# Certification Specifications for ETSO (CS ETSO) Amendment 17 — Change information

The European Union Aviation Safety Agency (EASA) publishes issues of certification specifications (CSs) as consolidated documents. These documents are used to establish the certification basis for applications submitted after the date of entry into force of the applicable issue.

The consolidated CS-ETSO Amendment 17 (the Annex to ED Decision 2022/018/R) does not highlight the changes introduced. To show the changes, this change information document was created, using the following format:

(a) deleted text is ~~struck through~~;

(b) new or amended text is highlighted in blue;

(c) an ellipsis '[…]' indicates that the rest of the text is unchanged.

***Note to the reader***

*In amended, and in particular in existing (that is, unchanged) text,* 'Agency' *is used interchangeably with* 'EASA'. *The interchangeable use of these two terms is more apparent in the consolidated versions. Therefore, please note that both terms refer to the* 'European Union Aviation Safety Agency (EASA)'.

# SUBPART A — GENERAL

## 1. APPLICABILITY

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

1.2 The ~~M~~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 ~~d~~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, entitled 'Airborne Software Development Assurance using EUROCAE ED-12 and RTCA ~~d~~Document DO-178', which~~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 software level, also known as the 'item development assurance level (IDAL)', ~~should~~ shall be determined according to the failure conditions to which it contributes; see ~~by using the guidance proposed in~~ Section 2.4 for guidance. The applicant must declare the software level(s) to which the software has been developed and verified.

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[1], entitled '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)', ~~should~~ shall be determined according to the failure conditions to

[1] Refer to ED Decision 2020/010/R (https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2020010r ~~https://www.easa.europa.eu/document-library/agency-decisions~~).

which it contributes; see ~~by using the guidance proposed in~~ Section 2.4 for guidance. The applicant must declare the hardware DAL(s) to which ~~it~~the item has been developed and verified.

2.4 Failure condition classification and development assurance

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 (for further guidance see AMC material to related aircraft level requirements in the applicable certification specification (CS), for instance, AMC ~~CS~~ 25.1309 or AMC ~~CS~~ 23.2500/2510~~for further guidance~~).

~~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.~~

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. The assumed failure classification should be at least as high as the minimum hazard classification level required in the ETSO.

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-79A/ARP4754A, 'Guidelines for Development of Civil Aircraft and Systems', dated December 2010, 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.

When the article implements software or airborne electronic hardware, the ETSO article shall be developed according to at least the development assurance level that is appropriate for the failure condition classifications that are expected for the intended installation.

EUROCAE/SAE ~~d~~Document ED-79A/ARP~~ ~~4754A~~, 'Guidelines for Development of Civil Aircraft and Systems', dated December 2010,~~ should be used ~~to assign the development assurance levels of the ETSO article, software and AEH. The document should also be used~~ as guidance to ensure that a proper development, validation and verification process is followed for the ETSO article and its functional requirements.

[...]

## 3. ADDITIONAL 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 ~~S~~standards documents referred to in this CS-ETSO may be purchased or obtained from the following organisations:

[...]

— RTCM documents:
Radio Technical Commission for Maritime Services
1621 N. Kent St., Suite 705
Arlington, Virginia 22209 USA

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

[...]

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# SUBPART B — LIST OF ETSOs

[...]

**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 | Aircraft Position Lights | CS-ETSO/13 |

| **EASA ETSO ref.** | **Title** | **Last amended by** |
|---|---|---|
| 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 |
| ETS0-C44c A1 | Fuel Flowmeters | CS-ETSO/8 |
| ETS0-C45b A1 | Manifold Pressure Instruments | CS-ETSO/8 |
| ETSO-C46a | Maximum Allowable Airspeed Indicator System | CS-ETSO/Initial Issue |
| ETS0-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/~~7~~17 |
| ETS0-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-C63~~e~~f | Airborne Weather Radar Equipment | CS-ETSO/~~13~~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 |

| EASA ETSO ref. | Title | Last amended by |
|---|---|---|
| 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 |
| ETSO-C90d A1 | Cargo Pallets, Nets and Containers | CS-ETSO/11 |
| ETSO-C92c | Ground Proximity Warning, Glide Slope Deviation Alerting Equipment | CS-ETSO/Initial Issue |
| ETSO-C95a | Mach Meters | CS-ETSO/7 |
| ETSO-C96~~b~~c | Anticollision Light Systems | CS-ETSO/~~13~~17 |
| 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 ~~A1~~ | Air Data Computer | CS-ETSO/~~8~~17 |
| ETSO-C109 | Airborne Navigation Data Storage System | CS-ETSO/Initial Issue |
| ETSO-C110a | Airborne Passive Thunderstorm Detection Systems | CS-ETSO/Initial Issue |
| ETSO-C112e | Secondary Surveillance Radar Mode S Transponder | CS-ETSO/11 |
| 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 |

| EASA ETSO ref. | Title | Last amended by |
|---|---|---|
| ETSO-C118a | Traffic Alert and Collision Avoidance System I (TCAS I) | CS-ETSO/13 |
| ETSO-C119~~d~~e | Airborne Collision Avoidance System II (ACAS II) Version 7.1 with Hybrid Surveillance | CS-ETSO/~~11~~17 |
| ETSO-C121b | Underwater Locating Device | CS-ETSO/8 |
| ETSO-C126c | Emergency Locator Transmitter | CS-ETSO/16 |
| ETSO-C127~~b~~c | Rotorcraft, Transport Aeroplane, and Small Aeroplane Seating Systems | CS-ETSO/~~11~~17 |
| ETSO-C132a | Geosynchronous Orbit Aeronautical Mobile Satellite Services Aircraft Earth Station Equipment | CS-ETSO/12 |
| 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/~~11~~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-C157~~b~~c | Flight Information Services-Broadcast (FIS-B) Equipment | CS-ETSO/~~12~~17 |
| ETSO-C158 | Aeronautical Mobile High Frequency Data Link (HFDL) Equipment | CS-ETSO/7 |
| ETSO-C159d | Next Generation Satellite Systems (NGSS) Equipment | CS-ETSO/16 |

| EASA ETSO ref. | Title | Last amended by |
|---|---|---|
| ETSO-C160a A1 | VDL Mode 2 Communications Equipment | CS-ETSO/16 |
| ETS0-C161~~a~~b | Ground-Based Augmentation System Positioning and Navigation Equipment | CS-ETSO/~~7~~17 |
| ETSO-C162~~a~~b | Ground-Based Augmentation System Very High Frequency Data Broadcast Equipment | CS-ETSO/~~7~~17 |
| ETSO-C165b | Electronic Map Systems for Graphical Depiction of Aircraft Position | CS-ETSO/16 |
| ETS0-C166b A3 | 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/13 |
| ~~ETSO-C168~~ | ~~Aviation Visual Distress Signals~~ | ~~CS-ETSO/16~~ |
| 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 |
| ETSO-C173a | Nickel-Cadmium, Nickel Metal-Hydride, and Lead-Acid Batteries | CS-ETSO/11 |
| ETS0-C174 A1 | Battery-Based Emergency Power Unit (BEPU) | CS-ETSO/8 |
| ETSO-C175 | Galley Cart, Containers and Associated Components | CS-ETSO/3 |
| ETSO-C178a | ~~Single Phase 115 VAC, 400 Hz Arc Fault~~ Aircraft Circuit Breakers | CS-ETSO/~~8~~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 |

| **EASA ETSO ref.** | **Title** | **Last amended by** |
|---|---|---|
| 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 |

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| 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-2C169a | VHF Radio Communications Transceiver Equipment Operating within the Radio Frequency Range 117.975 to 137 Megahertz | CS-ETSO/6 |
| 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-2C502 | Helicopter Crew and Passenger Integrated Immersion Suits | CS-ETSO/1 |
| ETSO-2C503 | Helicopter Crew and Passenger Immersion Suits for Operations to or from Helidecks Located in a Hostile Sea Area | CS-ETSO/1 |
| ETSO-2C504 | Helicopter Constant-Wear Life Jackets for Operations to or from Helidecks Located in a Hostile Sea Area | CS-ETSO/1 |
| ETSO-2C505 | Helicopter Life Rafts for Operations to or from Helidecks Located in a Hostile Sea Area | CS-ETSO/1 |
| 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-2C519 | Emergency Breathing Systems (EBSs) | CS-ETSO/16 |
| ETSO-2C520 | 406-MHz Satellite Personal Locator Beacon | CS-ETSO/17 |
| ETSO-2C521 | Electronic Flight Bag (EFB) Software Applications | CS-ETSO/17 |
| ETSO-2C522 | Helicopter Terrain Awareness and Warning System (HTAWS) Advanced Features | CS-ETSO/17 |

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# INDEX 1 EUROPEAN TECHNICAL STANDARD ORDERS

## ETSO-C55a A1

FUEL AND OIL QUANTITY INSTRUMENTS

**1 Applicability**

This ETSO provides ~~gives~~ the requirements that~~which~~ fuel and oil quantity instruments 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 a~~A~~pplicable 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~~The applicable standards are those provided in ~~the~~:

— SAE Aerospace Standard (AS) 405C 'Fuel and oil quantity Instruments', dated July 2001 ~~as amended and supplemented by this ETSO:~~; or

— SAE Aerospace Standard (AS) 405D 'Fuel and oil quantity Instruments', dated August 2012,

both modified by Appendix 1 to this ETSO.

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

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

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

As specified in ~~the~~ SAE Aerospace Standard AS-405C or AS405D.

3.1.3 ~~Computer~~ Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware ~~Qualification~~

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

## 4 Marking

4.1 General

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

4.2 Specific

~~a.~~ ~~Mark at~~ At least one major component must be permanently and legibly marked with all the information in SAE AS405C or AS405D, Section 3.2 (except paragraph 3.2.b). Also, ~~mark~~ the component must be marked with the following information:

(1) The basic type and accuracy classification, and

(2) The fluids for which the instrument is substantiated.

~~b. If the fuel and oil quantity instrument includes a digital computer, then the part number must include hardware and software identification. Or, you can use a separate part number for hardware and software. Either way, you must include a means to show the modification status.~~

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

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/7]
[Amdt ETSO/17]

# APPENDIX 1 TO ETSO-C55a A1 —.FUEL AND OIL QUANTITY INSTRUMENTS

This Appendix prescribes the minimum performance standard for fuel and oil quantity instruments, as modified by EASA.

The applicable standard is:

— SAE AS405C 'Fuel and Oil Quantity Instruments', dated July 2001; or
— SAE AS405D 'Fuel and oil quantity Instruments', dated August 2012.

Conformance with the following paragraphs of SAE AS405C or AS405D is not required: 3.1, 3.1.1, 3.1.2, 3.2 and 4.2.1.

A.1. ADDITIONS TO SAE AS405C or AS405D, PARAGRAPH 5

Paragraph 5.7, Instrument Setup

a. Before starting tests, set up the instrument as follows:

(1) place the sensor component in a simulated fuel or oil tank, and the indicator and other components in a convenient location; and

(2) connect all the components using the same means as is required when the instrument is in service.

b. You may choose to test individual components. When testing components individually, provide proper inputs or outputs for the components being tested.

Paragraph 5.8, Accuracy Tolerances

All accuracy tolerances are for the complete system. Before testing components individually, connect the components per the manufacturer's instructions. The complete system must meet the tolerances of Table 1 (see SAE AS8029, 'Minimum Performance Standard for Fuel and Oil Quantity Indicating System Components', dated June 1983):

**Table 1 — Accuracy tolerances for the complete system**

| Class | Accuracy tolerance |
|---|---|
| 1 | ± 0.75 % full scale |
| 2 | ± 2 % of full scale |
| 3 | ± 3 % of full scale |

Paragraph 5.9, Ambient Room Conditions

At ambient room conditions, test the instrument for scale errors, hysteresis errors, friction errors, and position errors. The resulting total error must not exceed the values in the applicable listing in Table 1 of this Appendix.

Paragraph 5.10, Applicable Environmental Conditions

Test the instrument under the applicable environmental conditions. The resulting total error must not exceed the values in the applicable listing in Table 1 of this Appendix.

A.2. MODIFICATIONS TO SAE AS405C or AS405D, PARAGRAPH 6

| Replace all the wording in: | With: |
|---|---|
| Paragraph 6.1, Scale Error | Adjust the tank unit and all the components before the test. You cannot adjust anything during the test. Immerse the tank unit, and compensators when used, in the test fluid. Calculate the percentage of errors by comparing the readings taken from the design calibration of the system or component you are testing. |
| Paragraph 6.2, Friction | Test all the components with moving parts for friction errors at several points. Test the components by applying the needed inputs to bring the output to a desired test point. Hold the input constant while taking the two output readings. Take the first reading before vibrating the indicator. Take the second reading after vibrating the indicator. |
| Paragraph 6.4, Position Error | To obtain a reading near mid-scale, the fluid tank should be about half-full, or have the equivalent electrical input. Hold each component (except the tank unit) in several different positions and record any change in output. Test the instrument for position errors in several positions. |

A.3. ADDITIONS TO SAE AS405C or AS405D, PARAGRAPH 6.

Paragraph 6.8, Hysteresis Error

Test the instrument for hysteresis at several points. Increase the test fluid level or apply equal inputs to each selected test point and hold them while taking a reading.

Paragraph 6.9, Speed of Response

At ambient room conditions, the indicator must register from empty to full or vice versa in less than 30 seconds, but more than 5 seconds. When testing at any environmental extremes, the speed of response must not exceed 3 times the time measured at ambient room conditions.

A.4. MODIFICATIONS TO SAE AS405C or AS405D, PARAGRAPH 7

*Replace:*

> ‘As many instruments as deemed necessary to demonstrate that all instruments will comply with the requirements of this section shall be tested in accordance with the manufacturer’s recommendation.’

*with the following:*

'Performance tests: The following tests, in addition to any others deemed necessary by the manufacturer, shall be the basis for determining compliance with the performance requirements of this standard.'

A.5. ADDITIONS TO SAE AS405C or AS405D, PARAGRAPH 7

Add the following new paragraphs:

Paragraph 7.7, Operational Shock Tests

Use the test requirements in Section 7 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.8, Explosion Proof Test

Use the test requirements in Section 9 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.9, Power Input Test

Use the test requirements in Section 16 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.10, Voltage Spike Test

Use the test requirements in Section 17 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.11, Audio Frequency Conducted Susceptibility Test

Use the test requirements in Section 18 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.12, Induced Signal Susceptibility Test

Use the test requirements in Section 19 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.13, Radio Frequency Susceptibility Test

Use the test requirements in Section 20 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.14, Emission of Radio Frequency Energy Test

Use the test requirements in Section 21 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.15, Lightning Induced Transient Susceptibility Test

Use the test requirements in Section 22 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.16, Lightning Direct Effects Test

Use the test requirements in Section 23 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.17, Electrostatic Discharge Test

Use the test requirements in Section 25 of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1.

Paragraph 7.18, Flammability Test

All the materials used must be self-extinguishing when tested in accordance with the applicable requirements of RTCA/DO-160E or later version as defined in CS-ETSO, Subpart A, paragraph 2.1, Section 26, Category C, Flammability Test. This requirement does not apply to small parts (where the greatest equipment dimension is less than 50 mm, such as knobs, fasteners, seals, grommets and small electrical parts) that do not contribute significantly to fire propagation.

[Amdt ETSO/17]

# ETSO-C63ef

## AIRBORNE WEATHER RADAR EQUIPMENT

### 1 Applicability

This ETSO provides the requirements that airborne weather radar 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.

This ETSO standard addresses weather detection and ground mapping, forward-looking wind shear detection, forward-looking turbulence detection, and atmospheric threat awareness capability. It does not include flight guidance system functionality in support of an approved wind shear detection and avoidance system.

### 2 Procedures

2.1 General

The a~~A~~pplicable 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~~ The applicable standard is that provided in RTCA Document DO-220A, Change 1, *Minimum Operational Performance Standards ~~(MOPS)~~ for Airborne Weather Radar Systems*, dated ~~March 17, 2016~~ 17 August 2018, for the equipment classes defined in Table 1.

***Table 1 — Airborne Weather Radar Equipment Classes and Applicable MPSs***

| Equipment Class | Equipment Type | Minimum Performance Standards |
|---|---|---|
| A | Forward-Looking Wind ~~s~~Shear Detection Capability | The following sections of RTCA DO-220A, Change 1:<br>Section 2.2, with the following exclusions: paragraphs 2.2.1.3.6, 2.2.1.3.7, 2.2.2, 2.2.4, and 2.2.5~~.~~, and<br>Sections 2.3 (performance under environmental conditions) and 2.4 (test requirements) as applicable to the class. |
| B | Forward-Looking Turbulence Detection Capability | The following sections of RTCA DO-220A, Change 1:<br>Section 2.2, with the following exclusions: paragraphs 2.2.1.3.5, 2.2.1.3.7, 2.2.2, 2.2.3, and 2.2.5~~.~~, and<br>Sections 2.3 (performance under environmental conditions) and 2.4 (test requirements) as applicable to the class. |
| C | Airborne Weather and Ground Mapping Pulsed Radar | The following sections of RTCA DO-220A, Change 1:<br>Section 2.2, with the following exclusions: paragraphs 2.2.1.3.5, 2.2.1.3.6, 2.2.1.3.7, 2.2.3, 2.2.4, and 2.2.5~~.~~, and<br>Sections 2.3 (performance under environmental conditions) and 2.4 (test requirements) as applicable to the class. |

| Equipment Class | Equipment Type | Minimum Performance Standards |
|---|---|---|
| D | Atmospheric Threat Awareness Capability | The following sections of RTCA DO-220A, Change 1:<br>Section 2.2, with the following exclusions: paragraphs 2.2.1.3.5, 2.2.1.3.6, 2.2.2, 2.2.3, and 2.2.4.<br>Sections 2.3 (performance under environmental conditions) and 2.4 (test requirements) as applicable to the class. |

~~***Table 1 – Airborne Weather Radar Equipment Classes and Applicable MPS***~~

Any of these classes may be implemented individually or in combination. Therefore, a piece of equipment may be eligible for one or more classes.

**Functionality**

This ETSO standard applies to equipment intended to:

(1) Provide airborne wind shear detection (equipment Class A). Equipment Class A provides forward-looking wind shear detection functionality. However, this ETSO does not include flight guidance system functionality in support of an approved wind shear detection and avoidance system;

(2) Provide advanced and advisory indication of potentially hazardous turbulence conditions detectable by weather radar, together with other flight information, to assist pilots with turbulence avoidance decisions (Equipment Class B);

(3) Detect and display echoes from precipitation to assist in flight crew analysis of weather. Maintain contact with geographic features such as international shoreline boundaries as a supplement to navigational orientation (Equipment Class C); and

(4) Provide timely and advisory information to pilots to enhance their situational awareness of atmospheric activity and assist with atmospheric threat avoidance decisions (Equipment Class D).

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 defined in paragraph~~s~~ 3.1.1(2) or 3.1.1(4) resulting in unannunciated malfunction ~~of the function~~ or missed detection is a minor failure condition.

Failure of the function defined in paragraph 3.1.1(1) or 3.1.1(3) resulting in unannunciated malfunction ~~of the function~~ or missed detection is a major failure condition.

Loss of the functions defined in paragraph 3.1.1 is a minor failure condition.

3.2.2 Installation Manual

The applicant should provide a manual(s) containing the following items:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability;

(2) For Equipment Class B, identify the installation instructions for the identified aircraft class selected from RTCA/DO-220A, Change 1, paragraph 2.2.4.1, Table 2-4;

(3) The ~~E~~expected radome performance for the electromagnetic signals passing through it (paragraph 2.2 of RTCA DO-213A, Change 1 Minimum Operational Performance Standards for Nose-Mounted Radomes, dated ~~March 17, 2016~~ June 21, 2018);

(4) The ~~W~~weather performance index (range) in accordance with the requirements of RTCA DO-220A, Change 1; and

(5) The ~~W~~wind shear detection range in accordance with the requirements of RTCA DO-220A, Change 1.

## 4 Marking

4.1 General

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

4.2 Specific

The markings must also include the equipment class(es), as defined in Table 1.

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

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

# ETSO-C96bc

## ANTICOLLISION LIGHT SYSTEMS

### 1 Applicability

This ETSO provides the requirements thatwhich 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 Aapplicable 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 forthThe applicable standard is that provided in the Society of Automotive Engineers, Inc., (SAE) Aerospace Standard AS8017CD "*Minimum Performance Standard for Anticollision Light Systems*", dated June 2011 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

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

4.2 Specific

None.

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 Documents**

See CS-ETSO, Subpart A, paragraph 3.

