ADS-B Transmitting Subsystem with no Transponder Antenna Offset data. Transmit Aircraft Operational Status Messages at the nominal rate. Verify that 'ME' bits 36 – 40 are set to ALL ZEROs in the Surface Aircraft Operational Status Messages when the OM subfield format code is equal to ONE (binary 01). Change the Transponder Antenna Offset input such that it is non-zero. Make the change such that it is detected at least 100 milliseconds prior to the next scheduled Surface Aircraft Operational Status Message transmission. Verify that the Transponder Antenna Offset is properly reported in the next transmitted Surface Aircraft Operational Status Message when the OM subfield format code is equal to ONE (binary 01).

Step 5: Aircraft Operational Status Message – 'Aircraft Length and Width Code' Subfield (§2.2.3.2.7.2.11)

Set the ADS-B Transmitting Subsystem to On-Ground Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with the Minimum Length and Width values from Table 2-71 indicated. Verify that the 'ME' bits 21 – 24 are set to ALL ZEROs (binary 0000). Insert changed data to the ADS-B System to cause a change to occur in the Length and Width subfield, and so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the binary values in 'ME' bits 21 – 24 equals the corresponding binary values in the same row of the table.

Step 6: Aircraft Operational Status Message – Subtype '0/1' – 'ADS-B Version Number' Subfield (§2.2.3.2.7.2.5)

The ADS-B Version Number is a static parameter that is verified in §2.4.3.2.7.2.5.

Step 7: Aircraft Operational Status Message – Subtype '0/1' – 'NIC Supplement-A' Subfield (§2.2.3.2.7.2.6)

Continue transmitting Aircraft Operational Status Messages at the nominal rate with NIC Supplement-A set to ZERO. Verify that 'ME' bit 44 is set to ZERO. Insert data to the ADS-B System to cause a change to occur in the subfield with NIC Supplement-A set to ONE, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 44 is set to ONE.

Set the ADS-B Transmitting Subsystem to On-Ground Status. Repeat this procedure and verify that the Subtype is set to ONE (1) and that 'ME' bit 44 is set to the appropriate value.

Step 8: Aircraft Operational Status Message – Subtype '0/1' – 'NAC_P' Subfield (§2.2.3.2.7.2.7)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with an EPU greater than or equal to 10 NM indicated. Verify that the NAC_P Subfield ('ME' bits 45 – 48) is set to ZERO (binary 0000). Insert data to the ADS-B System to cause a change to occur in the NAC_P subfield, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the binary value in the NAC_P Subfield equals the corresponding binary value in the NAC_P Binary column in the same row of the Table 2-68.

Set the ADS-B Transmitting Subsystem to On-Ground Status. Repeat this procedure and verify that the Subtype is set to ONE (1) and that 'ME' bits 45 – 48 are set to the appropriate values.

Step 9: Aircraft Operational Status Message – Subtype '0/1' – 'SIL' Subfield (§2.2.3.2.7.2.9)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with unknown SIL Data. Verify that the SIL subfield ('ME' bits 51 – 52) equals ZERO (binary 00). Insert data to the ADS-B System to cause a change to occur in the SIL subfield to indicate 1×10^{-3} per flight hour or per sample, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the SIL subfield equals ONE (binary 01).

Set the ADS-B Transmitting Subsystem to On-Ground Status. Repeat this procedure and verify that the Subtype is set to ONE (1) and that 'ME' bits 51 – 52 are set to the appropriate values.

Step 10: Aircraft Operational Status Message – Subtype=1 – 'Track Angle/Heading' Subfield (§2.2.3.2.7.2.12)

Set the ADS-B Transmitting Subsystem to On-Ground Status. Continue transmitting Aircraft Operational Status – Subtype=1 Messages at the nominal rate with Track Angle indicated. Verify that 'ME' bit 53 is set to ZERO (0). Insert data to the ADS-B System to cause a change to occur in the Track Angle/Heading subfield with Heading indicated and such that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 53 is set to ONE (1).

Step 11: Aircraft Operational Status Message – Subtype '1' – 'HRD' Subfield (§2.2.3.2.7.2.13)

Set the ADS-B Transmitting Subsystem to On-Ground Status. Continue transmitting Aircraft Operational Status – Subtype '1' Messages at the nominal rate with True North indicated. Verify that 'ME' bit 54 is set to ZERO (0). Insert data to the ADS-B System to cause a change to occur in the HRD subfield with Magnetic North indicated, such that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that 'ME' bit 54 is set to ONE (1).