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

## APPENDIX 1 TO ETSO-C96c — ANTICOLLISION LIGHT SYSTEMS

A.1 In Section 1.2 of Society of Automotive Engineers, Inc., (SAE) Aerospace Standard AS8017D 'Minimum Performance Standard for Anticollision Light Systems', dated August 2017, below the row defining Class III and the new row defining Class IV, add the following:

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

Below the lines defining the different classes in Section 1.2 of Society of Automotive Engineers, Inc., (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 Society of Automotive Engineers, Inc., (SAE) AS8017D 'Minimum Performance Standard for Anticollision Light Systems', dated August 2017, remove the following:

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

A.3 In Section 3.4 of Society of Automotive Engineers, Inc., (SAE) 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 with the alternate colour definitions detailed in Section 3.4.1 (without compliance with 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]

# ETSO-C106a ~~A1~~

AIR DATA COMPUTER

## 1 Applicability

This ETSO ~~gives~~ provides the requirements that~~which~~ air data computers 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 ~~A~~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 ~~Minimum performance standards set forth~~ in ~~the~~ SAE ~~Aerospace Standard (AS)~~ AS~~-~~8002B ~~„~~‘Air Data Computer’~~“~~, dated 28 April 2020.~~April 1, 1985, as amended by this ETSO:~~

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

~~Static source error correction (if applicable)~~

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

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

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

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

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

~~— Exception TABLE 3, CALIBRATED AIRSPEED: A looser tolerance of ± 6.5 km/h (3.5 knots) may be used at the 148 km/h (80 knots) reference point.~~

3.1.2 Environmental Standard

See 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.

**4 Marking**

4.1 General

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

4.2 Specific

~~None.~~Marking of the type of air data computer is required (i.e. Type 1 or Type 2).

**5 Availability of referenced document**

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/8]
[Amdt ETSO/17]

# ETSO-C119de

## AIRBORNE COLLISION AVOIDANCE SYSTEM II (ACAS II) VERSION 7.1 WITH HYBRID SURVEILLANCE

### 1 Applicability

This ETSO provides the requirements thatwhich Airborne Collision Avoidance System II (ACAS II) Version 7.1 equipment that are 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 Aapplicable 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 The applicable standards are those provided in EUROCAE Document ED-143, 'Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II)', dated September 2008, Section 2 as modified by Change 1 dated April 2009, Change 2 (Version 7.1) dated April 2013, and by Appendix 1 to this ETSO and EUROCAE Document ED-221A, 'Minimum Operational Performance Standards (MOPS) for Traffic Alert and Collision Avoidance System II (TCAS II) Hybrid Surveillance', dated April 2013 December 2015, Sections 2 and 3, as modified by Appendix 2 to this ETSO.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Computer Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware Qualification

See CS-ETSO, Subpart A, paragraph 2.3.

#### 3.2 Specific resulting in misleading information

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 hazardous failure condition.

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

### 4 Marking

### 4.1 General

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

### 4.2 Specific

None.

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]
[Amdt ETSO/17]

# APPENDIX 1 TO ETSO-C119de – TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM II (TCAS II) VERSION 7.1 AMENDMENT TO THE EUROCAE ED-143 CHANGE 2 REQUIREMENTS

This Appendix lists the EASA modifications to the MPS for Traffic Alert Aand Collision Avoidance System (TCAS) Airborne Equipment, TCAS II Change 2, dated April 2013.

When the own ship is on the ground, clarification is required to allow the system to limit the output of TCAS intruders to the display to those within 3 000 feet of the own altitude. In lieu of Section '2.2.2 System Performance' of EUROCAE ED-143 Change 2, substitute the following:

**'2.2.2 System Performance**

***Note:*** *When operating within the maximum aircraft transponder population and electromagnetic interference levels defined in subparagraph 2.2.1.2, TCAS II will provide a level of performance for active surveillance of targets-of-interest that will support the requirements for generation of collision advisory information.*

*Specifically, TCAS II will generate a surveillance track in range and altitude on a target-of-interest at the range and with the track probability and range accuracy specified below. This is to ensure that a correct resolution advisory can be issued in time for the pilot to maintain adequate vertical separation at closest-point-of-approach.*

*TCAS II will also generate, whenever possible, a surveillance track in range and altitude on a target-of-interest at the range and with the track probability and range accuracy specified below such that a correct traffic advisory can be issued as a precursor to the resolution advisory.*

*In addition to the surveillance requirements to support the generation of resolution and traffic advisories, TCAS II will display the range and, if available, the altitude and bearing position information on targets that generate advisories. The bearing position information will be generated according to the accuracy requirement specified below.*

*TCAS II will also generate for display, whenever possible, surveillance range, altitude and bearing position information on Mode C and Mode S aircraft that are within the range specified below and within ± 10 000 ft altitude relative to TCAS II when airborne, and within ± 3 000 ft altitude relative to TCAS II when on the ground.*

*It is acceptable to limit the output of TCAS intruders to the display to those within 3 000 ftfeet of the own altitude when the own aircraft is on the ground. This is permitted (but not required) so that the altitude surveillance volume for TCAS Mode C intruders can be consistent with the Mode S surveillance altitude limits modified in EUROCAE ED-143 Change 2 (Section 2.2.4.6.2.2.1). This allowance to limit the display to ± 3 000 ft does not modify the surveillance altitude volumes which are defined in EUROCAE ED-143, Section 2.2.4.6.*

*The system shall use the definition of on-ground as defined in EUROCAE ED-143, Volume II, Section 2.1.14. Alternatively, the system may use the definition of 'operating on Ssurface' in EUROCAE ED-221A, sSection 2.2.8, for on-ground.'*

[Amdt ETSO/11]
[Amdt ETSO/17]

# APPENDIX 2 TO ETSO-C119de – — TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM II (TCAS II) VERSION 7.1 HYBRID SURVEILLANCE AMENDMENT TO THE EUROCAE ED-221A REQUIREMENTS

This Appendix lists the EASA modifications to ~~MPS~~ EUROCAE ED-221A for Traffic Alert and Collision Avoidance System II (TCAS II) Hybrid Surveillance, dated ~~April 2013~~ December 2015.

To facilitate the monitoring by maintenance personnel of the hybrid surveillance functionality, add the following requirement as the fifth paragraph (including the Note) in Section 2.2.10, Monitoring Requirements:

> 'TCAS II units shall provide a means for presenting logged hybrid surveillance faults to maintenance personnel to enable on-wing monitoring of hybrid surveillance functionality at periodic intervals.

*Note:* This requirement enables the implementation of a scheduled maintenance task to ensure that hybrid surveillance is functional on aircraft without a centralised warning system and/or an on-board maintenance computer.'

~~Text from EUROCAE ED-221 is provided here as needed to provide context. Text to be added is underlined. Text to be removed is lined through.~~

~~**1 To ensure proper revalidation when own aircraft is operating on the surface, in the first paragraph of EUROCAE ED-221, section 2.2.7.5 'Revalidation', insert the following** new underlined text:~~

~~An established track that is under hybrid surveillance (per §2.2.7.1) **shall** be subject to revalidation. If a track under hybrid surveillance does not satisfy the first (altitude) condition of §2.2.6.1.4, it shall be subject to revalidation every 60th surveillance update interval; if it satisfies the first and second (altitude and range) conditions of §2.2.6.1.4 but not the third (airborne) condition, it shall be subject to revalidation every 10th surveillance update interval; if it satisfies the first condition of §2.2.6.1.4 but not the second (range) condition, it **shall** be subject to revalidation at intervals calculated according to the following procedure. The revalidation interval *t* **shall** be calculated at the time of the initial successful validation and at the time of each successful revalidation. It **shall** be used as the number of surveillance update intervals until the next revalidation attempt.~~

~~1.2 Because there is a requirement specifying creation of information which is never used, in EUROCAE ED-221, section 2.2.11 'Interface to the CAS Logic', delete existing lined through text from the first paragraph as follows:~~

~~Position data for tracks under passive surveillance may be provided to the CAS logic via the interface specified in Ref. A, §2.2.4.8.1. If this is done, information **shall** be provided in addition to that required in Ref. A, §2.2.4.8.l(a) to distinguish a position report that resulted from a passive reception of an Airborne Position Message from one that resulted from an active interrogation.~~

~~1.3 Tests 2, 3a and 3b specified in EUROCAE ED-221, section 2.4.2.5 'Verification of Acquisition and Maintenance of Established Tracks Using Active Surveillance' (§2.2.6), do not need to be performed as their expected results are incorrect. Test coverage of the input conditions associated with those tests is provided, in aggregate, by other existing tests in EUROCAE ED-221.~~

1.4 A new Test 11a is required in addition to the existing Test 11 specified in EUROCAE ED-221, section 2.4.2.6 'Verification of Maintenance of Established Tracks using Passive Surveillance' (§2.2.7). This new test is to verify the revalidation rate when own aircraft is operating on the surface. Perform this new test in addition to the existing Test 11; the new test does not replace Test 11. Insert the following new underlined text after existing Test 11:

**Test 11a (Intruder Revalidation Rate when own aircraft is operating on the surface §2.2.7.5)**

This test verifies the revalidation rate when own aircraft is operating on the surface based on the altitude and range criteria for active tracking (§2.2.7.5).

(The following tests may be performed using ADS-B reports or directly decoded ADS-B messages. TIS-B and ADS-R data is not permitted.)

**Scenario Description**

- Intruder 1 shows that when own aircraft is operating on the airport surface and an intruder is within the altitude and range criteria for active surveillance it will be tracked using hybrid surveillance with a 10-second revalidation rate (§2.2.7.5).
- Intruder 2 shows that when own aircraft is operating on the airport surface and an intruder is within the altitude but not the range criteria for active surveillance it will be tracked using hybrid surveillance with a variable revalidation rate according to the requirements in (§2.2.7.5).

TCAS Aircraft

Altitude = 0 ft (Ground Level)

Altitude Rate = 0 FPM

Position = Sydney

Radio altitude input = 0 ft

Ground Speed is valid and at 0 knots and TCAS Air/Ground (OOGROUN) indicates on-ground.

Intruder Aircraft #1

Altitude = 2 000 ft

Altitude Rate = 0 FPM

Range = 2 NM

Relative Speed = 0 kt

At T = 100 the intruder is terminated.

Intruder Aircraft #2

Altitude = 2 000 ft

Altitude Rate = 0 FPM

Range = 8 NM

Relative Speed = 0 kt

At T = 100 the intruder is terminated.

**Success Criteria**

For the tests in this section, the revalidation rate for each applicable success criteria was identified using the table in §2.2.7.5. If the implementation uses the equation method, then the revalidation interval can be longer by 10 to 20 seconds. Care should be taken to verify that the success criteria matches the value expected based on the implementation.

For each intruder:

The surveillance reports to the CAS logic are present for the duration of the track. Verify that the track is under passive surveillance.

Intruder 1

Verify that revalidation interrogations are transmitted every 10 seconds.

Intruder 2

Verify that revalidation interrogations are transmitted every 30 seconds.

The revalidation rate for each applicable success criteria was identified using the table in §2.2.7.5. If the implementation uses the equation method, then the revalidation interval can be longer by up to 10 to 20 seconds. Care should be taken to verify that the success criteria matches the value expected based on the implementation.

1.5 EUROCAE ED-221 removes a provision which allowed for larger range calculation errors above ± 60 degrees latitude from RTCA/DO-300, Section 2.2.7.6 (from which ED-221 is derived), but the associated tests were not updated accordingly. To account for the removal of that provision, delete the following lined through text from EUROCAE ED-221, sections 2.4.2.8 'Verification of Error Budget in Computing Slant Range from Passive Data' and 2.4.2.10 'Verification of DF17 Decoding', and insert as underlined below a clarifying note in Appendix A 'Conversion of Reported Positions to Slant Range', section A.1 'Overview'.

**2.4.2.8 Verification of Error Budget in Computing Slant Range from Passive Data**

(…)

If the test method is used to demonstrate compliance with the requirement, then this paragraph describes one potential scenario. Own aircraft and intruder aircraft are travelling towards each other at 600 kt at high latitude (near 60 degrees). If the error between the passive range estimate and active range measurement is less than 145 meters then the intent of the requirement is met. The error in range computation of tests at slower closure rates can be used to extrapolate or predict errors at the 1 200 kt closure rate.

(…)

**2.4.2.10 Verification of DF17 Decoding**

(…)

Success Criteria

All Intruders.

For all of the Intruders with Latitudes within ±60 degrees, verify that the range for each intruder is within 145 m of the calculated range identified in Table 3.

~~For all of the Intruders with Latitudes within ±60 degrees, verify that the bearing for each intruder is within 3 degrees of the calculated bearing identified in Table 3.~~

~~Verify that the error in range from the calculated range does not use more of the error budget allowed for range based on the completion of Test §2.4.2.8 (Verification of Error Budget in Computing Slant Range from Passive Data) Test 1.~~

~~(…)~~

## ~~A.1 OVERVIEW~~

~~This Appendix provides useful guidance on computing range from own and reported position data. This Appendix does not recommend a particular implementation and should be used for reference only.~~

~~Firstly, the exact conversion equations from position to slant range are given. The computational requirements for the exact conversion equations are reasonable and could be used as is for modern processors and typical TCAS traffic loads.~~

~~Secondly, several approximate conversion equations from position to slant range are presented. For circumstances where hybrid surveillance is implemented as a software upgrade to existing processors, it may be desirable to use approximations to the conversion equations to reduce the computational requirements. The errors in the approximate equations are presented and compared to the computational accuracy requirements of §2.2.7.6, which requires a maximum 145 m processing error when calculating slant range.~~

~~*Note: The equations in A.2 provide an example of conversion equations which meet the accuracy requirements. The approximation equations provided in the Appendix may not provide the required accuracy.*~~

[Amdt ETSO/11]
[Amdt ETSO/17]

# ETSO-C127~~b~~c

## ROTORCRAFT, TRANSPORT AEROPLANE, AND SMALL AEROPLANE SEATING SYSTEMS

**1 Applicability**

This ETSO provides the Minimum Performance Standards (MPSs) that rotorcraft, large (transport) aeroplane, and small aeroplane seating systems of the following designated types 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's standards~~The standards of this ETSO apply to equipment intended to be utilised as aircraft seating systems of the following classifications:

**(1) Seat Type and applicable Aircraft Category:**

(a) Type A ~~Airplane~~Aeroplane. Aircraft Category: Transport

(b) Type B Rotorcraft. Aircraft Category: Large (Transport) or Small (Normal)

(c) Type C Small ~~Airplane~~Aeroplane. Aircraft Category:

(CS-23 up to Amendment 4) Normal, Utility, Acrobatic, or Commuter;

(CS-23 Amendment 5 and subsequent amendments) Normal Level 1, Normal Level 2, Normal Level 3, Normal Level 4.

**(2) Seat Subtype:**

(a) Subtype 1 Passenger

(b) Subtype 2 Flight Attendant

(c) Subtype 3 Observer

(d) Subtype 4 Pilot/Co-pilot

**(3) Seat Orientation:**

~~(a) Forward-Facing~~

~~(b) Rearward-Facing~~

~~Note: Seats with installation limitations of angles more than 18 degrees from the aircraft centre line are not addressed by this standard. See Appendix 1 to this ETSO amending SAE AS8049B, subsection 5.3.3.5.i.~~

(a) Forward facing — Installation of forward-facing seating systems in the aircraft at up to an angle of 18° relative to the aircraft longitudinal axis.

(b) Rearward facing — Installation of rearward-facing seating systems in the aircraft at up to an angle of 18° relative to the aircraft longitudinal axis.

(c) Side facing — Installation of side-facing seating systems in the aircraft at between 80° and 100° relative to the aircraft longitudinal axis.

(d) Oblique facing — Installation of forward-facing seating systems in the aircraft, at greater than 18° and no greater than 45° relative to the aircraft longitudinal axis.

**2 Procedures**

**2.1 General**

The ~~A~~applicable procedures are detailed in CS-ETSO, Subpart A.

**2.2 Specific**

None.

**3 Technical Conditions**

**3.1 ~~General~~ Basic**

The standards of this ETSO apply to equipment intended to be utilised as aircraft seating systems.

3.1.1 Minimum Performance Standard

New models of rotorcraft, large (transport) aeroplane ~~airplane~~, and small aeroplane ~~airplane~~ seating systems identified and manufactured on or after the effective date of this ETSO must meet the requirements in the following standards: ~~SAE International's Aerospace Standard (AS) 8049B, Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft, dated January 2005, as modified by Appendix 1 to this ETSO; SAE Aerospace Recommended Practice (ARP) 5526C, Aircraft Seat Design Guidance and Clarifications, dated May 2011, as modified by Appendix 1 to this ETSO; and Appendix 2 to this ETSO (for specific elective requirements).~~

— SAE AS8049C, 'Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated August 2015, as modified by Appendix 1 to this ETSO;

— SAE AS8049/1B, 'Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated December 2016, as modified by Appendix 1 to this ETSO;

— SAE ARP5526D, 'Aircraft Seat Design Guidance and Clarifications', dated July 2015, as modified by Appendix 1 of this ETSO;

— SAE AS6316, 'Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft', dated June 2017, as modified by Appendix 1 to this ETSO;

— SAE ARP6337, 'Design, Manufacturing, and Performance Standard for Composite Materials Used on Aircraft Seat Structures', dated November 2020, as modified by Appendix 1 of this ETSO, and by Appendix 2 to this ETSO for specific elective requirements.

3.1.1.1 Functional Qualification

Demonstrate the required functional performance under the test conditions specified in:

— SAE AS8049C, 'Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated August 2015, as amended by Appendix 1 of this ETSO for forward- and aft-facing seats;

— SAE AS8049/1B, 'Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated December 2016, as modified by Appendix 1 to this ETSO for side-facing seats;

— SAE AS6316, 'Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft', dated June 2017, as modified by Appendix 1 to this ETSO for oblique-facing seats;

— SAE ARP5526D, 'Aircraft Seat Design Guidance and Clarifications', dated July 2015, as amended by Appendix 1 to this ETSO;

— SAE ARP6337, 'Design, Manufacturing, and Performance Standard for Composite Materials Used on Aircraft Seat Structures', dated November 2020, as modified by Appendix 1 to this ETSO; and

— Appendix 2 of this ETSO for specific elective requirements.

3.1.2 Environmental Standard

~~None~~ Not applicable.

3.1.3 ~~Computer~~ Software

~~None~~ Not applicable.

3.1.4 Airborne Electronic Hardware

Not applicable.

**3.2 Specific**

~~None.~~

3.2.1 Failure Condition Classification

There is no standard minimum failure condition classification for this ETSO. The failure condition classification appropriate for the article will depend on the intended use of the article in a specific aircraft. The loss of function and the malfunction failure condition classifications for which the equipment is designed should be documented.

## 4 Marking

**4.1 General**

~~Marking is detailed in CS-ETSO, Subpart A, paragraph 1.2. In addition, each seating system shall be legibly and permanently marked with the following:~~

The permanent and legible marking of at least one major component is required, with all the information as detailed in CS-ETSO, Subpart A, paragraph 1.2.

**4.2 Specific**

The markings must also include the serial number and the following:

~~(i)~~ (1) The specific seat MPS complied with as abbreviated by paragraphs 4.2(1)(a)~~4.a.(1).(a) through~~ to 4.2(1)(e)~~4.a.(1).(e)~~ below. Separate each applicable identifier with a dash.

For example, a large (transport) aeroplane ~~airplane~~ passenger seat that ~~is~~ may be used as a forward-facing~~,~~ or a rearward-facing seat~~,~~ and that meets the step load on the baggage bar standard~~,~~ and the ~~meets~~ higher static loads ~~shall~~ must be marked as: Type A-T-1-FF-RF-a-~~e~~d.

(a) The seat type, use: 'Type A' for Aeroplane ~~Airplane~~, 'Type B' for Rotorcraft, or 'Type C' for Small Aeroplane ~~Airplane~~.

(b) The seat type shall be followed by the aircraft category, use: 'T' for Transport, 'N' for Normal, 'U' for Utility, 'A' for Acrobatic, or 'C' for Commuter. If the seat is intended to be used on aircraft compliant with CS-23 Amendment 5 or later amendments, the seat type must be followed by the aircraft category, use 'NL' for Normal and 1, 2, 3, 4 for the aircraft certification level, for example 'NL1' for Normal category Level 1, 'NL2' for Normal category Level 2, etc.

(c) The aircraft category ~~shall~~ must be followed by the appropriate seat subtype: use '1' for Passenger, '2' for Flight Attendant, '3' for Observer, or '4' for Pilot/~~Copilot~~Co-pilot.

(d) The subtype ~~shall~~ must be followed by the appropriate seat-facing designation, use: 'FF' for Forward Facing, ~~or~~ 'RF' for Rearward Facing, 'SF for Side Facing, or 'OB' for Oblique Facing.

(e) The seat-facing designations ~~shall~~ must be followed by the applicable paragraph letter of the elective criteria defined in Appendix 2 of this ETSO, use: 'a' for Step Load on Baggage Bars, ~~'b' for Flight Attendant Step Load, 'c' for Testing to Higher Static Loads, 'd' for Hand Holds, 'e' for Flammability – Large Exposed Non-metallic Parts~~ 'b' for Electrically Actuated Features, 'c' for Secondary Structure Abuse Loads, 'd' for Testing to Higher Static Loads, 'e' for Hand Holds, 'f' for Lithium Containing Batteries, 'g' for Flammability — Non-Traditional, Large, Non-metallic Parts.

~~(ii)~~ (2) The seating system, safety belt restraint system, and seat cushion part numbers.

~~(iii)~~ (3) The document reference that contains the installation instructions and limitations.

~~(iv)~~ (4) For Type A and Type B-Transport passenger, flight attendant and observer seating systems, mark each seat cushion to be qualified with ~~'Complies with CS 25.853(c)', or 'Complies with CS 29.853(b)', as applicable when tested in accordance with the requirements of Section 3.4.2 of SAE AS8049A, as revised by subparagraph 2.2.3 of Appendix 1 of this ETSO~~ 'Meets the provisions of CS-25, Appendix F, Part II'.