Step 12: Aircraft Operational Status Message – Subtype=0 – 'GVA' Subfield (§2.2.3.2.7.2.8)

Set the ADS-B Transmitting Subsystem to Airborne Status. Continue transmitting Aircraft Operational Status Messages at the nominal rate with an unknown geometric vertical accuracy. Verify that the GVA subfield ('ME' bits 49 – 50) is set to ZERO (binary 00). Insert data to the ADS-B System to cause the GVA to be set to < 150 meters, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the GVA subfield is set to ONE (binary 01).

Step 13: Aircraft Operational Status Message – Subtype '0/1' – 'SIL Supplement' Subfield (§2.2.3.2.7.2.14)

Continue transmitting Aircraft Operational Status Messages at the nominal rate with a SIL probability based on a 'per hour' probability. Verify that the SIL Supplement subfield ('ME' bit 55) is set to ZERO (0). Insert data to the ADS-B System to cause the SIL probability to be based on a 'per sample' probability, so that the change is detected at least 100 milliseconds prior to the next scheduled Aircraft Operational Status Message transmission. Verify that the SIL Supplement subfield is set to ONE (1).

Set the ADS-B Transmitting Subsystem to On-Ground Status. Repeat this procedure and verify that the Subtype is set to ONE (1) and that 'ME' bit 55 is set to the appropriate value.

[Amdt ETSO/18]

ETSO-C219a

AIRBORNE COLLISION AVOIDANCE SYSTEM (ACAS) XA/XO

1 Applicability

This ETSO provides the requirements that ACAS Xa/Xo equipment that is designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 Procedures

2.1 General

Applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

None.

3 Technical Conditions

3.1 Basic

3.1.1 Minimum Performance Standard

Standards set forth in EUROCAE ED-256 Revision A, 'Minimum Operational Performance Standards for Airborne Collision Avoidance System X (ACAS X) (ACAS Xa and ACAS Xo)', dated 28 June 2023.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1, and EUROCAE ED-256 Revision A, Section 2.3.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

3.2.1.1 Failure of the function defined in paragraph 3.1.1 of this ETSO that results in misleading information is:

(a) a hazardous failure condition for un-annunciated failures that could either generate an incorrect RA or result in a missing RA;

(b) a major failure condition for un-annunciated failures that could generate a false RA.

3.2.1.2 Failure of the function defined in paragraph 3.1.1 of this ETSO that results in the loss of the function (annunciated) is a minor failure condition.

Note: As used in this paragraph:

— an incorrect RA is when an RA condition exists and an RA is issued but the RA provides incorrect guidance;

— a missing RA is when an RA condition exists but an RA is not issued;

— a false RA is when an RA is issued but an RA condition does not exist.

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

None.

5 Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/18]

ETSO-C220

GNSS-AIDED INERTIAL SYSTEMS

1 Applicability

This ETSO provides the requirements that GNSS-aided inertial systems providing position outputs that are designed 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

a. Some GNSS-aided inertial systems have been approved in accordance with RTCA DO-229() or RTCA DO-316(), Appendix R, which set out the requirements and test procedures for the tightly integrated GPS/inertial system. However, EASA will no longer accept any applications for the development of new articles or for major changes to existing articles using these sets of criteria after 12 months from the effective date of this ETSO.

b. Some GNSS-aided inertial systems have been approved in accordance with ETSO-C201(), 'Attitude and Heading Reference Systems (AHRS)', with the navigation capability of the product being approved as a non-ETSO function (i.e. the position outputs of the GNSS-aided inertial system making up the AHRS). ETSO-C201() remains effective and is a prerequisite for GNSS-aided inertial systems incorporating attitude and heading functions. However, EASA will no longer accept any new applications for ETSO-C201() that seek the approval of position outputs as a non-ETSO function.

c. Due to the wide range of possible GNSS-aided inertial systems capabilities, manufacturers shall define the equipment's intended function and demonstrated performance. The word 'system' includes all components or units necessary for the GNSS-aided inertial system to perform its intended function (excluding GNSS receiver functions that meet the requirements of ETSO-C196(), ETSO-C145() or ETSO-C146(), and AHRS functions that meet the requirements of ETSO-C201()).

3 Technical Conditions

3.1 Basic

3.1.1 Minimum Performance Standard

The applicable standard is that provided in RTCA DO-384, 'Minimum Operational Performance Standards (MOPS) for GNSS Aided Inertial Systems', dated 17 December 2020.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

3.2.2 Integrity Protection Limits

Both Advanced Receiver Autonomous Integrity Monitoring (ARAIM) and RTCA DO-384 for GNSS-aided inertial systems define ways to compute protection limits with the same integrity and continuity objectives. However, the hypotheses taken into account by ARAIM are much more stringent than the hypotheses taken into account by RTCA DO-384.

a. While RTCA DO-384 relies on the GPS prior satellite failure rate of 10^{-5}/hour for integrity, it does not take into account the temporal effects considered by ARAIM, which lead to more pessimistic probabilities of missed detection, to guarantee the integrity risk over the exposure period. For GNSS-aided inertial systems, manufacturers shall evaluate whether RTCA DO-384's temporal error characterisation, satellite mean fault duration and algorithm sampling rate are adequate.

b. When assigning a probability of misleading information equal to or less than 10^{-7}, manufacturers shall consider additional fault modes or anomalies affecting multiple (two or more) satellites. The GPS Standard Positioning Service (SPS) Performance Standard specifies that the probability of a GPS major service failure on two or more satellites due to a common cause (Pconst) shall not exceed 10^{-8} (consistent with the proposed amendment to ICAO Annex 10, 'Aeronautical telecommunications', Volume I, 'Radio navigation aids'). Manufacturers may use the tests described in RTCA DO-384, Appendix Q, 'Alternate Trajectories', to demonstrate the performance of the GNSS-aided inertial system in detecting, mitigating and recovering from multiple satellite failures.

3.2.3 Gravity Model

The following reference should be considered in addition to the references listed in RTCA DO-384, Appendix O: Needham, T. and Braasch, M., 'Gravity Modeling in GNSS-Aided Inertial Navigation System Safety Considerations', *NAVIGATION: Journal of the Institute of Navigation*, Vol. 69, No 2, 2022, navi.520.

3.2.4 Alternative GNSS Trajectories

If the equipment provides detection and mitigation of the effects of erroneous (or alternative) GNSS trajectories, then the applicant shall test the equipment according to RTCA DO-384, Appendix Q, 'Alternate Trajectories'.

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

None.

5 Availability of Referenced Document

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/18]

ETSO-2C169b

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

1 Applicability

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

2 Procedures

2.1 General

Applicable procedures are detailed in CS-ETSO Subpart A.

2.2 Specific

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

3 Technical Conditions

3.1 Basic

3.1.1 Minimum Performance Standard

a. Receiver–Transmitter Equipment

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

Table of Equipment Classes for VHF Communication Equipment

Equipment Class	Description
C	Receiver used in a 25 kHz channel separation environment having off-set carrier operation
D	Receiver used in a 25 kHz channel separation environment not having off-set carrier operation
E	Receiver used in an 8.33 kHz channel separation environment not having off-set carrier operation
H1 and H2	Receivers which are to be used in an 8,33 kHz channel separation environment and

Equipment Class	Description
	intended for off-set carrier operation with only two carriers.
3	Transmitter used in a 25 kHz channel separation environment and intended to operate with a range of 200 nautical miles.
4	Transmitter used in a 25 kHz channel separation environment and intended to operate with a range of 100 nautical miles.
5	Transmitter used in an 8.33 kHz channel separation environment and intended to operate with a range of 200 nautical miles.
6	Transmitter used in an 8.33 kHz channel separation environment and intended to operate with a range of 100 nautical miles.

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

For equipment embedded with audio intercom functions for more than two intercom users (two microphones and two audio outputs), the applicant also has to apply for ETSO-C139a, 'Aircraft Audio Systems and Equipment'.

For equipment that also provides control panel functionalities, the additional requirements set forth in Appendix 1 of this standard also apply.

b. Antenna Equipment

Requirements set forth in paragraphs 2.1, 2.2.14, 2.2.15, 2.3.9 and 2.3.10 of RTCA document DO-186B, 'Minimum Operational Performance Standards for Airborne Radio Communications Equipment Operating within the Radio Frequency Range 117.975–137.000 MHz', dated 8 November 2005, and associated testing procedures.