Also, mark permanently and legibly the following, with at least the manufacturer's name, subassembly part number, and the ETSO number:

(1) each component that is easily removable (without hand tools); and

(2) each subassembly of the article that you determined may be interchangeable.

~~(v) Each separate component that is easily removable (without hand tools, except those components that are ETSO articles), each interchangeable element, and each separate sub-assembly of the article that the manufacturer determines may be interchangeable with other seating systems must be permanently and legibly marked with at least the name of the manufacturer, manufacturer's sub-assembly part number, and the ETSO number.~~

~~**4.2 Specific**~~

~~None.~~

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]
[Amdt ETSO/17]

# APPENDIX 1 TO ETSO-C127~~b~~c – MPS FOR ROTORCRAFT, TRANSPORT AEROPLANE, AND SMALL AEROPLANE SEATING SYSTEMS

1.0. Forward- and aft-facing seating systems must meet the requirements of Table 1 of this Appendix. This Appendix prescribes the EASA modifications to the MPS for SAE International's Aerospace Standard (AS) ~~8049B~~ 8049C, ~~*Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft*~~ 'Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated ~~January 2005~~ August 2015. When the SAE section *recommends (or suggests, advises, etc.)* something, and it is part of the MPS, the recommendation becomes a *requirement*. In addition, modify AS~~8049B~~8049C as follows:

***Table 1 — SAE AS~~8049B~~8049C***

| When reading AS8049~~B~~C… | Do the following: |
|---|---|
| Section 1 | Disregard |
| Section 2 | Disregard |
| Section 3 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>~~Page 5, disregard subsection 3.1.~~<br>~~---~~<br>~~Page 6, replace subsection 3.2.7 to read as follows:~~<br><br>~~3.2.7 When an under-seat baggage restraint is incorporated in a passenger seat, it shall be designed to restrain at least 9.1 kg (20 lb) or its placarded weight of stowed items per passenger place under the *dynamic and static (forward and sideward directions only)* test conditions of this document in a manner that will not significantly impede rapid egress from the seat.~~<br>~~---~~<br>On ~~P~~page 6, replace subsection 3.2.15 by the following ~~to read as follows~~:<br><br>~~*3.2.15 Except for rearward facing seats and seats equipped with multiple anchorage point pelvic restraints (e.g. Y-belts), the pelvic restraint system shall be designed such that the vertical angle between the pelvic restraint centerline and the seat reference point (SRP) waterline shall range from 35° to 55°. The SRP water line is a line/plane passing through the SRP parallel to the floor waterline. The pelvic restraint centerline is formed by a line from the pelvic restraint anchorage to a point located 250 mm (9.75 in) forward of the SRP and 180 mm (7.0 in) above the SRP water line. In addition, the pelvic restraint anchorage point(s) must be located no further than 2.0 inches forward of the SRP (ref Figure 1A). See the FAA AC 21-34 for additional guidance for acceptable seat belt geometry.*~~<br>*3.2.15 Except for rearward-facing seats and seats equipped with multiple anchorage point pelvic restraints (e.g. Y-belts), the pelvic restraint system must be designed such that the vertical angle between the pelvic restraint centre line and the seat reference point (SRP) waterline must range from 35° to 55°. The SRP waterline is a line/plane passing through the SRP parallel to the floor waterline. The pelvic restraint centre line is formed by a line from the pelvic restraint anchorage to a point located 9.75 inches (250 mm) forward of the SRP and 7.0 inches (180 mm) above the SRP waterline. In addition, the pelvic restraint anchorage point(s) must be located no further than 2.0 inches (51 mm) forward of the SRP (ref. ARP5526D). See AC 21-34 for additional guidance on acceptable seat belt geometries.* |

| When reading AS8049BC… | Do the following: |
|---|---|
| | ~~---~~<br>~~Page 6, add subsection 3.2.16 to read as follows:~~<br><br>~~*3.2.16 All hinged armrest caps installed along an aisle must close as a result of normal movement along the aisle. Caps must not snag clothing or present any other impediment to egress when contacted by a person moving in either direction along the aisle.*~~<br>---<br>On ~~P~~page 6, ~~add~~ replace subsection 3.2.17~~,~~ by the following~~to read as follows~~:<br>~~*3.2.17 Safety belt restraint systems must be equipped with a metal-to-metal latching device.*~~<br>*3.2.17 Safety belt restraint systems must meet the requirements of E/TSO-C22g 'Safety Belts' or E/TSO-C114 'Torso Restraint Systems' (or later EASA/FAA revisions), and each must be equipped with a metal-to-metal latching device.*<br>---<br>~~Page 6, add subsection 3.2.18 to read as follows:~~<br><br>~~*3.2.18 Design seat stowage compartments to prevent the contents becoming a hazard by shifting under the load conditions identified in Table 4 and subsection 5.3.1. Specify the maximum weight of the contents allowed in each stowage compartment.*~~<br>~~---~~<br>~~Page 6, add subsection 3.2.19 to read as follows:~~<br><br>~~*3.2.19 The seat reference point (SRP) must be determined using only one of the methods described in Figure 1B. The selected method shall be documented, and must be used consistently when evaluating all variations of the seat ETSOA model or future changes to the seat ETSOA model design.*~~<br>On page 7, for Type B seats, replace subsection 3.3.1 by the following:<br><br>*3.3.1 The materials must be suitable and durable for use in aircraft seats, as established by tests or experience, accounting for statistical variability in the material and the effects of environmental conditions such as the temperature and humidity expected in service. Materials which could affect the safety of the aircraft or the occupants must be controlled to ensure the strength and other properties defined in the design data. Special factors must be developed for application per subsection 4.1 for each part of the structure whose strength is:*<br><br>*(1) uncertain;*<br>*(2) likely to deteriorate in service before normal replacement; or*<br>*(3) subject to appreciable variability due to uncertainties about:*<br>*i. the manufacturing processes; or*<br>*ii. the inspection methods.*<br><br>*The use of materials such as fibre-reinforced materials (i.e. composites) used to fabricate components of the seat within the primary load path (to include seat backs and pans) requires unique considerations for material and process control, generation of design values, consideration of the environmental and variability factors, identification and substantiation of potential damage, developing criteria to assess the post-impact structural integrity, and creating instructions* |

| When reading AS8049BC… | Do the following: |
|---|---|
| | *for continued airworthiness (ICAs). Applicants may follow the relevant guidance in AC 20-107B when addressing these concerns.*<br><br>*Test plans to develop design allowable data and special factors or alternative justification for the use of service history must be approved in advance by EASA.*<br><br>*Note: An ETSO approval does not include installation approval in an aircraft, and special conditions may be required to gain installation approval if the design includes new and novel materials and processes (e.g. composite materials, bonded joints, or additive manufacturing) in the primary load path.*<br><br>*Applicants for seat installations under CS-27 and CS-29 should ensure that all the composite seat components comply with the relevant regulatory requirements for material and process control, and that the manufacturing and service instructions are adequate to ensure that the seat complies with the crashworthiness requirements throughout its life.*<br><br>---<br><br>On page 7, for Type A-T, Type C seats (all the aircraft categories detailed in 1(1)c of this ETSO), replace subsection 3.3.1 by the following:<br><br>*3.3.1 The materials must be suitable and durable for use in aircraft seats, as established by tests or experience, accounting for statistical variability in the material and the effects of environmental conditions such as the temperature and humidity expected in service. Materials which could affect the safety of the aircraft or the occupants must be controlled to ensure the strength and other properties defined in the design data. Special factors must be developed for application per subsection 4.1 for each part of the structure whose strength is:*<br><br>*(1) uncertain;*<br><br>*(2) likely to deteriorate in service before normal replacement; or*<br><br>*(3) subject to appreciable variability due to uncertainties about:*<br><br>*i. the manufacturing processes; or*<br><br>*ii. the inspection methods.*<br><br>*For the use of materials such as fibre-reinforced materials (i.e. composites) used to fabricate components of the seat within the primary load path (to include seat backs and pans) apply Table 5 of Appendix 1 of this ETSO.*<br><br>*Note: An ETSO approval does not include installation approval in an aircraft, and special conditions may be required to gain installation approval if the design includes new and novel materials and processes (e.g. composite materials, bonded joints, or additive manufacturing) in the primary load path.*<br><br>*Applicants for seat installations under CS-23 and CS-25 should ensure that all the composite seat components comply with the relevant regulatory requirements for material and process control, and that the manufacturing and service instructions are adequate to ensure that the seat complies with the crashworthiness requirements throughout its life.*<br><br>---<br><br>On page 7, replace subsection 3.3.2 by the following: |

| When reading AS8049BC… | Do the following: |
|---|---|
| | *3.3.2 The methods and processes used for fabrication and assembly must produce consistently sound seats. If a fabrication process requires close control to reach this objective, the process must be performed in accordance with the design data (e.g. process specification).*<br><br>---<br><br>On page 7, add subsection 3.3.4 as follows:<br><br>*3.3.4 Each part of the seat structure must be protected against deterioration or loss of strength in service due to any cause (such as corrosion, wear, impact damage, environmental degradation, etc.) and have provisions for ventilation and drainage where necessary for protection.*<br><br>---<br><br>On page 7, replace subsection 3.4.1 by the following:<br><br>*3.4.1 All the materials used on seats must meet the requirements of subsection 3.4.1.1, 3.4.1.2, 3.4.1.3, or 3.4.1.4. The definition and use of parts that are considered small parts that would not contribute significantly to the propagation of a fire must be approved in advance by EASA. When inflatable materials are used (i.e. material used in the fabrication of inflatable restraints, airbags, etc.), the inflatable material must meet the flammability requirements of CS-25, Appendix F, Part I (a)(iv).*<br><br>*Note: Inflatable materials used in devices to increase occupant safety are a novel or unusual design feature that may be subject to special conditions and additional certification requirements for installation approval. The fire protection properties of the material may be demonstrated by following FAA Policy Statement PS-ANM-25.853-01 R2, 'Flammability Testing of Interior Materials' (dated 3 July 2013) or tested in accordance with the applicable chapter of the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12.*<br>---<br>Add subsections 3.4.1.1, 3.4.1.2, 3.4.1.3, and 3.4.1.4 as follows:<br><br>*3.4.1.1 All the materials used on Type A-T and Type B-T seats must be tested in accordance with the procedures, and meet the fire protection requirements, of CS-25, Appendix F, Part I, except where the material properties, size and quantity would not create or propagate a cabin fire. The fire protection properties of the material may also be demonstrated by following FAA Policy Statement PS-ANM-25.853-01 R2, 'Flammability Testing of Interior Materials' (dated 3 July 2013) or tested in accordance with the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 1 or 3.*<br><br>*3.4.1.2 All the materials used on Type B-N, Type C-N, Type C-NL1, Type C-NL2, Type C-NL3, Type C-U, and Type C-A seats must have flame-resistant properties. The materials must be tested to and must meet the requirements of paragraph 8.b of FAA Advisory Circular (AC) 23-2A Change 1, 'Flammability Tests' (dated 15 February 2013).*<br><br>*3.4.1.3 All the materials used on Type C-C seats must be tested in accordance with the test procedures of CS-23, Appendix F, Part I (Amendment 5) or the* |

| When reading AS8049BC… | Do the following: |
|---|---|
| | *Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 1 or 3, and must meet the following flammability performance requirements:*<br><br>*3.4.1.3.1 The panels, walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must be self-extinguishing. The average burn length may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.*<br><br>*3.4.1.3.2 Floor coverings, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, electrical conduits, transparencies, moulded and thermoformed parts, and trim strips (decorative and chafing) that are constructed of materials not covered in subsection 3.4.1.3.3 must be self-extinguishing. The average burn length may not exceed 8 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.*<br><br>*3.4.1.3.3 Acrylic windows and signs, parts constructed in whole or in part of elastomeric materials, seatbelts, and shoulder harnesses may not have an average burn rate greater than 2.5 inches per minute.*<br><br>*3.4.1.3.4 Except for electrical wire cable insulation, and for small parts where the material properties, size, and quantity would not create or propagate a cabin fire, the materials in items not specified in subsections 3.4.1.3.1 through 3.4.1.3.3 may not have a burn rate greater than 4.0 inches per minute.*<br><br>*3.4.1.4 All the materials used on Type C-NL4 seats must be self-extinguishing and tested in accordance with the test procedures of CS-23, Appendix F (Amendment 4), or the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 1.*<br><br>---<br><br>On page 8, replace subsection 3.4.2 by the following:<br><br>*Cushion systems on Type A-T and Type B-T passenger, flight attendant and observer seats must meet the fire protection requirements of CS-25, Appendix F, Part II. The fire protection properties of the material may also be demonstrated by following FAA AC 25.853-1, 'Flammability Requirements for Aircraft Seat Cushions' (dated 17 September 1986), tested in accordance with the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 7 and, where applicable, FAA Policy Statement ANM-115-07-002, 'Policy Statement on Certification for Flammability of Lightweight Seat Cushions' (dated 16 April 2009).*<br><br>---<br><br>On page 8, replace subsection 3.4.3 by the following:<br><br>*The insulation on electrical wires and cables on all Type A, Type B and Type C seats must meet the fire protection requirements of CS-25, Appendix F, Part I, (a)(3), or the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 4.* |

| When reading AS8049BC… | Do the following: |
|---|---|
| | ~~Page 10, replace subsection 3.4.1 to read as follows:~~<br><br>~~*3.4.1 Test the materials in Type A Transport and Type B Transport seating systems, ensuring they meet the fire protection properties specified in CS-25, Appendix F, Part I, paragraph (a)(1). The material's fire protection properties may be demonstrated using the methods provided in the FAA policy statement, PS-ANM-25.853-01-R2, Flammability Testing of Interior Materials, which may permit substantiation based on previously tested materials. The definition and use of parts that are considered small parts that would not contribute significantly to the propagation of a fire must be approved in advance by EASA. When inflatable restraints are included, the airbag material shall meet the flammability requirements of CS-25, Appendix F, Part I(a)(iv).*~~<br>~~*Note: Inflatable restraints are a new and novel technology that may be subject to significant additional special conditions and certification requirements for installation approval.*~~<br><br>~~*Materials in Normal, Utility and Acrobatic category Type C seating systems must have flame-resistant properties as defined in 14 CFR Part 1. Test the materials to meet the requirements of paragraph 8.b of the FAA Advisory Circular (AC) 23-2A, Change 1, Flammability Tests. Commuter category Type C seating systems shall meet the flammability performance requirements defined in CS 23.853(d)(3), and tested as prescribed in CS-23, Appendix F, Part I.*~~<br><br>~~*Materials in Type B Normal Rotorcraft seating systems must have flame-resistant properties as defined in **14 CFR Part 1**. Test the materials to meet the requirements of paragraph 8.b of the FAA Advisory Circular 23-2A 'Flammability Test', dated May 11, 2007. The material's fire protection properties may also be demonstrated by analysis (similarity) to provide equivalent protection.*~~<br><br>~~*Type A — Transport airplane insulation on electrical wire and electrical cable, and materials used to provide additional protection for the wire and cable, must be self-extinguishing when tested in accordance with the applicable portions of Appendix F, Part I of CS-25.*~~<br><br>~~*Type B — Rotorcraft insulation on electrical wire and cable must be self-extinguishing when tested in accordance with Appendix F, Part I(a)(3), to CS-25.*~~<br><br>~~*Type C seats with insulation on electrical wire and electrical cable must be self-extinguishing when tested at an angle of 60 degrees in accordance with the applicable portions of Appendix F to CS-23. The average burn length must not exceed 3 inches (76 mm) and the average flame time after removal of the flame source must not exceed 30 seconds. Drippings from the test specimen must not continue to flame for more than an average of 3 seconds after falling.*~~<br>~~———————————————————————~~<br>~~Page 10, replace subsection 3.4.2 to read as follows:~~<br><br>~~Type *A Transport and Type B Transport* — passenger, flight attendant, and observer seat cushion systems shall be tested to and shall meet the fire protection provisions of CS-25 Appendix F, Part II. *The material's fire protection may also be demonstrated by following the FAA AC 25.853-1 'Flammability Requirements for Aircraft Seat Cushions' and, where applicable, the FAA Policy Statement ANM-115-07-002 on certification for flammability of lightweight seat cushions.*~~ |

| When reading AS8049BC… | Do the following: |
|---|---|
| | ~~---~~<br>~~Page 12, replace subsection 3.5.7 to read as follows:~~<br><br>~~3.5.7 Deployable Items: Certain items on the seat, such as food trays, leg rests, arm caps over in-arm tray tables, etc., are used by passengers in flight and are required to be stowed for taxi, takeoff and landing. Deployment of such items should be treated as 'permanent deformation' if the item deploys into an area that must be used by multiple passengers (in addition to the occupant of the seat) for egress. The location of the measuring point used for determining the deformation of the deployed item shall be either at the point of full deployment or at the point of the actual deployment if a partially deployed item resists further deployment upon application of a static load of 45 N (10 lb) along the direction of the inertial load path. Such deployments can be considered acceptable, even if they exceed the provisions of 3.5 and its subparagraphs, if they are readily pushed out of the way by normal passenger movement, and remain in a position that does not affect egress (i.e., when pushed out of the way it remains in that position). Normal passenger movement is the act of the seated occupant getting up out of the seat and moving to egress the airplane (i.e., unbuckling their restraint, standing, turning towards the aisle and moving into the aisle). It does not include additional movements to lift or stow items, or latching an item in place. Any items that remain in a position that would affect egress shall be reported as permanent deformation.~~<br><br>~~*If the food tray table deploys as a result of being struck by the ATD head during a row-to-row HIC test and the food tray table is easily pushed out of the way, the deployment is acceptable and does not need to be considered as permanent deformation (except for seats installed where deployment may affect egress through a required exit path — see below). It is not required for the food tray table to remain in a position that does not affect egress. 'Easily pushed out of the way' is not required to be by normal passenger movement. Determination of the food tray deploying as a result of being struck by the ATD head during the test shall be made by evaluation of the high-speed film/video.*~~<br><br>~~*If the food tray table deploys as a result of being struck by the ATD head during the test and the food tray table is not easily pushed out of the way, the deployment shall be treated as permanent deformation.*~~<br><br>~~*Any food tray deployment on a seat that will be installed where deployment may affect egress through a required exit path, regardless of being struck by the ATD head, shall be treated as permanent deformation.*~~ |
| Section 4 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 14, revise column 5 in Table 4A as follows:<br>Type C-C and C-NL4 Seats<br>General Aviation (Commuter Category)<br>General Aviation (Normal Category Level 4)<br>Factor<br>9.0 (4)<br>1.5 (2)(4)<br>3.0 (2)(4)<br>6.0 (2)(4)<br>N/A<br>170 pounds (77 kg) (5) |

| When reading AS8049BC… | Do the following: |
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| | ---<br>On page 14, add an additional column in Table 4A as follows:<br><br>Type C-NL1, NL2, and NL3 Seats<br>General Aviation (Normal Category Level 1, Level 2, and Level 3)<br>Factor<br>9.0 (4)<br>1.5 (2)(4)<br>3.0 or 4.5 (2)(4)<br>3.0 (2)(4)<br>N/A<br>170 pounds (77 kg) or 190 pounds (86 kg) (5)(6)<br>---<br>On page 14, replace Note (6) in Table 4A by the following:<br><br>*Use a 190-pound occupant weight to account for the weight of a parachute.*<br>---<br>On page 14, replace Note (4) in Table 4A by the following:<br><br>*For Type C seats, the load factors may need to be increased according to CS 23.562(d), or CS 23.2270, Amendment 5.*<br>---<br>On page 14, replace Note (2) in Table 4A by the following:<br><br>*Elective: Increase these load factors as necessary for aircraft-model-specific flight and ground loads. All the seat adjustment positions and occupancy variations, including those used in flight, must be evaluated when using these increased load factors. Load factors at directions other than those prescribed by Table 4A as modified by this Appendix may be tested. Document the increased load factors and report them. You must also mark them on the ETSO placard (see Appendix 2, paragraph (d) of ETSO-C127c).*<br>---<br>On page 17, replace Note (1) in Table 4C by the following:<br><br>*Applicable only to Type C-N, C-NL1, C-NL2, C-NL3, C-NL4, Type C-U, Type C-C, and Type C-A seats.*<br>~~Page 16, replace note (1) in Table 4 to read as follows:~~<br><br>~~*The 4.0 ultimate load factor applies to the seat assembly (except for the fittings). The highest special factor of safety (e.g. casting) applicable to any part (except for the fittings) shall be applied to the 4.0 ultimate load factor. Fittings (as defined in paragraph 4.1.3) must meet a minimum applied load factor of 4.0 g. The 4.0 applied load factor for the fittings includes the 1.33 fitting factor. If multiple special factors of safety are applicable to the fittings (e.g. fitting factor and casting factor), then as indicated in paragraph 4.1.4, the fitting shall be tested statically to the highest applicable special factor of safety. Since for the fittings the 4.0 g applied load factor already includes the 1.33 fitting factor, the 1.33 fitting factor is divided out before the highest special factor of safety is applied.*~~ |