The antenna shall be qualified according to the applicable sections of the environmental standard referenced in Section 3.1.2 below.

3.1.2 Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 Computer Software

See CS-ETSO Subpart A paragraph 2.2.

3.1.4 Electronic Hardware Qualification.

See CS-ETSO Subpart A paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4.

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

4 Marking

4.1 General

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

4.2 Specific

None

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/6]
[Amdt ETSO/18]

Appendix 1 to ETSO-C169b — ADDITIONAL REQUIREMENTS FOR CONTROL PANELS

In a system that provides an interface for human interaction, such as a control panel and/or a display screen, human performance becomes an essential part of overall system performance. It is therefore essential that human–machine interface designers conduct early evaluations of the capabilities of the human and the system to perform the intended functions. For this reason, the following additional requirements apply to communications equipment with embedded control panels.

1.1 Definitions

Control Panel: a set of controls used by the operator to select and adjust the operational settings of the communications equipment, including, but not limited to, the following functionalities:

— adjusting the volume of the audio output;

— tuning the operative frequency;

— adjusting the squelch level;

— monitoring the current operational status.

1.2 General

The design of the physical and functional features of the communications equipment control panel shall be as simple as possible to enable easy, fast and intuitive operation of the equipment under any potential flight conditions and to avoid any misled or erroneous operation.

For knob controls, the following notes apply:

— clockwise turn: increase in values or digits, or item selection to the right, scrolling down;

— counterclockwise turn: decrease in values or digits, or item selection to the left, scrolling up.

For push-button controls, the following notes apply:

— the legend shall be consistent with the intended function;

— either the control can be a toggle or the function shall not require more than two pushes to revert to the previous values/setting.

If the physical controls are shared between different functions (e.g. a volume knob used for tuning), there must be a clear indication of the active function.

The Control Panel layout shall be designed to prevent any inadvertent use of the controls while operating the equipment.

1.3 Volume Control

The volume of the audio output shall be set by means of a physical control that can be accessed immediately (i.e. adjusting the volume by means of a menu setting is not acceptable).

If the physical control is shared with other functions, there must be a means to automatically revert to the volume control after a predetermined time.

1.4 Tuning Control

The tuning function shall be implemented by a physical control not requiring more than two actions to operate.

1.5 Squelch Level

The squelch function shall be implemented by a physical control not requiring more than two actions to operate.

1.6 Monitoring of the Equipment Status

The monitoring of the equipment status (i.e. the display) shall be simple, intuitive and effective under any potential lighting condition.

[Amdt ETSO/18]

ETSO-2C502a

ROTORCRAFT INTEGRATED IMMERSION SUITS

1 Applicability

This ETSO gives the requirements which integrated immersion suits for use on rotorcraft 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

The applicable standards are those provided in ASD-STAN document prEN4863, edition P1, dated May 2022.

3.1.2 Environmental Standard

None.

3.2 Specific

None.

4 Marking

4.1 General

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

4.2 Specific

The specific marking requirements are detailed in ASD-STAN document prEN4863, edition P1, dated May 2022.

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/1]
[Amdt ETSO/18]

ETSO-2C503a

ROTORCRAFT IMMERSION SUITS FOR OPERATIONS TO OR FROM HELIDECKS LOCATED IN A HOSTILE SEA AREA

1 Applicability

This ETSO gives the requirements which immersion suits for use on rotorcraft operating to or from helidecks located in a hostile sea area (as defined in Annex I ('Definitions for terms used in Annexes II to V') to Commission Regulation (EU) No 965/2012) 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

The applicable standards are those provided in ASD-STAN document prEN4863, edition P1, dated May 2022.

3.1.2 Environmental Standard

None.

3.2 Specific

None.

4 Marking

4.1 General

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

4.2 Specific

The specific marking requirements are detailed in ASD-STAN document prEN4863, edition P1, dated May 2022.