| When reading AS8049BC… | Do the following: |
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| | ~~---~~<br>~~Page 16, replace note (2) in Table 4 to read as follows:~~<br><br>~~*(2) Elective: Increase these load factors as necessary for reduced weight gust/flight loads or landing requirements. Loads at angles other than those prescribed by Table 4 may be tested. All seat adjustment positions and occupancy variations, including those used in flight, must be evaluated when using these increased load factors. Document the increased load factors. They must also be marked on the ETSO placard (see Appendix 2).*~~<br>~~---~~<br>~~Page 16, replace note (4) in Table 4 to read as follows:~~<br><br>~~(4) Normal, Utility, Acrobatic and Commuter Category.~~<br>~~---~~<br>~~Page 16, delete note (7) in Table 4.~~<br><br>~~Explanation: The seating system's manufacturer doesn't control the CS-23 requirements applying to the seat installation. The manufacturer may test to load factors higher than required in Table 4 under the provisions of Appendix 2, paragraph c, to this ETSO.~~<br>~~---~~<br>~~Page 16, add a reference of note (8) to be applicable to the *Upward load direction for Type C Seat* in Table 4. Add note (8) to Table 4 to read as follows:~~<br><br>~~*(8) Use a factor of 4.5 for Acrobatic Category seats.*~~ |
| Section 5 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 18, replace Section 5.0 by the following:<br><br>*The initial qualification of a seat shall be performed by static and dynamic tests. Computer modelling analytical techniques may be used as established by AC 20-146, Revision A, paragraph 2.5. The use of computer modelling analytical techniques must be established by the applicant and accepted by EASA.*<br>---<br>On page 22, replace subsection 5.1.9 by the following:<br><br>*The load due to any item of mass, including the seat that is not restrained by the occupant restraint system, must be applied in a representative manner at the CG of the mass, or with a corrective factor applied in a conservative manner relative to the CG of the item of mass.*<br><br>*Note: If the retention of an item of mass attached to the seat is demonstrated by the dynamic qualification tests of subsection 5.3, no further demonstration of retention for the forward and downward static conditions is required; however, a demonstration of retention of items of mass for the side, up, and aft static conditions is still required.*<br>---<br>On page 24, replace subsection 5.3 by the following:<br><br>*5.3 Dynamic Qualification Tests* |

| When reading AS8049BC… | Do the following: |
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| | *This section specifies the dynamic tests to satisfy the requirements of this document.*<br><br>*For Type A seats: You may demonstrate compliance with the dynamic test procedures and documentation of subsection 5.3.1 'Dynamic Impact Test Parameters' to subsection 5.3.9.2 'Impact Pulse Shape' of SAE AS8049C by the equivalent procedures of FAA AC 25.562-1B, Change 1. The equivalent method must be included in the document that contains the installation instructions and limitations, and must be used consistently when evaluating all the variations of the seat and any subsequent changes to the seat design.*<br><br>*For Type A seats: You can also use the simplified procedures for head injury criteria (HIC) outlined in AC 25.562-1B, Change 1, instead of the test conditions in AS8049C subsection 5.3.6.2.*<br><br>*Except for Hybrid III ATDs (49 CFR Part 572, Subpart E) modified in accordance with SAE Technical Paper 1999-01-1609, the use of an equivalent ATD must be established by the applicant and accepted by EASA.*<br><br>----------<br><br>Add subsection 5.3.1.5 as follows:<br><br>*5.3.1.5 Sensor-driven restraint systems*<br><br>*If a sensor-driven restraint system (e.g. an airbag, inflatable restraint, seatbelt pre-tensioner, deployable panel) is used as part of the seating system, additional threshold testing must be conducted to ensure that the structural and occupant injury criteria continue to be met when the sensor-driven restraint system does not activate. The threshold test must test the seating system at an inertial load no less than the maximum dynamic impact acceleration allowed by the sensor-driven restraint system without activating.*<br><br>*For seats with sensor-driven restraint systems, it must be shown that the system will activate and provide protection under emergency landing conditions where it is necessary to prevent serious injury to the occupants. The system must provide a consistent approach to injury protection throughout the range of occupants (2-year-old child to 95th percentile male) whether it is designed to manage injury parameters (e.g. HIC, Nij, neck rotation, etc.) or occupant motion. The system must be included in each test. If sensor-driven restraint systems influence the test results, they must be active during the test.*<br><br>*Seats that require a sensor-driven restraint system to meet the requirements of this ETSO must include the detailed design definition of the system and any other information required for installation as part of the document that contains the installation instructions and limitations.*<br><br>*Sensor-driven restraint systems may be used to control occupant motion. The intended function of the system must be demonstrated during each applicable test.*<br><br>----------<br><br>On page 35, replace subsection 5.3.3.5(i) by the following:<br><br>*(i) The side-facing seat requirements are defined in Table 3 of the Appendix to this ETSO.* |

| When reading AS8049BC… | Do the following: |
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| | ---<br>On page 35, add subsection 5.3.3.5(j) as follows:<br><br>*(j) The oblique-facing seat requirements are defined in Table 4 of the Appendix to this ETSO.*<br>---<br>On page 39, replace subsection 5.3.4.1(a) by the following:<br><br>*(a) Sled or drop tower vehicle acceleration data measurements must be in accordance with the Channel Class 60 requirements.*<br>---<br>On page 42, replace subsection 5.3.6.3 by the following:<br><br>*5.3.6.3 If a non-symmetrical upper torso restraint system (such as a single diagonal shoulder belt) is used in a system, it must be installed in the test fixture in a position representative of that in the aircraft.*<br>*For a forward-facing seat equipped with a single diagonal shoulder belt, the Test 2 yaw direction must be selected to address the direction which would increase the likelihood of the occupant not being restrained (typically over the trailing shoulder) and assessment of the maximum upper torso restraint load, which requires testing in the critical structural direction. In some cases, this may require testing in both directions of yaw.*<br><br>*For a Type A seat, testing per AC-25.562-1B, Change 1, paragraph 3.b(3), may be used.*<br>---<br>On page 44, replace subsection 5.3.8.3(a) by the following:<br><br>*(a) Prior to seating the ATD, all the seat adjustments and controls must be set as indicated in 5.3.6.4. To the extent that they influence the injury criteria, all the seat adjustments and controls should be in the design position intended for a 50th percentile male occupant. If seat restraint systems are being tested that are to be used in applications where special requirements dictate their position for landing or take-off, those positions should be used in the tests.*<br>---<br>On page 44, replace subsection 5.3.8.3(d) and (e) by the following:<br><br>*(d) Once all lifting devices have been removed from the ATD, it should be rocked slightly to settle it in the seat.*<br>*(e) The ATD's knees should be separated by approximately 4 inches (100 mm).*<br><br>---<br>On page 47, replace subsection 5.3.9.4 by the following:<br><br>*5.3.9.4 Head Injury Criteria (HIC)* |

| When reading AS8049BC… | Do the following: |
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| | *Head Injury Criterion (HIC) data for determining the HIC needs to be collected during the tests discussed in this document only if the ATD's head is exposed to impact on aircraft interior features (not including the floor or the ATD's own leg) during the test. The HIC is calculated according to the following equation:*<br>$$\mathrm{HIC} = \left[ (t_2 - t_1) \left\{ \frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt \right\}^{2.5} \right]_{\max}$$<br>*where $t_1$ and $t_2$ are any two points in time (in seconds) during the head impact, and $a(t)$ is the resultant head acceleration (expressed in g) during the head impact.*<br><br>*The HIC is a method for defining an acceptable limit, i.e. the maximum value of the HIC must not exceed 1000 for head impact against interior surfaces in a crash. The HIC is invariably calculated by computer-based data analysis systems, and the discussion that follows outlines the basic method for computation. The HIC is based on data obtained from three mutually perpendicular accelerometers installed in the head of the ATD in accordance with the ATD specification. Data from these accelerometers is obtained using a data system conforming to Channel Class 1000, as described in SAE J211. Only the data taken during head impact with the aircraft interior needs to be considered; this is usually indicated by a rapid change in the magnitude of the acceleration data. Film of the test may show head impacts that can be correlated with the acceleration data by using the time base common to both the electronic and photographic instrumentation. Simple contact switches that do not significantly alter the surface profile could also be used to define the initial contact time.*<br><br>*In many cases, a full system sled test to evaluate specific occupant injury conditions may not be needed to evaluate a redesign of the seat system that affects only the HIC. In such cases, the photometric head path data can be gathered and used to ensure that no contact will occur, or to define the head angle and velocity at impact. This data can then be used in a component test of severity comparable to the whole-system sled test. Other factors, such as the inertial response of the impact target, must be accounted for in the component test conditions so that the impact condition is representative. The component testing methods used for HIC measurements must be demonstrably equivalent to whole-system sled test HIC measurements.*<br><br>*Additionally, a seat may be designed for use in multiple locations where head contact against a range of unknown bulkhead targets is anticipated (e.g. front-row seats). For these seats, the HIC may be measured using a representative impact target mounted in front of the seat at the installation setback, or a range of setbacks. This target will represent typical fixtures such as galleys, partitions, lavatories, and closets, and its stiffness will be representative for those monuments. If contact occurs, the HIC must not exceed 1000.*<br><br>*When the seat is evaluated against unknown bulkhead targets using a representative impact target, the detailed design definition of the impact target, and any other information required for the installation (e.g. the stiffness), must be included as part of the document that contains the installation instructions and limitations.*<br><br>*When considering multiple seat pitches or setbacks from interior components, or considering a range of occupant statures, the HIC evaluation should be made* |

| When reading AS8049BC… | Do the following: |
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| | *when a solid head strike occurs during the dynamic test. Regardless of whether the head contact is a solid strike or a glancing blow, the HIC value must be calculated and must not exceed 1000.*<br><br>*The ATD head should not sweep by the seat back/interior component with no apparent interruption in the head path movement, even though there may have been contact on the top of the head.*<br><br>*The following evaluations of the test data can be used to determine whether a solid head strike has occurred:*<br><br>*a. A review of the dynamic test videos and evaluation of the ATD head path movement, head contact, and head reaction at contact should be made. There should be a noticeable change in the head movement at the time of contact.*<br><br>*b. A review of the post-test photographs and an evaluation of the ATD head contact markings should be made. The contact marks (see subsection 5.3.8.4) should show that the area of the ATD head contact was not only across the top of the head.*<br><br>*c. A review and evaluation of the ATD head acceleration plots (x, y, z and resultant) should be made. The resultant ATD head acceleration plot during the time period in which the critical HIC calculation was made should show an abrupt change in the head acceleration. In addition, the individual direction ATD head acceleration plots should be evaluated to determine which component direction contributes primarily to the resultant head acceleration. A primary contribution of the x-component indicates more of a solid head strike occurring. A primary contribution of the z-component indicates more of a top of the head contact and the top of the head moving forward into the seat/interior component as the head is sweeping by the seat/interior component.*<br><br>---<br><br>On page 49, replace subsection 5.3.9.9 by the following:<br><br>*5.3.9.9 Femur load (type A-T seats): Data for measuring femur loads can be collected in the tests discussed in this document if the ATD's legs contact seats or other structures. The maximum compressive load in the femur can be obtained directly from a plot or listing of each femur load transducer output. If the value of peak acceleration measured in the test exceeds the level given in Figure 6, 7A, or 7B, the femur load measured in the test may be adjusted by no more than 10 % by multiplying the measured values by the ratio of the peak acceleration given in Figure 6, 7A, or 7B, divided by the measured peak acceleration, if necessary. Data need not be recorded in each individual test if a rational comparative analysis is available for showing compliance. For large clearance installations (distance from the seat reference point (SRP) to the strike target is greater than 40 inches (100 cm) nominally), no data is necessary to substantiate the femur loads; however, appropriate limitations must be included in the document that contains the installation instructions and limitations.*<br><br>*Extensive seat testing has shown that the femur loading criterion is not usually exceeded; therefore, recording femur loads may not be necessary during the test if you can show compliance by rational comparative analysis using data from* |

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| | *previous tests. However, the rational analysis must show that the testing applies to the seat design, and you must include appropriate limitations in the document that contains the installation instructions and limitations.*<br><br>---<br><br>On page 49, replace subsection 5.3.9.12 by the following:<br><br>*5.3.9.12 Seat Attachment Reactions*<br><br>*The data of the maximum loads imposed on the tracks or fittings at all the seat attachment points must be collected and recorded (see subsection 5.3.3.2). This data can be obtained directly from the output of the load cell at each attachment location.*<br><br>---<br><br>On page 50, replace subsection 5.3.10.1.1(e) and (f) by the following:<br><br>*(e) A statement confirming that the data collection was performed in accordance with the requirements of this document, or a detailed description of the actual procedure used and a technical analysis showing equivalence to the requirements of this document.*<br><br>*Note: Unless otherwise specified in the ETSO, you must obtain EASA approval for any deviations from the requirements of the AS8049C subsections identified as the MPS of this ETSO.*<br><br>*(f) The manufacturer, governing specification, serial number, and test weights of the ATDs used in the tests, and a description of any modifications or repairs performed on the ATDs that could cause them to deviate from the specification.*<br><br>*Note: Unless otherwise specified in the ETSO, you must obtain EASA approval for any deviations from the requirements of the AS8049C subsections identified as the MPS of this ETSO.*<br><br>---<br><br>Add subsection 5.4.11 as follows:<br><br>*5.4.11 If the ATD is exposed to impact with aircraft interior features during the test:*<br><br>*(a) if the test uses a Hybrid II ATD, then:*<br><br>*(1) the interaction must not rotate the head about its vertical axis, relative to the torso, by more than 105 degrees in either direction from forward facing, or introduce a feature or surface that produces concentrated loading on the neck, and*<br><br>*(2) the head centre of gravity must not stop sliding down the seat back for more than 10 milliseconds while the torso is still moving downward; or*<br><br>*(b) if the test uses an FAA Hybrid III or equivalent, then:* |

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| | *(1) the interaction must not rotate the head about its vertical axis, relative to the torso, by more than 105 degrees in either direction from forward facing, or introduce a feature or surface that produces concentrated loading on the neck, and*<br><br>*(2) the Nij (calculated in accordance with 49 CFR 571.208) must be below 1.0, where Nij = (Fz/Fzc) + (Mocy/Myc), and the Nij critical values are:*<br><br>*i. Fzc = 1 530 lbf for tension*<br>*ii. Fzc = 1 385 lbf for compression*<br>*iii. Myc = 229 lbf ft in flexion*<br>*iv. Myc = 100 lbf ft in extension*<br><br>*(3) the peak upper neck Fz is less than 937 lbf in tension and 899 lbf in compression.*<br><br>*(c) If testing is first conducted with the Hybrid II ATD and the interaction could cause serious human injury as defined in paragraph (a)(2) (e.g. chin snagging on a horizontal seat back feature), then subsequent testing may be accomplished with the FAA Hybrid III or equivalent. To show acceptability using the FAA Hybrid III or equivalent:*<br><br>*(1) the ATD must be positioned so that the chin will strike above the seat feature which caused the unacceptable interaction in the initial Hybrid II ATD test,*<br><br>*(2) testing must demonstrate the same behaviour as shown with the Hybrid II ATD in order for the safety demonstration to be valid, and*<br><br>*(3) the loads in (b)(1) and (b)(2) must be reported.*<br><br>*(4) If the test demonstrates an acceptable interaction per paragraph (a)(1), and the loads in (b)(1) and (b)(2) are below the limits, no further substantiation is necessary.*<br><br>*(5) Due to differing chin shapes and neck stiffnesses, the chin of the FAA Hybrid III ATD or equivalent may or may not hang up on the seat feature. If the head stops, the stop time may exceed 10 ms provided that the loads in (b)(1) and (b)(2) are not exceeded.*<br><br>~~Page 21, replace subsection 5.1.9 to read as follows:~~<br><br>~~5.1.9 The load due to any item of mass, including the seat that is not restrained by the occupant restraint system, must be applied in a representative manner at the c.g. of the mass, or with a corrective factor applied in a conservative manner relative to the c.g. of the item of mass.~~<br><br>~~*Note: If the retention of an item of mass attached to the seat is demonstrated (by the dynamic qualification tests of subsection 5.3), the static retention for the forward and down static conditions doesn't need to further be demonstrated.*~~ |

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| | ~~*However, the retention of items of mass for the side, up and aft static conditions must still be demonstrated.*~~<br>~~---~~<br>~~Page 23, replace subsection 5.2.2 to read as follows:~~<br><br>~~5.2.2 The seat structure must be able to support ultimate loads without failure for at least 3 seconds. If it can be shown that failure of an armrest on a seat assembly does not reduce the degree of safety afforded the occupant(s) or become a hazard, such failure will not be cause for rejection.~~<br><br>~~*Note: If the retention of an item of mass attached to the seat is demonstrated by the dynamic qualification tests of subsection 5.3, the static retention for the forward and down static conditions don't need to further be demonstrated. However, the retention of items of mass for the side, up and aft static conditions must still be demonstrated.*~~<br>~~---~~<br>~~Page 23, replace 5.3 to read as follows:~~<br><br>~~5.3 Dynamic Qualification Tests:~~<br><br>~~This section specifies the dynamic tests to satisfy the requirements of this document.~~<br><br>~~*For Type A Seats: it may be demonstrated the compliance with the dynamic test procedures and documentation of subsections 5.3.1 'Dynamic Impact Test Parameters' through subsection 5.3.9.2 'Impact Pulse Shape' of SAE AS 8049B by the equivalent procedures of the FAA AC 25.562-1B. The equivalent method shall be documented in the document that contains installation instructions and limitations, and must be used consistently when evaluating all variations of the seat or future changes to the seat design.*~~<br><br>~~*For Type A Seats: the simplified procedures for head injury criteria (HIC) outlined in the FAA AC 25.562-1B can also be used instead of the test conditions in AS8049B subsection 5.3.6.2.*~~<br><br>~~*Except for Hybrid III ATDs (**49 CFR Part 572, Subpart E**) modified in accordance with SAE Technical Paper 1999-01-1609, use of an equivalent ATD must be established by the applicant and accepted by EASA.*~~<br>~~---~~<br>~~Page 23, replace subsection 5.3.1.2 to read as follows:~~<br><br>~~5.3.1.2 Test 2 (Figures 6, 7A, and 7B), as a single row seat test, determines the performance of a system in a test condition where the predominant impact force component is along the aircraft longitudinal axis and is combined with a lateral impact force component. This test evaluates the structural adequacy of the seat, permanent deformation of the structure, the pelvic restraint and upper torso restraint (if applicable) behaviour and loads, and may yield data on ATD head displacement, velocity, and acceleration time histories and the seat leg loads imposed on the seat tracks or attachment fittings.~~<br><br>~~*For seats intended to be installed at an angle relative to the longitudinal axis of the aircraft that is greater than 2° (but less than 18°), the test yaw angle for the test that substantiates those seats shall be 10° plus or minus the intended*~~ |

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| | ~~*installation angle (if more critical) depending on which yaw angle results in the most critical attachment fitting resultant loads.*~~<br>~~---~~<br>~~Page 37, replace subsection 5.3.3.5.i to read as follows:~~<br><br>~~Side-Facing Seats: *Seats with installation limitations of angles more than 18° from aircraft centerline are not addressed by this standard.*~~<br>~~---~~<br>~~Page 37, replace subsection 5.3.3.6 to read as follows:~~<br><br>~~5.3.3.6 Multiple Row Test Fixtures: In tests of passenger seats that are normally installed in repetitive rows in the aircraft, head and knee impact conditions are best evaluated through tests that use at least two rows of seats. These conditions are usually critical only in Test 2. This test allows direct measurements of the head and femur injury data.~~<br><br>~~a. The fixture shall be capable of setting the aircraft longitudinal axis at a yaw angle of – 10° and + 10°. The fixture should also allow adjustment of the seat pitch.~~<br>~~b. To allow direct measurement of head acceleration for head injury assessment for a seat installation where the head of the occupant is within striking distance of structure, a representative impact surface may be attached to the test fixture in front of the front row seat at the orientation and distance from the seat representing the aircraft installation.~~<br>~~c. *Test 2 (Figures 6, 7A, & 7B) conducted solely to collect head/knee path data should be conducted with 0° yaw and without floor deformation. The test must be conducted on the seat with the greatest overhang among the seats selected for the applicable forward longitudinal dynamic structural test. It is acceptable to use the opposite hand part for this seat. The occupancy used in the applicable forward longitudinal dynamic structural test must be used for this test. For consistency, a floor should be used for tests used to gather head path data. It is acceptable to collect ATD head path data in the applicable forward longitudinal dynamic structural test.*~~<br>~~d. *Seats designed for seat tracks that are not in-line and parallel (track-break seats) typically require special floor attachment fittings. The installation of the seat tracks on the test fixture for these seats is unique, and depends on the intended seat location in the airplane. The test setup must represent the seat track orientation on the airplane (that is, angles, offsets, forward/aft distance, and so forth) of seat tracks under the aft attachments vs. the forward attachments).*~~<br>~~---~~<br>~~Page 43, replace subsection 5.3.5 to read as follows:~~<br><br>~~5.3.5 Selection of Test Articles: Many seat designs comprise a family of seats that have the same basic structural design but differ in detail. For example, a basic seat frame configuration can allow for several different seat leg locations to permit installation in different aircraft. If these differences are of a nature that their effect can be determined by rational analysis, then the analysis can determine the most critical configuration. As a minimum, the most critically stressed configuration shall be selected for the dynamic tests so that the other configurations could be accepted by comparison with that configuration.~~<br><br>~~There are two factors that must be considered in selecting the critical structural test configurations. First, the seat to aircraft interface loads (undeformed seat)~~ |

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| | ~~can be determined by rational analysis for the seat design and load configurations. The rational analysis can be based on static or dynamic seat/occupant analytical methods. The rational analysis can form the basis for selecting the most highly stressed critical configuration based on load. Additionally, the effects of seat deformation should be considered. As noted, a family of seats typically includes seat models with varied seat leg locations. The effects of floor deformation are more critical for narrowly spaced legs. Thus, a test or rational analysis of the seat model with the minimum seat leg spacing must be conducted to evaluate the most highly stressed critical configuration based on deformation.~~<br>~~---~~<br>~~Page 44, replace subsection 5.3.5.1 to read as follows:~~<br><br>~~5.3.5.1 In all cases, the test article must be representative of the final production article in all structural elements, and shall include the seat, seat cushions, restraints and armrests. It must also include a functioning position adjustment mechanism and correctly adjusted break over (if present).~~<br><br>~~Weights simulating luggage carried by luggage restraint bars (9.1 kg (20 lb) per passenger place) need only be representative masses.~~<br><br>~~Items 0.15 kg (0.33 lb) or greater that are part of the seat and affect the dynamic performance of the seat, including occupant injury and egress, must be representative of the production item and production means of attachment on the test article.~~<br><br>~~Items 0.15 kg (0.33 lb) or greater that are part of the seat but do not affect the dynamic performance of the seat, including occupant injury and egress, may be representative masses, but the production means of attachment must be on the test article.~~<br><br>~~Items less than 0.15 kg (0.33 lb) and their means of attachment are not required to be on the test article. However, the mass of the item must be included on the test article as ballast.~~<br><br>~~Wiring harnesses, regardless of weight, may be represented on the test article by ballast weights. The production means of attachment need not be included in the test.~~<br><br>~~Life vests must be installed on the test article, if provisions are provided, but are not required to be the production life vest. Any life vest of equivalent weight, or greater, may be included on the test article. *The life vest may be ballasted to substantiate heavier life vests. The life vest must represent the size and configuration of the production life vest if its size or configuration could affect retention of the life vest*.~~<br><br>~~***For Type A seats**, if an item of mass that does not affect the dynamic performance of the seat fails during a test that is otherwise acceptable, then the design may be validated by a 24g static test. The failed test article must be redesigned unless the failure is attributable to test setup or non-representative test article. The certified gross weight of the test article must be adjusted to account for any separation of mass due to failure. Apply the load for the 24g test in the same direction as the load vector in the dynamic test where the failure~~ |

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| | ~~occurred. Any preload, such as due to floor warpage, of the failed article must be represented in the static 24g test.~~<br><br>~~In any case, the separation of an item of mass should not leave any sharp or injurious edges. Function of equipment or subsystems after the test is not required. Once it has been demonstrated that an item of mass can be retained in its critical loading case, subsequent tests may be conducted with the item secured for test purposes.~~<br>~~_____~~<br>~~Page 45, replace subsection 5.3.6.3 to read as follows:~~<br><br>~~5.3.6.3 If a non-symmetrical upper torso restraint system (such as a single diagonal shoulder belt) is used in a system, it shall be installed on the test fixture in a position representative of that in the aircraft. For a forward-facing seat equipped with a single diagonal shoulder belt, the Test 2 yaw direction should be selected such that the belt passes over the *leading shoulder.*~~<br><br>~~*Note: **For a Type A seat**, additional tests may be required with the single diagonal shoulder belt passing over the trailing shoulder in order to evaluate retention of the harness on the occupant shoulder. As applicable, test per the FAA AC-25.562-1B, paragraph 3.b.(3).*~~<br>~~_____~~<br>~~Page 50, replace subsection 5.3.9.2 to read as follows:~~<br><br>~~5.3.9.2 Impact Pulse Shape: Data for evaluating the impact pulse shape are obtained from an accelerometer that measures the acceleration in the direction parallel to the inertial response shown in Figures 6, 7A, and 7B. The impact pulses intended for the tests discussed in this document have an isosceles triangle shape. These ideal pulses are considered minimum test conditions. Since the actual acquired test pulses will differ from the ideal, it is necessary to evaluate the acquired test pulses to ensure the minimum requirements are satisfied.~~<br><br>~~The five properties of the ideal pulse that must be satisfied by the acquired test pulse are (referring to Figures 6, 7A, and 7B, and as discussed in Appendix A):~~<br><br>~~Pulse shape: isosceles triangle~~<br>~~Greq: peak deceleration required by test condition~~<br>~~Treq: rise time required by test condition~~<br>~~V: total velocity change required by test condition~~<br>~~Vtr: velocity change required during Treq (Vtr = V/2)~~<br><br>~~A graphical technique can be used to evaluate pulse shapes that are not precise isosceles triangles. Appendix A presents the graphical method of evaluating the acquired pulse (the recorded test sled acceleration versus time).~~<br><br>~~For the acquired pulse to be acceptable, *the requirements of Appendix A shall be met.*~~<br>~~_____~~<br><br>~~Page 54, replace subsection 5.3.9.9 to read as follows:~~<br><br>~~5.3.9.9 Femur Load (Type A Seats): Data for measuring femur loads can be collected in the tests discussed in this document if the ATD's legs contact seats or other structure. The maximum compressive load in the femur can be obtained~~ |

| When reading AS8049BC… | Do the following: |
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| | ~~directly from a plot or listing of each femur load transducer output. If the value of peak acceleration measured in the test exceeds the level given in Figure 6, 7A, or 7B, the femur load measured in the test may be adjusted by no more than 10 % by multiplying the measured values by the ratio of the peak acceleration given in Figure 6, 7A, or 7B, divided by the measured peak acceleration, if necessary. Data need not be recorded in each individual test if rational comparative analysis is available for showing compliance. For large clearance installations (distance from seat SRP to strike target is greater than 100 cm (40 in.) nominally), no data is necessary to substantiate femur loads. *However, appropriate limitations must be documented.*~~<br><br>~~*Extensive seat testing has shown that the femur loading criterion is not usually exceeded therefore, recording femur loads may not be necessary during the test if it can be shown compliance by rational comparative analysis using data from previous tests. However, the rational analysis must show that the testing applies to the seat design, and must include appropriate limitations which must be documented.*~~<br>~~---~~<br>~~Page 54, replace subsection 5.3.9.11 to read as follows:~~<br><br>~~5.3.9.11 Seat Deformation: The permanent deformations affecting aircraft evacuation shall be evaluated and documented.~~<br><br>~~The floor deformation fixture may be returned to the flat floor condition for documenting seat deformation. This documentation can take the form of dimensioned scale drawings that show the seat in its deformed condition relative to a reference origin, such as a floor track fitting which can be related to the aircraft interior. If the seat deformation is not critical, still photographs of the seat (with dimensional targets or grids in place so that measurements can be made) will provide adequate documentation. Any actions necessary for proper seat functions, such as stowage of the seat when the ATD is removed, shall be observed and documented.~~<br><br>~~*Safety belt restraint systems must not yield to the extent they would impede rapid evacuation of the occupant.*~~<br>~~---~~<br>~~Page 56, replace subsections 5.3.10.1.1.e and 5.3.10.1.1.f to read as follows:~~<br><br>~~e. A statement confirming that the data collection was done in accordance with the requirements of this document, or a detailed description of the actual procedure used and technical analysis showing equivalence to the requirements of this document.~~<br>~~**f. Manufacturer, governing specification, serial number, and test weight of ATDs used in the tests, and a description of any modifications or repairs performed on the ATDs that could cause them to deviate from the specification.**~~ |
| Section 6 | Disregard and refer to paragraph **4** of this ETSO. |
| Section 7 | Disregard |
| Appendix A | No Changes |

2.0 This paragraph prescribes the MPS for SAE International ~~ARP5526C~~ ARP5526D ‘Aircraft Seat Design Guidance and Clarifications’, dated ~~May 2011~~ July 2015. When the SAE section *recommends (or suggests, advises, etc.)* something, and it is part of the MPS, the

recommendation becomes a *requirement*.
In addition, modify ~~ARP5526C~~ ARP5526D as follows:

***Table 2 — SAE ~~ARP5526C~~ARP5526D***

| When reading ARP5526~~C~~D… | Do the following: |
|---|---|
| Section 1 | Disregard |
| Section 2 | Disregard |
| Section 3 | Disregard all the subsections in Section 3 not listed below. The following subsections apply as modified:<br><br>On ~~P~~page ~~5~~7, replace subsection 3.2.2 by the following~~to read as follows~~:<br><br>*3.2.2 Recommended Practice*<br><br>*Seatbelt misalignment is a condition where the seatbelt and/or shackle is positioned to give the impression that the belt has been properly tightened, when in fact there is slack in the system or the shackle is positioned so that it will not carry the force generated in an emergency landing or turbulence condition.*<br><br>*Restraint system anchorages should provide self-aligning features. If self-aligning features are not provided, the static and dynamic tests in this document should be conducted with the restraints and anchorages positioned in the most adverse configuration allowed by the design. The anchorage system must minimise the possibility of incorrect installation or inadvertent disconnection of the restraints.*<br><br>*The seat belt installation should not appear to the belted occupant to be properly adjusted (snug) while there is significant (2.54 cm (1 inch) or more) slack in the system, which may pay out in an emergency landing situation. For example, the belt installation should not be able to be caught between seat features such that the occupant would not know that there was slack in the belt, which could allow the occupant to slide forward during an emergency landing or turbulence.*<br><br>*When the seat system is adjusted to and from all in-flight positions, it must not allow the occupant restraint to become trapped or damaged in the seat structure or mechanisms.*<br><br>*To evaluate this requirement, translate the unoccupied seat through all the adjustable positions with the restraint system unfastened and the seat cushions installed. Evaluate the size and location of any gap created for the potential of the unfastened restraint to become trapped or damaged with subsequent seat motion.*<br><br>*To test the installed seat belt for misalignment, the seat should be positioned in its taxi, take-off and landing conditions. Installations on seats having bottom cushions that can be removed or incorrectly repositioned without tools should be evaluated with the cushions installed, removed and incorrectly repositioned. The belt and shackle combination should be manipulated with one hand in an attempt to place the restraint in a non-design configuration where it could carry the seatbelt adjustment forces. Particular effort should be made to place the restraint in a position that the restraint forces would not be applied to the hook of the shackle in the same manner as they would be applied in a straight tension pull on the belt. Attempts should be made with the restraint in its normal shape, a single twist of the webbing and/or a single fold of the webbing. Typical areas around the restraint shackle that should be checked are the plastic shrouding around the armrest, the hydraulic seat recline device, the seat pan, anti-rotation brackets/stops, seat pan supports and exposed fasteners. If a condition of* |

| When reading ARP5526eD… | Do the following: |
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| | *potential misalignment is identified, the seatbelt and shackle, in that condition, should be loaded by a restorative force of 22.2 N (5 pounds) applied through the belt in the direction in which it would be loaded in the emergency landing or turbulence situation. If the load is carried in the misaligned condition, the design is unacceptable. The examples in subsection 3.2.3 illustrate various misalignment conditions that have been found to be unacceptable, as indicated. These examples are not intended to be all-inclusive.*<br><br>*To test the belt for inadvertent disengagement, where disengagement is defined as the separation of the restraint's attachment fitting from the seat structure, the belt should be tested in all orientations with the seat in the taxi, take-off and landing conditions with the seat cushions installed. Interactions with belts in adjacent seats, where the belts could be inadvertently crossed and used by occupants in those adjacent seats, must be evaluated for the possibility of disengagement.*<br><br>---<br><br>On page 13, replace subsection 3.3.2 by the following:<br><br>*3.3.2 Recommended Practice*<br><br>*The terms 'life preserver', 'life vest' and 'life jacket' may be used interchangeably. When life preserver stowage provisions are included as part of the seat design, the stowage provisions must provide access to a life preserver for each seating position. The life preserver stowage must be designed and located such that the requirements of this section are met. The installation, operating and maintenance instructions must also reflect the requirements of this section. For example, the installation instructions must account for the allowable life preserver weight and size, and marking requirements, as well as the required unobstructed area to remove the life preserver from the container. Furthermore, the operating instructions must report the detailed content of the simulated preflight briefing and any special instructions for unique aspects of the operation of the design that should be considered for operational use and continued performance.*<br><br>*a. The life preserver must be restrained under all applicable loading conditions; i.e. the retention device must not allow the preserver to come free during emergency landing static and dynamic conditions, taxi, take-off, landing, turbulence, and during stowage and removal of underseat baggage.*<br><br>*b. Any life preserver locating placard installed on the seat must accurately state the location of the life preserver and be adequately marked per 3.8.2 of ARP5526D, as modified by this Appendix (e.g. 'LIFE PRESERVER UNDER CENTRE ARMREST'). For life preserver locations other than under the seat or under a console between the seats, mark 'LIFE PRESERVER' or 'LIFE PRESERVER INSIDE' on the container or compartment, unless the location is identified with a pull strap. Pull straps must be red or labelled 'PULL' or 'PULL FOR LIFE PRESERVER' in a contrasting colour. A symbolic placard may be used in lieu of text provided it has been shown to be comprehensible to the flying public. For seats intended to be installed in sequential rows, a placard may be fixed on the seat back, stating the location of the life preserver for the occupant seated behind.* |

| When reading ARP5526ED… | Do the following: |
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| | c. The retrieval path of the life preserver must be free of obstructions due to movement of the life preserver container, and/or seat or aircraft components (e.g. seat legs, cushions, baggage bars, shrouds, etc.) when the seat is in the configuration for taxi, take-off and landing.<br><br>d. The life preserver stowage must not present any sharp edges or points that could damage the life preserver or cause injury to the occupants.<br><br>e. For underseat pan storage on passenger seats (excluding centre console storage):<br><br>1) a pull strap must be connected to the life preserver, or a pull strap or latch must be on the compartment opening, such that when the strap or latch is pulled, the preserver is presented on the strap or the occupant can reach into the compartment to retrieve the life preserver;<br><br>2) the life preserver must be located no more than 3 inches (7.62 cm) aft of the front edge of the seat bottom (i.e. the seat frame or cushion), whichever is further forward;<br><br>3) unless limited by seat cushions or structures (e.g. the seat leg, floor, etc.), designs utilising a pull strap must permit retrieval of the life preserver when pulled from any angle between:<br><br>a) 45 degrees up and 50 degrees down from the horizontal plane,<br><br>b) 45 degrees left and 45 degrees right from the container centre line;<br><br>4) for designs utilising a pull strap, normal seat operation or underseat baggage storage activities must not sweep the pull strap into an unreachable location;<br><br>5) the life preserver container, or compartment, as installed on the seat must protect the life preserver from inadvertent damage from normal passenger movements such as the stowage and removal of underseat baggage.<br><br>f. Demonstrate that the life preserver is within easy reach of, and may be readily removed by a seated and belted occupant (shoulder strap(s) may be removed prior to demonstration), for all seat orientations and installations that are intended for use during taxi, take-off and landing. In lieu of an actual life preserver, a representative object (e.g. in size and weight) may be utilised for testing. The evaluation to quickly retrieve the preserver is to begin with the occupant in the seated position, hands in their lap. Timing begins with the movement of their hand(s) from their lap to reach for the preserver, and ends with the occupant having the preserver in their hand(s) and fully removed from the stowage container. It does not include the time for the occupant to return to the upright position, to remove a pull strap from the preserver (if used) or to open the preserver package provided by the preserver manufacturer. Test the critical configuration(s) (including the minimum approved seat pitch for passenger seats, and the most confined surrounding area for the flight attendant and cockpit seats) to demonstrate retrieval in less than 10 seconds by a minimum of 5 test subjects with a success rate of no less than 75 per cent. The test must evaluate three anticipated occupant test subject size categories: the 5th, 50th and 95th percentile. At least one |

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| | *occupant from each size category must demonstrate successful retrieval within 10 seconds. The test subjects for either the 5th or 95th percentile occupant category must not exceed 40 % of the overall test subject population.*<br>*1) For passenger seats, the test subjects must be naïve. For the purpose of this test, naïve test subjects are defined as ones who must have had no experience within the prior 24 months in retrieving a life preserver. The subjects must receive no retrieval information other than a typical preflight briefing. The occupant size categories to be evaluated must be defined as follows:*<br>*a. a 5th percentile occupant is no taller than 60 inches (1.5 m),*<br>*b. a 50th percentile occupant is at least 63 inches (1.6 m) tall but no taller than 70 inches (1.8 m),*<br>*c. a 95th percentile occupant weighs at least 244 lb (110.7 kg).*<br>*2) For flight attendant and observer seats, the test subjects do not need to be naïve. The occupant size categories to be evaluated must be defined as follows:*<br>*a. a 5th percentile occupant is no taller than 60 inches (1.5 m),*<br>*b. a 50th percentile occupant is at least 63 inches (1.6 m) tall but no taller than 70 inches (1.8 m),*<br>*c. a 95th percentile occupant weighs at least 244 lb (110.7 kg).*<br>*3) For pilot/co-pilot seats, the test subjects do not need to be naïve. The occupant size categories to be evaluated must be defined as follows:*<br>*a. a 5th percentile occupant is no taller than 62 inches (1.57 m),*<br>*b. a 50th percentile occupant is at least 63 inches (1.6 m) tall but no taller than 70 inches (1.8 m),*<br>*c. a 95th percentile occupant weighs at least 244 lb (110.7 kg).*<br>---<br>On page 14, replace subsection 3.3.3 by the following:<br>*3.3.3 Recommended Practice for Life Vests in Leg Rests*<br>*All the requirements under 3.3.2 are applicable to life vests in leg rests, with the following additions:*<br>*— Retrieval of life vest*<br>*The footrest must not impact on the accessibility of the pull strap or life vest, and must be evaluated in all its positions to ensure that it can be readily moved out of the way.* |

| When reading ARP5526eD… | Do the following: |
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| | *— Inadvertent opening*<br>*The life vest container must not be susceptible to inadvertent opening by a seated occupant's foot or feet.*<br>*— Effect of static and dynamic deformations on life vest retrievability*<br>*The distance between the life vest container post deformation (plastic deformation only) and the aircraft floor should be such that the retrieval of the life vest will not be obstructed. Seat tracks and track covers should be considered.*<br>---<br>3.6.2 for Type A-T seats, apply as written.<br>3.7.2 for Type A-T seats, apply as written.<br>---<br>On page 20, replace subsection 3.8.2 by the following:<br>*3.8.2 Recommended Practice*<br>*Safety placards on occupant seats should be permanently affixed, located such that they cannot be easily obscured, and of a type that cannot be easily erased. The height and colour contrast of the lettering should be sufficient to allow the placard to be read by the intended occupant (e.g. a placard located on the back of the seat should be designed to allow the occupant seated behind to easily read it at the anticipated installed pitch.)*<br>---<br>3.10.2: apply as written.<br>3.11.2: apply as written.<br>---<br>On page 29, replace subsection 3.12.2 by the following:<br>*3.12.2 Recommended Practice*<br>*Edges that could cut skin during normal use (including edges on electrical equipment) should be eliminated, and for maintenance, should be minimised. To be considered non-injurious, edges that are accessible (as defined in subsection 3.11.2.1) and could cut skin during normal use must meet either of the standards listed below:*<br>*1. NASA Standard 3000 Volume I (NASA–STD-3000 Vol I), Man-Systems Integration Standards, Revision B, July 1995, Section 6.3.3,*<br>*or*<br>*2. UL 1439, Standard for Tests for Sharpness of Edges on Equipment, Edition 4, 26 February 1998, with revisions up to 6/1/2004.*<br>*In addition, the seat should not have any features whose edges or corners are exposed when deployed and present an impediment to an occupant's egress (e.g. a cocktail table, seat back and in-arm video, flip-out PCU, ashtray, etc.).*<br>--- |

| When reading ARP5526ED… | Do the following: |
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| | On page 30, replace subsection 3.13.2 by the following:<br><br>*3.13.2 This section recommends a test method that demonstrates that items on seats located within the striking radius of the head are not injurious to the occupant of a seat or a nearby seat. The component tests are defined in FAA Policy Memo ANM-03-115-31, and in this context, the striking radius of the head is defined in AC 25-17A, Change 1, Section 25.785.88.b(8), see Figure 88-2.*<br><br>3.14.2: apply as written.<br><br>3.15.2: apply as written.<br><br>3.17.2: apply as written for Type A-T passenger seats.<br><br>---<br><br>On page 46, replace subsection 3.19.2 by the following:<br><br>*3.19.2 Recommended Practice*<br><br>*Flight crew seats (cockpit) and restraints should accommodate adult occupants ranging in stature (standing height) from 5 feet 2 inches (1.57 m) to 6 feet 3 inches (1.9 m).*<br><br>*Flight attendant seats and restraints should accommodate adult occupants ranging in stature (standing height) from a 5th percentile female to a 95th percentile male according to Table 7. If required, additional anthropometric measurements can be obtained from the CAESAR study (reference 2.1.2).*<br><br>**Table 7 — CAESAR anthropometric database sitting and standing heights**<br><br>\| \| CAESAR \|<br>\| --- \| --- \|<br>\| Sitting 5% Female \| 31.86 inches (80.9 cm) \|<br>\| Sitting 95% Male \| 38.78 inches (98.5 cm) \|<br>\| Standing 5% Female \| 60.08 inches (152.6 cm) \|<br>\| Standing 95% Male \| 74.83 inches (190.1 cm) \|<br><br>Crew restraint systems, while fastened, should neither significantly impede access to controls nor prevent the crew from performing their duties.<br><br>---<br><br>3.20.2: apply as written.<br><br>3.21.2: apply as written.<br><br>3.24.2: apply as written.<br><br>---<br><br>On page 50, replace subsection 3.25.2 by the following:<br><br>*3.25.2 Recommended Practice*<br><br>*Where the seat being reclined could adversely affect emergency evacuation, the passenger seat recline and control mechanisms should have an override feature so that the reclined seat back may be moved to the upright position without activating the recline control button.* |