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/1]
[Amdt ETSO/18]

ETSO-2C504a

ROTORCRAFT CONSTANT-WEAR LIFE JACKETS FOR OPERATIONS TO OR FROM HELIDECKS LOCATED IN A HOSTILE SEA AREA

1 Applicability

This ETSO gives the requirements which adult constant-wear life jackets for use on rotorcraft operating to or from helidecks located in a hostile sea area (as defined in Annex I ('Definitions for terms used in Annexes II to V') to Commission Regulation (EU) No 965/2012) 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

The applicable standards are those provided in ASD-STAN document prEN4862, edition P1, dated February 2022.

3.1.2 Environmental Standard

None.

3.2 Specific

None.

4 Marking

4.1 General

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

4.2 Specific

The specific marking requirements are detailed in ASD-STAN document prEN4862, edition P1, dated February 2022.

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/1]
[Amdt ETSO/18]

ETSO-2C505a

ROTORCRAFT LIFE RAFTS FOR OPERATIONS TO OR FROM HELIDECKS LOCATED IN A HOSTILE SEA AREA

1 Applicability

This ETSO gives the requirements which life rafts required to be carried on rotorcraft operating to or from helidecks located in a hostile sea area (as defined in Annex I ('Definitions for terms used in Annexes II to V') to Commission Regulation (EU) No 965/2012) 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

The applicable standards are those provided in ASD-STAN document prEN4886, edition P1, dated June 2023.

3.1.2 Environmental Standard

None.

3.2 Specific

None.

4 Marking

4.1 General

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

4.2 Specific

The specific marking requirements are detailed in ASD-STAN document prEN4886, edition P1, dated June 2023.

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/1]
[Amdt ETSO/18]

ETSO-2C519a

EMERGENCY BREATHING SYSTEMS (EBSs)

1 Applicability

This ETSO provides the requirements which emergency breathing systems (EBSs) for operations to or from helidecks that are located in hostile sea areas (as defined in Annex I ('Definitions for terms used in Annexes II to V') to Commission Regulation (EU) No 965/2012) that are designed and 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

The 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

The applicable standards are those provided in AeroSpace and Defence Industries Association of Europe — Standardization (ASD-STAN) document prEN4856, edition P2, dated June 2022.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Software

None.

3.1.4 Airborne Electronic Hardware

None.

3.2 Specific

3.2.1 Failure Condition Classification

None.

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

The specific marking requirements are detailed in ASD-STAN document prEN4856, edition P2, dated June 2022.

5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/16]
[Amdt ETSO/18]

ETSO-2C521 A1

ELECTRONIC FLIGHT BAG (EFB) SOFTWARE APPLICATIONS

1 Applicability

This ETSO provides the requirements that electronic flight bag software applications that are designed 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

The applicable standard is that provided in EUROCAE ED-273, 'Minimum Operational Performance Standard for Electronic Flight Bag (EFB) Software Applications', dated August 2021.

3.1.2 Environmental Standard

Not applicable.

3.1.3 Software

See the software development assurance method described in EUROCAE ED-273, 'Minimum Operational Performance Standard for Electronic Flight Bag (EFB) Software Applications', Section 2.4.

Alternatively, see CS-ETSO Subpart A paragraph 2.2.

3.1.4 Airborne Electronic Hardware

Not applicable.

3.2 Specific

3.2.1 Failure Condition Classification

A safety risk assessment must be performed per EUROCAE ED-273, 'Minimum Operational Performance Standard for Electronic Flight Bag (EFB) Software Applications', Section 2.2. The assumptions, mitigation and prevention means identified in this risk assessment must be made available to the aircraft operator as required by the standard.

Alternatively, see CS-ETSO, Subpart A, paragraph 2.4.

3.2.2 Documentation

The applicant shall develop and make available to the aircraft operator the operational, loading and configuration instructions as defined in EUROCAE ED-273, Chapter 4, including the following data.

— The minimum performance specifications for the EFB Host Platform (Hardware + Operating system). These should be consistent with the environment that has been used to demonstrate the functionalities of the EFB application.
— The test procedures to be performed by the installer once the EFB application is loaded and configured into the final host platform.

Please refer to EUROCAE ED-273, Section 4.2, for additional guidance.

4 Marking

4.1 General

The application shall include a function permitting the user to retrieve the markings required by CS-ETSO, Subpart A paragraph 1.2.

Note: The date of the official release of the EFB software application is a means to comply with point 21.A.807(a)(3).

4.2 Specific

None.

5 Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

[Amdt ETSO/17]
[Amdt ETSO/18]