| When reading ARP5526**C**D… | Do the following: |
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| | ---<br>3.32.2: apply as written.<br><br>In addition, the selected seat reference point (SRP) method must be documented, and must be used consistently when evaluating all variations of the seat ETSOA model and subsequent changes to the seat ETSOA model design.<br><br>---<br>Add '3.41.2 Recommended Practice' as follows:<br><br>*3.41.2 Recommended Practice*<br>*The passenger should not have ready access to the internal contents or electrical connections of any electrical components on the seat.*<br><br>~~3.2.2 Definition and Criteria: Seatbelt misalignment is a condition where the seatbelt and/or shackle is positioned to give the impression that the belt has been properly tightened, when in fact there is slack in the system or the shackle is positioned so that it will not carry the force generated in an emergency landing or turbulence condition.~~<br><br>~~*Restraint system anchorages should provide self-aligning features. If self-aligning features are not provided, the static and dynamic tests in this document should be conducted with the restraints and anchorages positioned in the most adverse configuration allowed by the design. The anchorage system shall minimise the possibility of incorrect installation or inadvertent disconnection of the restraints.*~~<br><br>~~The seat belt installation should not appear to the belted occupant to be properly adjusted (snug) while there is significant (2.54 cm (one inch) or more) slack in the system which may pay out in an emergency landing situation. For example, the belt installation should not be able to be caught between seat features such that the occupant would not know there was slack in the belt which may allow the occupant to slide forward during emergency landing or turbulence. To test the installed seat belt for misalignment, the seat should be positioned in its taxi, take-off and landing condition. Installations on seats having bottom cushions that can be removed or incorrectly repositioned without tools should be evaluated with the cushions installed, removed and incorrectly repositioned. The belt and shackle combination should be manipulated with one hand in an attempt to place the restraint in a non-design configuration where it could carry the seatbelt adjustment forces. Particular effort should be made to place the restraint in a position that the restraint forces would not be applied to the hook of the shackle in the same manner as they would be applied in a straight tension pull on the belt. Attempts should be made with the restraint in its normal shape, a single twist of the webbing and/or a single fold of the webbing. Typical areas around the restraint shackle that should be checked are the plastic shrouding around the armrest, the hydraulic seat recline device, the seat pan, anti-rotation brackets/stops, seat pan supports and exposed fasteners. If a condition of potential misalignment is identified, the seatbelt and shackle, in that condition, should be loaded by a restorative force of 22.2 N (five pounds) applied through the belt in the direction that it would be loaded in the emergency landing or turbulence situation. If the load is carried in the misaligned condition, the design is unacceptable. The examples in Section~~ |

| When reading ARP5526C D… | Do the following: |
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| | ~~3.2.3 illustrate various misalignment conditions that have been found to be unacceptable, as indicated. These examples are not intended to be all-inclusive.~~<br><br>~~To test the belt for inadvertent disengagement, where disengagement is defined as the separation of the restraint's attachment fitting from the seat structure, the belt should be tested in all orientations with the seat in the taxi, take-off and landing conditions with the seat cushions installed. Interaction of belts in adjacent seats, where the belts could be inadvertently crossed and used by occupants in those adjacent seats, must be evaluated for the possibility of disengagement.~~<br>~~---~~<br>~~Page 9, replace subsection 3.3.2 to read as follows:~~<br><br>~~*3.3.2 Definition and Criteria: The terms 'life preserver', 'life vest' and 'life jacket' may be used interchangeably. When life preserver stowage provisions are included as part of the seat design, the stowage provisions shall provide access to a life preserver for each seating position. The life preserver stowage shall be designed and located such that the requirements of this section are met. The installation, operating and maintenance instructions shall also reflect the requirements of this section. For example, installation instructions shall account for the allowable life preserver weight and size, marking requirements, as well as the required unobstructed area to remove the life preserver from the container. Furthermore, the operating instructions must report the detailed content of the simulated preflight briefing and any special instructions for unique aspects of the design operation that should be considered for operational use and continued performance.*~~<br>~~*a. The life preserver shall be restrained under all applicable loading conditions, i.e. the retention device shall not allow the life preserver to come free during emergency landing static and dynamic conditions, taxi, take-off, landing, turbulence, and during stowage and removal of underseat baggage.*~~<br>~~*b. Any life preserver locating placard installed on the seat shall accurately state the location of the life preserver and be adequately marked per 3.8.2 of this ARP5526 Revision C document (e.g. "Life preserver under center armrest"). For life preserver locations other than under the seat or under a console between the seats, mark "Life preserver" or "Life preserver inside" on the container or compartment, unless the location is identified with a pull strap. Pull straps shall be red or labelled "PULL" or "PULL FOR LIFE PRESERVER" in contrasting colour. A symbolic placard may be used in lieu of text. For seats intended to be installed in sequential rows, a placard may be on the seat back stating the location of the life preserver for the occupant seated behind.*~~<br>~~*c. The retrieval path of the life preserver shall be free of obstructions due to life preserver container movement and/or seat or aircraft components (e.g. seat legs, cushions, baggage bars, shrouds, etc.) when the seat is in the configuration for taxi, take-off and landing.*~~<br>~~*d. The life preserver stowage shall not present any sharp edges or points that could damage the life preserver or cause injury.*~~<br>~~*e. For underseat pan storage on passenger seats (excluding center console storage):*~~<br><br>~~*1) A pull strap shall be connected to the life preserver, or a pull strap or latch shall be on the compartment opening, such that when the strap or latch is pulled, the preserver is presented on the strap or the occupant can reach into*~~ |

| When reading ARP5526C D… | Do the following: |
|---|---|
| | ~~the compartment to retrieve the preserver (i.e. one or two motions of the occupant result in retrieval of the life preserver).~~<br>~~2) The life preserver shall be located no more than 3 inches aft of the front edge of the seat bottom, i.e. the seat frame or cushion, whichever is further forward.~~<br>~~3) Unless limited by seat cushions or structure (e.g. seat leg, floor, etc.), designs utilising a pull strap shall permit life preserver retrieval when pulled from any angle between:~~<br>~~a) 45 degrees up and 50 degrees down from the horizontal,~~<br>~~b) 45 degrees left and 45 degrees right from the container centerline.~~<br>~~4) For designs utilising a pull strap, normal seat operation or underseat baggage storage activities shall not sweep the pull strap into an unreachable location.~~<br>~~5) The life preserver container, or compartment, as installed on the seat shall protect the life preserver from inadvertent damage from normal passenger movement such as the stowage and removal of underseat baggage.~~<br>~~f. Demonstrate that the life preserver shall be within easy reach of, and shall be readily removed by a seated and belted occupant (shoulder strap(s) may be removed prior to demonstration), for all seat orientations and installations that are intended for use during taxi, take-off and landing. In lieu of an actual life preserver, a representative object (e.g. size and weight) may be utilised for testing. The evaluation to quickly retrieve the preserver is to begin with the occupant moving their hand(s) from the seated position to reach for the preserver and to end with the occupant having the preserver in their hand(s) and fully removed from the stowage container. It does not include the time for the occupant to return to the upright position, to remove a pull strap from the preserver (if used) or to open the preserver package provided by the preserver manufacturer. Test the critical configuration(s) to demonstrate retrieval in less than 10 seconds by a minimum of 5 test subjects with a success rate of no less than 75 %. The test shall evaluate three anticipated occupant test subject size categories: 5th, 50th and 95th percentile. At least one occupant from each size category shall demonstrate successful retrieval within 10 seconds. Test subjects for either the 5th or 95th percentile occupant category shall not exceed 40 % of the overall test subject population.~~<br>~~1) For passenger seats, the test subjects shall be naïve. For the purpose of this test, naïve test subjects shall be defined as: they shall have had no experience within the prior 24 months in retrieving a life preserver. Subjects must receive no retrieval information other than a typical preflight briefing. The occupant size categories to be evaluated shall be defined as:~~<br>~~a. A 5th percentile is no more than 60 in. (1.5 m) tall.~~<br>~~b. A 50th percentile is at least 63 in. (1.6 m) tall but no more than 70 in. (1.8 m) tall.~~<br>~~c. A 95th percentile weighs at least 244 lb (110.7 kg).~~<br>~~2) For flight attendant and observer seats, the test subjects do not need to be naïve. The occupant size categories to be evaluated shall be defined as:~~<br>~~a. A 5th percentile is no more than 60 in. (1.5 m) tall.~~<br>~~b. A 50th percentile is at least 63 in. (1.6 m) tall but no more than 70 in. (1.8 m) tall.~~<br>~~c. A 95th percentile weighs at least 244 lb (110.7 kg).~~<br>~~3) For pilot/co-pilot seats, the test subjects do not need to be naïve. The occupant size categories to be evaluated shall be defined as:~~ |

| When reading ARP5526**C**D… | Do the following: |
|---|---|
| | ~~*a. A 5th percentile is no more than 62 in. (1.57 m) tall.*~~<br>~~*b. A 50th percentile is at least 63 in. (1.6m) tall but no more than 70 in. (1.8 m) tall.*~~<br>~~*c. A 95th percentile weighs at least 244 lb (110.7 kg).*~~<br>~~---~~<br>~~3.6.2 For Type A seats, apply as written.~~<br>~~3.7.2 For Type A seats, apply as written.~~<br><br>~~---~~<br>~~Page 13, replace subsection 3.8.2 to read as follows:~~<br><br>~~3.8.2 Definition and Criteria: Safety placards on occupant seats should be permanently affixed, located such that they cannot be easily obscured and of a type that cannot be easily erased. The lettering height and colour contrast should be sufficient to allow the placard to be read by the intended occupant (e.g. placards located on the back of the seat should be designed to allow the occupant seated behind to easily read it at the anticipated installed pitch.)~~<br><br>~~---~~<br>~~3.9.2 Apply as written.~~<br>~~3.10.2 Apply as written.~~<br>~~3.11.2 Apply as written.~~<br><br>~~---~~<br>~~Page 20, replace subsection 3.12.2 to read as follows:~~<br><br>~~3.12.2 Definition and Criteria: Edges that could cut skin during normal *use (including in edges on electrical equipment)* should be eliminated and for maintenance should be minimised. *To be considered non-injurious, edges that are accessible (as defined in section 3.11.2.1) and could cut skin during normal use shall meet either of the standards listed below:*~~<br>~~*1. NASA Standard 3000 Volume I (NASA–STD-3000 Vol. I), Man-Systems Integration Standards, Revision B, July 1995, Section 6.3.3, or*~~<br>~~*2. UL 1439, Standard for Tests for Sharpness of Edges on Equipment, Edition 4, February 26, 1998, with revisions through 6/1/2004.*~~<br><br>~~In addition, the seat should not have any feature whose edges or corners are exposed when deployed, that presents an impediment to an occupant's egress (e.g. cocktail table, seat back and in-arm video, flip-out PCU, ashtray, etc.).~~<br>~~---~~<br>~~3.13.2 Apply as written.~~<br>~~3.14.2 Apply as written.~~<br>~~3.15.2 Apply as written.~~<br>~~3.17.2 For Type A passenger seats, apply as written.~~<br>~~3.20.2 Apply as written.~~ |
| ~~Appendix A~~ | ~~Apply Appendix A as necessary to comply with the requirements of this ETSO.~~ |
| ~~Appendix B~~ | ~~Disregard all subsections in Appendix B not listed below. The following subsections apply as modified:~~<br>~~---~~<br>~~B.1.1.14 Apply as written.~~<br>~~B.1.1.26 Apply as written.~~<br>~~---~~<br>~~Page 46, replace subsection B.1.1.28 to read as follows:~~ |

| When reading ARP5526eD… | Do the following: |
|---|---|
| | ~~B.1.1.28 Where seat recline could adversely affect emergency evacuation, passenger seat recline and control mechanisms should have an override feature so that the reclined seat back may be moved to the upright position without releasing the recline control button.~~ |

3.0. Side-facing seats must meet the requirements of Table 3 of the Appendix to this ETSO. It prescribes the MPS for SAE International AS8049/1B, 'Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated December 2016. When the SAE section *recommends (or suggests, advises, etc.)* something, and it is part of the MPS, the recommendation becomes a *requirement*. For the purpose of meeting the side-facing seat requirements of Table 3 of the Appendix to this ETSO, all the references to 'AS8049C' must be replaced by 'AS8049C as modified by Table 1 of the Appendix to this ETSO'. In addition, SAE AS8049/1B is modified as follows:

***Table 3 — SAE AS8049/1B***

| When reading AS8049/1B… | Do the following: |
|---|---|
| Section 1 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 3, replace subsection 1.1 by the following:<br>*1.1 Purpose*<br>*This SAE Aerospace Standard (AS) defines the Minimum Performance Standards (MPSs), qualification requirements, and minimum documentation requirements for side-facing seats in civil rotorcraft, transport aircraft, and general aviation aircraft. The goal is to achieve comfort, durability, and occupant protection under normal operational loads and to define test and evaluation criteria to demonstrate occupant protection when a side-facing seat/occupant/restraint system is subjected to statically applied ultimate loads and to dynamic test conditions.*<br>---<br>On page 3, replace subsection 1.3 by the following:<br>*1.3 Seat Types*<br>*This document covers all passenger and crew seats except pilot and co-pilot seats. Additionally, flight attendant seats are excluded for Type A-T seats.* |
| Section 2 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 4, replace subsection 2.1 by the following:<br>*2.1 Applicable Documents*<br>*This document is explicitly linked with and cannot be used without AS8049C. The requirements of each section of AS8049C apply to this document unless specifically modified by this document. Sections 3 to 7 of this document note only differences between the standards of this document and the standards of AS8049C. Sections 8 and 9 are reserved for future use, and the content specific to side-facing seats is found in Section 10. Test pulse evaluations must use the method defined in AS8049C Appendix A.* |

| | |
|---|---|
| Section 3 | Apply as written. |
| Section 4 | Apply as written |
| Section 5 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 8, subsection 5.3 is modified by adding subsection 5.3.1.5 as follows:<br><br>*5.3.1.5 If smaller occupants are permitted to occupy the seat, the range of occupants must include a 2-year-old child up to a 95th percentile male (see 10.8 for further discussion on the range of occupants). This requirement applies whether the sensor-driven restraint system is designed to manage injury parameters (HIC, neck rotation, etc.) or occupant motion.*<br><br>*Side-facing seating systems, including sensor-driven restraint systems, must be shown to meet the occupant injury criteria of subsection 10.7, as modified by this Appendix, throughout the entire range of yaw that encompasses installation angles ± 10 degrees relative to the aircraft longitudinal axis.*<br><br>*If a shoulder belt incorporating an airbag is used, care must be taken when placing the webbing load cell to ensure that an accurate measurement is made and that the load cell does not affect the performance of the airbag.* |
| Section 6 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 12, replace Section 6 by the following:<br><br>*6. Markings*<br><br>*The requirements prescribed in paragraph 4 of this ETSO are applicable to all side-facing seats, with the exception that side-facing seats must also be identified with the applicable occupant limitations prescribed by subsection 10.8.* |
| Section 7 | Disregard |
| Section 10 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 12, add subsection 10.1.2.1 as follows:<br><br>*10.1.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.1.2, then the detailed design definition of the contactable item evaluated per subsection 10.1.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.*<br>---<br>On page 13, add subsection 10.2.2.1 as follows:<br><br>*When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.2.2, then the detailed design definition of the contactable item evaluated per subsection 10.2.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.*<br>---<br>On page 13, replace subsection 10.3.1 by the following: |

| | |
|---|---|
| | *10.3.1 Occupant Simulation*<br><br>*Injury assessments must be evaluated for all the seat places of a multiple occupant seat structure. Injury assessments must be accomplished by performing one test with ES-2re ATD (49 CFR Part 572 Subpart U) at all seat places. Alternatively, these assessments must be accomplished by multiple tests that use an ES-2re in the seat place being evaluated, and a Hybrid II ATD (49 CFR Part 572, Subpart B) or its equivalent in all the seat places forward of the one being assessed, to evaluate the occupant interactions. In this case, the seat places aft of the one being assessed may be unoccupied.*<br><br>---<br><br>On page 14, add subsection 10.3.2.1 as follows:<br><br>*10.3.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.3.2, then the detailed design definition of the contactable item evaluated per subsection 10.3.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.*<br><br>---<br><br>On page 14, add subsection 10.3.3.1 as follows:<br><br>*10.3.3.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.3.3, then the detailed design definition of the contactable item evaluated per subsection 10.3.3 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.*<br><br>---<br><br>On page 17, replace subsection 10.7, Item 5, by the following:<br><br>*5. Leg: Axial rotation of the upper-leg (femur) is limited to 35 degrees in either direction from the nominal (pre-test) ATD seated position. This limit only applies to femur axial rotations caused by the lateral (relative to the ATD) swinging action of the lower legs, and not to any rotations caused by other leg articulations or rebound motion. For the purposes of this criteria, the rebound begins when the forward motion of the lower leg has stopped. The rotation can be measured by using video evidence or femur axial rotation sensors on the ATD.*<br><br>*For threshold tests only, if the pulse used for the threshold test has a lower energy than the research pulse used to develop the criteria (see FAA Report DOT/FAA/AM-17/2, 'Supplemental Injury Risk Considerations for Aircraft Side-Facing Seat Certification', dated January 2017), it is not necessary to meet the leg axial rotation requirement of AS8049/1B, subsection 10.7, Item 5, as modified by this Appendix*. |

4.0. Oblique-facing seats must meet the requirements of Table 4 of the Appendix to this ETSO. It prescribes the MPS for SAE International SAE AS6316, 'Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft', dated June 2017. When the SAE section *recommends (or suggests, advises, etc.)* something, and it is part of the MPS, the recommendation becomes a *requirement*. For the purpose of meeting the oblique-facing seat requirements of Table 4 of the Appendix to this ETSO, all the references to 'AS8049C' must be replaced by 'AS8049C as modified by Table 1 of the Appendix to this ETSO'. In addition, we have also modified AS6316 as follows:

***Table 4 — SAE AS6316***

| When reading SAE AS6316… | Do the following: |
|---|---|
| Section 1 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 3, replace subsection 1.1 by the following:<br>*1.1 Purpose*<br>*This SAE Aerospace Standard (AS) defines the Minimum Performance Standards (MPSs), qualification requirements, and minimum documentation requirements for oblique-facing seats in transport aircraft. The goal is to achieve comfort, durability, and occupant protection under normal operational loads and to define test and evaluation criteria to demonstrate occupant protection when an oblique-facing seat/occupant/restraint system is subjected to statically applied ultimate loads and to dynamic test conditions.*<br>*These criteria are limited to seats with an occupant facing direction greater than 18° and no greater than 45° relative to the aircraft longitudinal axis. Seats installed at angles greater than 30° relative to the aircraft longitudinal axis must have an energy-absorbing rest or shoulder harness and must satisfy the criteria listed in Table 2 as modified by this Appendix.*<br>---<br>On page 3, replace subsection 1.2 by the following:<br>*1.2 Seat Types*<br>*This document covers only Type A-T passenger seats.* |
| Section 2 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 3, replace subsection 2.1 by the following:<br>*2.1 Applicable Documents*<br>*This document is explicitly linked with and cannot be used without AS8049C. The requirements of each section of AS8049C apply to this document unless specifically modified by this document. Sections 3 through 7 of this document note only the differences between the standards of this document and the standards of AS8049C. Sections 8 and 9 are reserved for future use, and the content specific to oblique-facing seats is found in Section 10. Test pulse evaluations must use the method defined in AS8049C Appendix A.*<br>--- |

| | |
|---|---|
| | On page 3, disregard Section 2.1.1. |
| Section 3 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 7, disregard the modification to subsection 3.4.1. |
| Section 4 | Apply as written. |
| Section 5 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 7, subsection 5.3.4.1 is modified by adding the following:<br>*g. The ATD neck forces shall be measured in accordance with the requirements of Channel Class 1000.*<br>*h. The ATD neck forces used for calculating Nij shall be measured in accordance with the requirements of Channel Class 600.*<br>*i. The ATD neck moments shall be measured in accordance with the requirements of Channel Class 600.*<br>*j. The ATD spine accelerations shall be measured in accordance with the requirements of Channel Class 180.*<br>*k. The leg axial rotation obtained from the measured leg angular velocity by integration shall require angular velocity data measured in accordance with the requirements of Channel Class 180.*<br>---<br>On page 7, subsection 5.3.1.5 is modified by adding the following:<br>*Oblique-facing seating systems including sensor-driven restraint systems must be shown to meet the occupant injury criteria of Table 2 as modified by this Appendix throughout the entire range of yaw that encompasses installations at ± 10° relative to the aircraft longitudinal axis.* |
| Section 6 | Disregard |
| Section 7 | Disregard |
| Section 10 | Apply all the subsections unless disregarded or modified as shown below:<br>---<br>On page 9, add subsection 10.1.2.1 as follows:<br>*10.1.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.1.2, then the detailed design definition of the contactable item evaluated per subsection 10.1.2 and any other information required for the installation (e.g. stiffness), must be included as part of the installation instructions and limitations document.*<br>---<br>On page 10, add subsection 10.2.2.1 as follows:<br>*10.2.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.2.2, then the detailed design definition of the contactable item evaluated per subsection 10.2.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.* |

| | |
|---|---|
| | ---------- On page 11, replace Table 2, 'Neck', Item (4), by the following: *The neck must not impact on any surface that would produce significant concentrated loading on the neck.* ---------- On page 12, in Table 2, 'Femur', add Item (1) as follows: *Note: If contact occurs with other structure that is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated during the axial compressive load, then the detailed design definition of the item must be included as part of the installation instructions and limitations document.* ---------- On page 12, in Table 2, 'Femur', add Item (2) as follows: *Note: For threshold tests only, if the pulse used for the threshold test has a lower energy than the research pulse used to develop the criteria (see FAA Report DOT/FAA/AM-17/2, 'Supplemental Injury Risk Considerations for Aircraft Side-Facing Seat Certification', dated January 2017), it is not necessary to meet the leg axial rotation requirement of Table 2 as modified by this Appendix, Femur, Item (2).* |

5.0. Table 5 of the Appendix to this ETSO prescribes the MPS for SAE International ARP6337, 'Design, Manufacturing, and Performance Standard for Composite Materials Used on Aircraft Seat Structures', dated November 2020. When the SAE section *recommends (or suggests, advises, etc.)* something, and it is part of the MPS, the recommendation becomes a *requirement*. For the purpose of meeting the requirements of Table 5 of the Appendix to this ETSO, all the references to 'AS8049' and 'ARP5526' must be replaced by 'AS8049C as modified by Table 1 of the Appendix to this ETSO' and 'ARP5526D as modified by Table 3 of the Appendix to this ETSO' respectively.

In addition, SAE ARP6337 is also modified as follows:

***Table 5 — SAE ARP6337***

| When reading ARP6337… | Do the following: |
|---|---|
| Section 1 | Apply all the subsections unless disregarded or modified as shown below: ---------- On page 3, replace Table 1 by the following: |

| Seat Type | Aircraft Category | Applicable CSs |
|---|---|---|
| A-T | Large (Transport) Aeroplane | CS-25 |
| C | General Aviation Aircraft — All categories as specified in 1(1)(c) of this ETSO | CS-23 |

| | |
|---|---|
| Section 2 | Apply all the subsections unless disregarded or modified as shown below: |

| | |
|---|---|
| | ---<br>On page 6, disregard 2.1. |
| Section 3 | Apply as written. |
| Section 4 | Apply as written. |
| Section 5 | Apply as written. |
| Section 6 | Apply all the subsections unless disregarded or modified as shown below:<br><br>---<br>On page 18, Section 6 is modified as follows:<br><br>*6. Optionally, the composite seat structure can be subjected to the following environmental conditions described in EUROCAE ED-14/RTCA DO-160, according to paragraph 2.1 of CS-ETSO Subpart A, as outlined in Table 2 below. Comparison by similarity is acceptable if the test data is directly applicable to the material system, design details, and environmental conditions characteristic of the application. Testing may be combined sequentially to reduce the number of tests and optimise the use of test resources as noted in Section 3.2 of EUROCAE ED-14/RTCA DO 160.*<br><br>---<br>On page 18, Section 6.1 is modified as follows:<br><br>*6.1 Fluid Susceptibility*<br><br>*The composite seat structure should be exposed to the fluids at the temperatures listed in Table 3 using one of the methods described in EUROCAE ED-14/RTCA DO-160, according to paragraph 2.1 of CS-ETSO Subpart A, Section 11.0. Resin-dominated shear tests are best for detecting the effects of solvent exposure on resins; refer to DOT/FAA/AR-02/109 for guidance on the recommended tests. The solvent exposure and subsequent testing should be conducted at the temperatures expected during service.*<br><br>---<br>On page 18, Section 6.2 is modified as follows:<br><br>*6.2 Waterproofness*<br><br>*The composite seat structure shall withstand the effects of liquid water falling onto the seat, or the effects of condensation. The seat system shall be tested per Section 10.3.2 (drip test only) of EUROCAE ED-14/RTCA DO-160, according to paragraph 2.1 of CS-ETSO Subpart A. The seat manufacturer shall be able to demonstrate that the seat and the associated components are not adversely affected by the parameters considered.* |
| Section 7 | Apply as written. |
| Section 8 | Disregard. |
| Appendix A | Disregard. |

[Amdt ETSO/11]

[Amdt ETSO/17]

# APPENDIX 2 TO ETSO-C127~~b~~c – ELECTIVE MPS FOR ROTORCRAFT, TRANSPORT AEROPLANE, AND SMALL AEROPLANE SEATING SYSTEMS

Compliance ~~Complying~~ with the MPS described in these paragraphs is elective~~;~~, however, the MPS must be followed for the ~~one(s)~~ MPS with which the applicant has elected to comply. Deviations from an elective MPS must be approved by EASA. Applicants should document and report which elective MPS subparagraphs they complied with so they can receive credit under this ETSO. In addition, see ETSO paragraph 4(a)(1) for the marking requirements.

~~Per ETSO paragraph **3.1.1**, elective MPS subparagraphs complied with must be documented and reported to receive credit under this ETSO.~~

~~In addition, see ETSO paragraph **4.1.(i).(c)** for marking requirements.~~

a. Step Load on Baggage Bars: For seats where the baggage restraint allows application of a foot step load, apply the test criteria of ~~ARP5526C~~ ARP5526D, subsection 3.7.2. The testing must not degrade neither the basic forward nor the side load carrying capabilities noted in ~~AS8049B, Table 4,~~ AS8049C Table 4A, nor result in deformation, thus posing a tripping hazard.

~~b. Flight Attendant Step Load: For seats that include a built in flight attendant step in the seat design, demonstrate that such a step design meets expected service loads. Apply ARP5526C, Appendix B, subsection B.1.1.29, Table B1, to qualify the design.~~

b. Electrically Actuated Features: For seats with electrically actuated moving parts, which could potentially entrap and cause injury to passengers, apply ARP5526D, subsection 3.18.2.

c. Secondary Structure Abuse Loads: For seats that include the features listed in ARP5526D, Section 3.26.2, Table 9, apply the loads within the table to qualify the design.

~~c.~~d. Testing to Higher Static Loads: To substantiate ~~the~~ seats to load factors higher than those specified in ~~Table 4 of AS8049B~~ *Table 4A of AS8049C*, or to combine load factors, the higher load factors must be reported. The higher load factors must be marked on the ETSO placard.

~~d.~~e. Hand Holds: For seats designed to provide a handhold for passengers moving about the aeroplane~~airplane~~, apply ~~ARP5526C~~ ARP5526D, Section 3.1.2.

f. Batteries Containing Lithium: For seats with batteries containing lithium in their design, test and meet the requirements defined in ETSO-C142b (or later EASA-approved ETSO for non-rechargeable lithium batteries) or ETSO-C179b (or later EASA-approved ETSO for rechargeable lithium batteries). An ETSO approval does not include installation approval in an aircraft, and special conditions may be required to gain installation approval if the design includes lithium batteries.

~~e.~~*g.* Flammability — Large Exposed Non-metallic Parts*:* For Type A seats incorporating *non-traditional,* large non-metallic panels in their design, test and meet the fire protection provisions of Appendix F, ~~p~~Parts IV and ~~part~~ V (heat release and smoke emission) of CS-25. ~~*The* material's fire protection properties may be demonstrated using the methods provided in the FAA policy statement, PS-ANM-25.853-01-R2 'Flammability Testing of Interior Materials', which may permit substantiation based on previously tested materials.~~ Demonstrate the fire protection properties of the materials by using the methods provided in FAA policy statement PS-ANM-25.853-01-R2, 'Flammability Testing of Interior Materials', which may permit substantiation based on previously tested materials, and SAE ARP6199A, 'Method to Evaluate Aircraft Passenger Seats for the Test Requirements of 14 CFR Part 25 Appendix F, Parts IV and V'. Although ARP6199A provides an acceptable compliance method for determining which

panels on the seat must be evaluated and substantiated to comply with certain special conditions, the intent is to limit the quantities of materials that do not comply with the smoke emission and heat release test requirements.

In addition, report which parts meet the requirements of Appendix F, Parts IV and V, as part of your ETSO-furnished data.

[Amdt ETSO/11]
[Amdt ETSO/17]

# ETSO-C137a

## AIRCRAFT PORTABLE MEGAPHONES

**1 Applicability**

This ETSO provides the requirements that portable aircraft megaphones 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 SAE International's Aerospace Standard (AS) 4950B, 'Design and Performance Criteria for Transport Aircraft Portable Megaphones', dated March 2007, 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 Embedded Batteries

See CS-ETSO, Subpart A, paragraph 2.8.

**4 Marking**

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

None.

**5 Availability of Referenced Documents**

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/17]

# APPENDIX 1 TO ETSO-C137a — MPS FOR AIRCRAFT PORTABLE MEGAPHONES

SAE International's Aerospace Standard (AS) AS4950B, 'Design and Performance Criteria for Transport Aircraft Portable Megaphones', dated March 2007, is modified as per Table 1 below.

**Table 1 — Modification of AS4950B, 'Design and Performance Criteria for Transport Aircraft Portable Megaphones'**

| Location in AS4950B | Initial AS4950B text | Amending text |
|---|---|---|
| 3.4.1 | All materials used except small parts (knobs, triggers, fasteners, seals, and small electrical parts) that would not contribute significantly to the propagation of a fire shall be self-extinguishing when tested in accordance with the applicable requirements of 14 CFR 25.853. | Compliance shall be shown with the flammability test specified in EUROCAE ED-14G / RTCA DO-160G, Section 26 for Category C: Flammability. If ignition occurs inside or outside the equipment, the equipment shall not propagate the flame. |

[Amdt ETSO/17]

# ETSO-C139a A1

## AUDIO SYSTEMS AND EQUIPMENT

**1 Applicability**

This ETSO provides the requirements thatwhich Audio Systems and Equipment 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 Aapplicable 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 The applicable standard is that provided in the RTCA DO-214A, 'Audio Systems Characteristics and Minimum Performance Standards for Aircraft Audio Systems and Equipment', dated 18 December 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 Computer Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware Qualification

See CS-ETSO, Subpart A, paragraph 2.3.

**3.2 Specific**

None.

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

**4 Marking**

**4.1 General**

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

**4.2 Specific**

None.

**5 Availability of Referenced Documents**

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]

[Amdt ETSO/17]

# APPENDIX 1 TO ETSO-C139a A1 — CORRECTION TO RTCA DO-214A, 'AUDIO SYSTEMS CHARACTERISTICS AND MINIMUM PERFORMANCE STANDARDS FOR AIRCRAFT AUDIO SYSTEMS AND EQUIPMENT'

## A1.1 Introduction

This Appendix corrects RTCA DO-214A, 'Audio Systems Characteristics and Minimum Performance Standards for Aircraft Audio Systems and Equipment', regarding an optical character recognition error in the value of a test capacitor in a test procedure not detected during the peer review process. The value was '1E-14 F (0.01 pF)' instead of the required '1E-8 F (0.01 µF)', so it was six orders of magnitude too low for interphone channels.

In addition, this Appendix clarifies RTCA DO-214A, 'Audio Systems Characteristics and Minimum Performance Standards for Aircraft Audio Systems and Equipment', regarding an ambiguous requirement for the HOT microphone feature in Section 1.4.5.

## A1.2 Correction

In Section 2.8.2.9 of RTCA DO-214A, 'Audio Systems Characteristics and Minimum Performance Standards for Aircraft Audio Systems and Equipment', '0.01 pF' is replaced by '10 nF'.

[Amdt ETSO/17]

# ETSO-C157~~b~~c

## FLIGHT INFORMATION SERVICES-BROADCAST (FIS-B) EQUIPMENT

### 1 Applicability

This ETSO ~~gives~~ provides the requirements that~~which~~ Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment 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 ~~A~~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

~~This~~ These standards apply to equipment intended to display weather and other non-air-traffic-control-related flight advisory information to pilots in a manner that will enhance their awareness of the ~~flight~~ conditions of flight.

~~Standards set forth~~ The applicable standards are those provided in ~~the Radio Technical Commission for Aeronautics (~~RTCA~~), Inc.,~~ ~~D~~document DO-267A, ‘Minimum Aviation System Performance Standards (MASPS) for Flight Information Services-Broadcast (FIS-B) Data Link’, Rev. A, dated 29 April 2004, or DO-358A, ‘Minimum Operational Performance Standards (MOPS) for Flight Information Services-Broadcast (FIS-B) with Universal Access Transceiver (UAT)’, dated ~~March 24, 2015~~ 27 June 2019~~.~~ defined in the following ~~t~~Table 1.

The applicant shall demonstrate ~~Demonstrate~~ the required functional performance under the test conditions as specified in ~~t~~Table 1.

***Table 1 — Equipment classes for FIS-B***

| Equipment Class | Equipment Name | Functionality | Test conditions |
|---|---|---|---|
| 1 | FIS-B Equipment using Universal Access Transceiver (UAT) and Interoperable with the Surveillance and Broadcast Services (SBS) Provider | ~~RTCA/DO358 Sections 2.2.~~ RTCA/DO358A Sections 2.1, 2.2 and 2.3. In accordance with Section 2.1.9, 'Equipment Classes', this includes the requirements in Appendix K, DO-358A EQUIPMENT CLASS TO REQUIREMENT MAPPING, for all the applicable FIS-B Equipment Class(es) in Table 2-1, FIS-B Equipment Classes, for which the manufacturer seeks ETSO authorisation. Manufacturers may implement as many, or as few, of the FIS-B Equipment Classes identified in Table 2-1 as are desired in their FIS-B equipment. Identify the supported FIS-B Equipment Classes in accordance with paragraph 4 of this ETSO. | ~~RTCA/DO-358, Sections 2.3 and 2.4.~~ RTCA/DO-358A, Sections 2.2 and 2.3, which are applicable to the FIS-B Equipment Class(es) implemented within the equipment as determined by DO-358A Table 2-1, Table K-1, and Table 2-33 and Section 2.4. |
| 2 | FIS-B Equipment not Interoperable with the SBS Provider | RTCA/DO-267A Section 2 (except 2.1.4; 2.2.12; and 2.2.13) and Section 3.8. | RTCA/DO-267A, Section 4. |

~~***Table 1. Equipment Classes for FIS-B***~~

Note*:* This ETSO is intended for equipment used in the US National Airspace System. UAT is not intended to be operated in European ~~A~~airspace.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 ~~Computer~~ Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware ~~Qualification~~

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

Failure of the function defined in paragraph 3.1.1 resulting in misleading weather or flight advisory information is a minor failure condition.

Loss of the function defined in paragraph 3.1.1 is a minor failure condition.

3.2.2 Manual

The applicant shall produce a manual that includes ~~including~~ operating instructions and equipment limitations. This manual must state the following:

*'FIS-B information may be used for pilot planning decisions focused on updating the pilot~~'~~'s awareness of the dynamic flight environment~~;~~, including avoiding areas of inclement weather that are beyond visual range and pilot near-term decisions where poor visibility precludes visual acquisition of inclement weather. FIS-B weather and NAS status information may be used as follows:*

*(a) To promote pilot awareness of the own ship location with respect to the reported weather, including hazardous meteorological conditions; NAS status indicators to enhance pilot planning decisions~~;~~ and pilot near-term decision-making.*

*(b) To cue the pilot to communicate with Air Traffic Control, a Flight Service Station specialist, operator dispatch, or airline operations control centre ~~center~~ for general and mission-critical meteorological information, NAS status conditions, or both.*

*FIS-B information, including weather information, NOTAMs, and TFR areas, are intended for the sole purpose of assisting in long-~~/~~ and near-term planning and decision making. The system lacks sufficient resolution and the updating capability necessary for aerial manoeuv~~e~~ring associated with immediate decisions. In particular, in extreme scenarios, the oldest weather radar data on the display can be up to 15 to 20 minutes older than the display's age indication for that weather radar data. Therefore, do not attempt to use FIS-B weather information to manoeuvre~~er~~ the aircraft at minimum safe distances from hazardous weather. ~~FIS-B information must not be used in lieu of a standard preflight briefing.'~~*

*FIS-B information may be used to support the preflight preparation required by the applicable regulations. However, depending on the intended operation, FIS-B may not provide all the available aeronautical or meteorological information concerning the flight. Regulatory compliant*

*preflight preparation may be accomplished using automated resources or by contacting a Flight Service Station.'*

In addition to the above operating instructions and equipment limitations, the following paragraph should be added for FIS-B Class 1 equipment only.

(c) *'FIS-B uplink is an FAA-approved source for METAR, TAF, WINDS, PIREPs, NEXRAD, AIRMET, SIGMET, and TFR information subject to the range limits for the broadcast of these products. FIS-B uplink is not an FAA-approved source for NOTAMs.'*

In addition to the above operating instructions and equipment limitations, the following paragraph should be added for FIS-B Class 2 equipment only.

(d) *'This FIS-B Class 2 equipment is not interoperable with the FAA SBS provider.'*

The manual shall describe in detail the functionality of each FIS-B Equipment Class (as defined in Table 2-1 of RTCA/DO-358A) implemented within the FIS-B equipment.

The manual shall describe any deviation in detail.

## 4 Marking

4.1 General

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

4.2 Specific

~~None~~

(a) The markings shall also identify the Equipment Class as defined in Table 1 of this ETSO, and for Equipment Class 1 (as defined in Table 1 of this ETSO) shall identify all the FIS-B Equipment Classes implemented within the FIS-B equipment as listed in RTCA/DO-358A, Table 2-1, as follows:

(1) Class 1 equipment (as defined in Table 1 of this ETSO) that incorporates all the FIS-B products listed in RTCA/DO-358A, Table 2-1, shall be marked as 'Equipment Class 1A'.

(2) Class 1 equipment (as defined in Table 1 of this ETSO) that incorporates all the FIS-B products listed in RTCA/DO-358A, Table 2-1, except for AIRMET, shall be marked as 'Equipment Class 1B'.

(3) Class 1 equipment (as defined in Table 1 of this ETSO) other than Equipment Class 1A and 1B as 'Equipment Class 1[suffix the Equipment Class Letters for all supported FIS-B products according to RTCA DO-358A, Table 2-1]'. For example, mark equipment that incorporates only METAR (C), TAF (D), PIREP (E), and Winds (F), as 'Equipment Class 1CDEF'.

(b) Class 2 equipment (as defined in Table 1 of this ETSO) shall be marked as 'Equipment Class 2'.

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/7]
[Amdt ETSO/12]
[Amdt ETSO/17]

# ETSO-C161~~a~~b

## GROUND-BASED AUGMENTATION SYSTEM POSITIONING AND NAVIGATION EQUIPMENT

**1 Applicability**

This ETSO provides ~~gives~~ the requirements that~~which~~ Ground-Based Augmentation System Positioning and Navigation Equipment that ~~are~~ 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 ~~A~~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~~ The applicable standard is that provided in ~~Radio Technical Commission for Aeronautics (~~RTCA~~)~~ ~~D~~document RTCA/DO-253D Change 1, Section 2, for GBAS airborne equipment class (GAEC) C to support GBAS Approach Service Type (GAST) C, or GAEC D to support both GAST C and GAST D approach service types. This ETSO also applies to equipment that implements the optional GBAS positioning service as defined in RTCA/DO-253D Change 1, Section 2.3. ~~DO-253C, Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment, dated 16/12/2008, section 2 as modified by appendices 1 and 2 of this ETSO for airborne equipment class (AEC) C to support Category I precision approach. These standards also apply to equipment that implements the optional GBAS positioning service. This ETSO does not apply to AEC D equipment as the additional requirements to support the GBAS Approach Service Type D and Category III precision approaches have not been validated. A new ETSO or a revision to this ETSO for AEC D equipment will be issued once these additional requirements are validated.~~

~~This TSO's standards~~The standards of this ETSO apply to equipment intended to output deviations relative to a precision approach path using GBAS, and to provide position information to a ~~an ETSO-C161a~~ navigation management unit that outputs deviation commands referenced to a desired flight path. ~~These standards do not address integration issues with other avionics except for automatic dependent surveillance.~~ The positioning and navigation functions are defined in Section 2.3 of RTCA/DO-~~253C~~253D Change 1. In accordance with Section 2.1 of RTCA/DO-~~253C~~253D Change 1, equipment obtaining this ETSOA must also comply with the position, velocity and time (PVT) output requirements of either ~~ETSO-C145c~~ETSO-C145e, ~~ETSO-C146c~~ETSO-C146e or ~~ETSO-C196a~~ETSO-C196b.

~~Note: ETSO-C196a, which is based on RTCA/DO-316, Minimum Operational Performance Standards for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment, is not referenced in RTCA DO-253C. RTCA/DO-316 was published after the publication of DO-253C. ETSO-C129a is not applicable to this ETSO.~~

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1. The required performance is defined in RTCA/DO-~~253C~~253D, Change 1, Section 2.4.

3.1.3 ~~Computer~~ Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware ~~Qualification~~

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

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

## 4 Marking

4.1 General

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

4.2 Specific

None.

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/3]
[Amdt ETSO/7]
[Amdt ETSO/17]

# APPENDIX 1 TO ETSO-C161A –
# MINIMUM PERFORMANCE SPECIFICATION FOR GROUND BASED AUGMENTATION SYSTEM POSITIONING AND NAVIGATION EQUIPMENT

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

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

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

***Table 2-7 GPS Tracking Constraints for DD DLL Discriminators***

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

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

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

3. Page 49, section 2.3.8.1.3, *add* a new paragraph g. to the list of conditions as follows:

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

4. Page 57, section 2.3.9.5, *replace* the differential correction magnitude check, $\delta PR_t$ equation as follows:

$$\delta PR_t = PRC_t + RRC_t^*(t - t_{zcount}) + TC_t$$

5. Page A-6, *replace* the Maximum Use Distance ($D_{max}$) definition as follows:
**Maximum Use Distance (Dmax) –** the maximum distance from the GBAS reference point for which the integrity is assured.

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

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

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

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

[Amdt ETSO/7]

# ~~APPENDIX 2 TO ETSO-C161A — MINIMUM PERFORMANCE SPECIFICATION FOR GNSS-BASED PRECISION APPROACH LOCAL AREA AUGMENTATION SYSTEM (LAAS) SIGNAL-IN-SPACE INTERFACE CONTROL DOCUMENT (ICD)~~

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

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

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

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

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

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

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

   ~~The valid range for runway number is 1-36.~~

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

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

   a. ~~Message Type 2, Additional Data Block 4, VDB Authentication Parameters description and Table 2-16 in DO-246D, section 2.4.4.1, pages 33 and 35.~~

   b. ~~Message Type 3 – Null Message and Table 2-17 Format of Message Type 3 in DO-246D, section 2.4.5, page 37.~~

   c. ~~Reference Path Identifier in DO-246D, section 2.4.6.4, page 53.~~

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

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

~~[Amdt ETSO/7]~~

# ETSO-C162~~a~~b

## GROUND-BASED AUGMENTATION SYSTEM VERY HIGH FREQUENCY DATA BROADCAST EQUIPMENT

### 1 Applicability

This ETSO provides ~~gives~~ the requirements that~~which~~ Ground-Based Augmentation System Very High Frequency Data Broadcast Equipment that ~~are~~ 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 ~~A~~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~~The applicable standards are those provided in ~~the Radio Technical Commission for Aeronautics (~~RTCA~~) D~~ document ~~DO-253C~~DO-253D, Change 1, 'Minimum Operational Performance Standards for GPS Local Area Augmentation System Airborne Equipment', dated ~~16/12/2008~~ 27 June 2019.

~~NOTE~~*Note:* All RTCA/~~DO-253C~~DO-253D Change 1 references to RTCA/DO 246() apply to RTCA/~~DO-246B~~DO-246E, including Change 1, 'GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-In-Space Interface Control Document (ICD)'~~, dated November 28, 2001. Modifications to these references are noted in appendix 2 of ETSO-C161a~~.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 ~~Computer~~ Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware ~~Qualification~~

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

### 4 Marking

4.1 General

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

4.2 Specific

None.

**5 Availability of Referenced Documents**

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/7]
[Amdt ETSO/17]

# ETSO-2C168a

AVIATION VISUAL DISTRESS SIGNALS

## 1 Applicability

This ETSO provides the requirements thatwhich aviation visual distress signals 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

For handheld, high-intensity, stroboscopic light sources that can be added to aviation survival kits to supplement pyrotechnic devices, the standards are those is that provided in SAE International's Aerospace Standard AS5134A, 'Aviation Distress Signal', dated 27 September 2007.

For handheld, high-intensity, light-emitting diode (LED) technology sources that can be added to aviation survival kits to supplement pyrotechnic devices, the standard is that provided in SAE International's Aerospace Standard AS5134C, 'Aviation Visual Distress Signals', dated August 2020, with the angle θ of Section 4.3.3 increased from 80° to 95°.

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

These light sources must:

— eliminate the significant potential equipment and personnel hazards that are posed by untrained personnel using pyrotechnics in inflatable life rafts; and

— provide an equivalent level of safety to pyrotechnics that aid in locating and rescuing aviation accident survivors.

**4 Marking**

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

None.

**5 Availability of Referenced Documents**

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/16]
[Amdt ETSO/17]

# ETSO-C178a

## ~~SINGLE PHASE 115 VAC, 400 HZ ARC FAULT~~ AIRCRAFT CIRCUIT BREAKERS

### 1 Applicability

This ETSO ~~gives~~ provides the requirements that~~which~~ ~~Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers~~ aircraft circuit breakers 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~~The applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

None.

### 3 Technical conditions

3.1 Basic

3.1.1 Minimum ~~p~~Performance ~~s~~Standard

~~Standards set forth in the SAE AS 5692, Arc Fault Circuit Breaker (AFCB), Aircraft, Trip-Free Single Phase 115 Vac, 400 Hz – Constant Frequency, dated October 2004. AFCBs may have separate indication of thermal and arcing faults to assist in fault isolation and performing proper repairs.~~

The applicable standards are those provided in Table 1 for the intended equipment class:

**Table 1 — Equipment class standards**

| Equipment class | Equipment type | Minimum Performance Standards |
|---|---|---|
| 1 | Alternating Current (AC) Arc Fault Circuit Breakers | SAE Aerospace Standard (AS) AS5692A, 'ARC Fault Circuit Breaker (AFCB), Aircraft, Trip-Free Single Phase and Three Phase 115 VAC, 400 Hz - Constant Frequency', dated December 2009 |
| 2 | Direct Current (DC) Arc Fault Circuit Breakers | SAE Aerospace Standard (AS) AS6019, 'ARC Fault Circuit Breaker (AFCB), Aircraft, Trip-Free 28 VDC', dated June 2012 |
| 3 | AC or DC Thermal Circuit Breakers | SAE Aerospace Standard (AS) AS58091A, 'Circuit Breakers, Trip-Free, Aircraft General Specification For', dated May 2012 |

3.1.2 Environmental ~~s~~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 ~~e~~Electronic ~~h~~Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure ~~c~~Condition ~~c~~Classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

**4 Marking**

4.1 General

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

4.2 Specific

~~None.~~

The class of the equipment shall be legibly and permanently marked.

**5 Availability of referenced documents**

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/8]
[Amdt ETSO/17]

# INDEX 2 EUROPEAN TECHNICAL STANDARD ORDERS

[…]

## ETSO-2C208

ELECTRICAL HOIST EQUIPMENT

### 1 Applicability

This ETSO provides the requirements for electrical hoist equipment that is designed and manufactured on or after the date of this ETSO.

To be eligible for the ETSO, the hoist equipment shall be equipped with an overload protection device.

Hoist equipment includes the hoist itself, load attachment means (cable, hook, etc.), control and monitoring interfaces, a structural interface to attach the hoist to the boom/rotorcraft structure and the overload protection device. The boom itself is not considered to be a part of the hoist equipment.

Electrical hoist equipment designed in accordance with this ETSO must be identified with the applicable ETSO marking.

This hoist ETSO covers articles which are intended to be operated in the complete range of possible hoist missions.

### 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 for hoist equipment is provided in SAE Aerospace Standard (AS) 6342, Minimum Operation Performance Standard for Helicopter Hoist Systems, dated December 2020, as modified by Appendix 1 to this ETSO.

Whenever the term ‘hoist’ is used in this SAE document, it is equivalent to the hoist equipment.

##### 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.

3.1.5 Development Assurance

See CS-ETSO, Subpart A, paragraph 2.4.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

The failure of the function defined in paragraph 3.1.1 of this ETSO is:

- Catastrophic for loss or malfunction of the hoist equipment (including the overload protection device), which could lead to serious injuries or a fatality (including the HEC).

In addition, no single failure of the hoist equipment shall result in a Catastrophic Failure Condition.

For the compliance demonstration of structural parts / structural elements, the single failure criteria should be addressed through, but not limited to, static, fatigue, damage tolerance and critical parts requirements.

Supporting information is provided in AMC 27/29.865(c)(2) and CS 27/29.1309.

3.2.2 Equipment Safety Assessment

The hoist manufacturer shall conduct an Equipment Safety Assessment, including a systematic, comprehensive evaluation of the hoist equipment to show that the safety objectives from the Functional Hazard Assessment (FHA) of the ETSO article and the derived safety requirements are met.

The latest revision of SAE ARP4761 provides guidance for the safety assessment process. Any assumptions taken by the hoist manufacturer shall be documented in the safety assessment. See also CS-ETSO, Subpart A, paragraph 2.4.

Note: Particular aircraft installations will drive additional, and more stringent, safety requirements for the hoist equipment. The ETSO applicant may elect to comply with these more severe aircraft installation requirements for the hoist equipment in the ETSO article FHA. If this option is selected, this shall be identified in the ETSO Certification programme, and demonstrated within the ETSO data package. Compliance with non-ETSO requirements will also be assessed during the approval (TC/STC) of the installation.

3.2.3 Installation Manual

The applicant shall document in an installation manual all information needed to substantiate the installation of the hoist equipment on a rotorcraft, including the following:

— Electrical interface definition and structural interface loads from the hoist system to the rotorcraft hoist attachment;

— Definition of the control and monitoring interfaces (per Appendix 1, Section 3.4.1.1);

— Maximum permanent deformation of the hoist after the application of the crash load factor (per Appendix 1 — Table 1 Section 3.6);

— Impact speed for the bird strike test (per Appendix 1 — Table 1 Section 3.6);

— Control means for the PQRS and BQRS (per Appendix 1 — Table 1 Section 4.6).

— The maximum rated load.

**4 Marking**

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

**5 Availability of Referenced Documents**

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/17]

# APPENDIX 1 TO ETSO-2C208 — ELECTRICAL HOIST EQUIPMENT

Appendix 1 identifies sections, paragraphs, figures or sentences from the SAE AS 6342 standard that are not applicable as minimum performance standards (MPS), and identifies requirements that are applicable in lieu of the referenced SAE text, or that are added to some sections of the SAE AS6342 standard. The information is provided in the form of three tables:

— Table 1 presents the amended text or additional text.

— Table 2 presents the additional definitions necessary for the ETSO.

— Table 3 presents the additional list of acronyms.

## Table 1 — Modifications of requirements for the ETSO

| When reading SAE AS6342 section | Apply the following |
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| 2.3 | Add to the HOIST definition the following:<br>The hoist is equivalent to the hoist equipment. Hoist equipment includes the hoist itself, load attachment means (cable, hook, etc.), control and monitoring interfaces (including pendants, controllers and their interconnecting wires), a structural interface to attach the hoist to the boom/rotorcraft structure and the overload protection device. The boom itself is not considered to be a part of the hoist equipment. |
| | Replace the HOIST SYSTEM definition as follows:<br>The system, inclusive of the hoist and ancillary components. For clarification, the hoist system includes the hoist equipment and other systems needed for integration to the rotorcraft and operation of the hoist. This includes but is not limited to, displays, controls within the cockpit and cabin, boom, rotorcraft wiring and the power supply. |
| | Add at the beginning of the LIMIT LOAD definition the following:<br>Limit loads are the maximum loads to be expected in service. |
| | Add at the end of the Limit Load Factor definition:<br>Note: For structure requirements, and systems such as OLPD, the static limit load factor of 3.5g can be reduced to the maximum load factor the rotorcraft can reach within the hoist operational envelope, but not less than 2.5g. |
| | Add at the beginning of the ULTIMATE LOAD definition the following:<br>Ultimate Loads are the limit loads multiplied by the prescribed factor of safety. |
| | Add Table 2 of Appendix 1 (see further below) to the section. |
| 2.4 | Add Table 3 of Appendix 1 (see further below) to the section. |
| 3.1 | Replace the section with the following:<br>Specific installation requirements additional to this minimum operation standard shall be defined in the ETSO certification programme. |

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| 3.3.2 | Replace the section with the following:<br><br>The hoist shall have a system to manage the reeling out and reeling in of the cable, minimising the possibilities of jamming, fouling, kinking, or excessive wear on the cable. |
| 3.3.2.2 | Replace the section with the following:<br><br>The storage provision (e.g. drum) shall be able to attach the cable end, and store all the usable cable. The storage provision shall minimise wear affecting either the cable or the storage provision. The design shall account for prevention of unravelling and damage of the cable on the drum. Potential environmental conditions such as vibration shall be taken into account. A means shall be provided to visibly check/inspect the storage of the cable. All reference to storage visibility shall be for maintenance on the ground, not necessarily for hoisting operations. |
| 3.3.4<br>2nd paragraph | Replace the paragraph with the following:<br><br>Cable rebound shall be characterised through testing by the hoist manufacturer, and a characterisation report shall be provided as part of the certification application. The rebound characterisation report shall include information about the influence of the different loading conditions and the influence of the different cable lengths related to the rebound behaviour. |
| 3.3.4<br>3rd paragraph | Replace the paragraph with the following:<br><br>For the structural substantiation, any damage threats and manufacturing flaws that can be encountered during manufacturing and in service, shall be taken into account. |
| 3.3.4<br>6th paragraph | Replace the paragraph with the following:<br><br>The cable is a life-limited part. Cable fatigue characteristics shall be determined by the hoist manufacturer. Methods for cable life calculation shall be defined. Cable inspection and acceptance criteria shall be defined by the hoist manufacturer and shall be provided in the maintenance manual. See 3.6.2. |
| 3.3.5<br>1st paragraph | Replace the paragraph with the following:<br><br>If a mis-wrap event can lead to a complete loss of hoisting function or to a loss of load, the hoist shall be provided with a cable foul/mis-wrap system that shall stop the hoist if a cable foul/mis-wrap develops. The system shall protect the cable from the effects of continued running when fouled or jammed. |
| 3.3.5<br>2nd paragraph | Replace the paragraph with the following:<br><br>Once initiated, the mis-wrap protection system may be capable of being overridden. The risk for continued hoist operation when overriding shall be identified by the hoist manufacturer. |
| 3.3.6 | Replace the section with the following:<br><br>Load Attachment Means<br><br>A load attachment means, such as a hook, shall be part of the hoist equipment.<br><br>The load attachment means (i.e. hook) shall be attached such that it can freely rotate through 360 degrees in either direction. The load attachment means assembly shall be designed to mitigate the risk of entanglement on obstacles.<br><br>Mechanism(s) shall be incorporated to avoid the possibility of unintentional load release. The mechanism(s) shall be designed to prevent tip loading and dynamic rollout. |
| 3.3.8 | Replace the section with the following:<br><br>The hoist shall be equipped with overload protection capability. |
| 3.4.1.1 | Replace the section with the following:<br><br>The hoist equipment shall monitor the safe operation of the hoist, through specific parameters including but not limited to the weight of the load, the fleet angle, the temperature of the |

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| | temperature-sensitive components. The hoist equipment shall provide the status information (I) to the aircrew.<br><br>The hoist manufacturer should define the recorded information (R) that is to be stored until the next scheduled maintenance and made available before the next flight. This recording may be performed either by the hoist equipment itself or be provided as an output to the aircraft systems for recording.<br><br>Typical information needed to ensure a safe operation of the hoist is, but not limited to, the following:<br><br>• Hoist active (I)<br><br>• End of travel (I)<br><br>• Caution zone (I)<br><br>• Quick-release system status (I+R)<br><br>• Fleet angle exceedance (R)<br>As a minimum, the flight crew shall be made aware of a fleet angle exceedance during post-flight check.<br><br>• Activation of overload protection (I+R)<br><br>• Load exceedance (I+R)<br>(sampling rates need to be sufficient to capture shock loads)<br><br>All operating limitations and other information necessary for safe operation must be provided as an output of the hoist equipment.<br><br>The monitoring (I and R) shall be described in the installation manual.<br><br>The display or recording of this information may be included in the ETSO article or may be handled as additional equipment by the STC or TC applicant for the installation.<br><br>Note: in the latter case, the additional equipment to display or recording of the information in the cockpit are not considered as part of the ETSO function. |
| 3.4.1.2 | Replace the headline of the section with the following:<br><br>Hoist Display and Recording Equipment |
| 3.4.1.2.3 | Replace the section with the following:<br><br>In addition to 3.3.5, if a mis-wrap event can lead to a hoist failure, the hoist equipment shall have a mis-wrap indicator, indicating that a cable foul/mis-wrap has occurred. |
| 3.4.1.2.4 | Replace the section with the following:<br><br>The hoist shall indicate and record when an over temperature condition is present. The hoist over temperature condition shall be defined by the hoist manufacturer, based on the specific design of the hoist equipment. |
| 3.4.2<br>1st paragraph | Replace the section with the following:<br><br>The hoist equipment shall be enabled to receive the following control signal inputs, with the following commands: |
| 3.4.3<br>8th paragraph | Replace the paragraph with the following:<br><br>The operator control shall meet the applicable environmental requirements, as stated in section 3.1.2. of the core part of the ETSO standard, for outside use. If the only storage position of the pendant is inside the cabin, the vibration level of chapter 4.9.5 of AS6342 for internally mounted equipment is sufficient. |

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| 3.4.3<br>End of paragraph | Complete the section with the following:<br>The operator control may include a BQRS activation.<br>The operator control shall be designed such that it minimises the inadvertent activation of critical functions during stowage. |
| 3.4.9<br>2nd paragraph | Replace the paragraph with the following:<br>A means to protect the hoist equipment from over-current (motor over torque) conditions shall be provided. |
| 3.4.10 | Replace the section with the following:<br>The hoist shall have a means to measure and record the usage of the system. The usage shall be calculated in operating hours (time while the hoist drive is active), hoist cycles or other equivalent method. |
| 3.5.1.1 | Delete the section (covered by ETSO standard text Chapter 3.2.2). |
| 3.5.4 | Delete the section. |
| 3.5.5 | Delete the section. |
| 3.5.6 | Delete the section. |
| 3.6 | Complete the section with the following:<br>Single critical load paths should be minimised.<br><u>Additional structural requirements</u><br>The hoist shall be able to withstand the most critical load factor expected in service. The load factors shall cover the entire rotorcraft operational envelope in which hoisting is allowed, including rapid direction reversal and rapid stops.<br>• Static flight load factor<br>The static flight load factor shall not be less than 2.5 g for HEC applications.<br>The substantiated load factor shall be stated in the hoist limitations.<br>• Dynamic load magnification factors<br>Any significant dynamic load magnification factors should be taken into account.<br>A dynamic load magnification factor is the difference between the static load factor (measured at the CG of the hoist) and the load factor at the load attachment means (e.g. hook). This occurs for example during maneuvering of the rotorcraft when the cable is at an angle compared to the hoist vertical axis.<br>• Crash load factors<br>The hoist equipment shall withstand the following load factors without failure for at least 3 seconds during a static load test. The 3 seconds do not apply if the tests are performed dynamically to simulate actual loading application.<br>(1) Upward – 1.5 g<br>(2) Forward – 12 g<br>(3) Sideward – 6 g<br>(4) Downward – 12 g<br>(5) Rearward – 1.5 g |

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| | The hoist cable is expected to be fully stowed during load factor tests. The maximum permanent deformation resulting from the application of the load factors shall be documented in the installation manual.<br><br>Hoist-Critical Parts<br><br>A hoist-critical part is a part, the failure of which could lead to serious injuries or a fatality (including the HEC), and for which critical characteristics have been identified and must be controlled to ensure the required level of integrity.<br><br>If the ETSO article includes hoist-critical parts, a list of the critical parts shall be established. Procedures shall be established to define the critical design characteristics, identify processes that affect those characteristics, and identify the design change and process change controls necessary for maintaining compliance with the ETSO standard.<br><br>Bird Strike<br><br>If the applicant has elected to demonstrate robustness against bird strike within the ETSO certification programme, an impact with a 1-kg bird, at a velocity compatible with the maximum allowed speed installed on a rotorcraft, shall not lead to the detachment of parts which could prevent continued safe flight and landing. Compliance must be shown by tests.<br><br>The impact speed shall be documented in the installation manual.<br><br>Cable attachment<br><br>The cable shall be attached to the drum. The attachment shall be able to withstand limit load conditions, or if limit load carrying capability cannot be shown, alternative means shall be provided to minimise the possibility of losing the load.<br><br>Interactions Systems and Structures<br><br>For ETSO article equipped with systems that affect structural performance, either directly or as a result of a failure or malfunction, the influence of these systems and their failure conditions shall be taken into account when showing compliance with the requirements of this ETSO standard. Appendix K to the CS-25 Amendment that is current at the time of the application, or in any later revision, should be used to evaluate the structural performance of ETSO article equipped with these systems. |
| 3.6.1<br>End of chapter | Complete the section with the following:<br><br>For static strength substantiation of composite structure, AMC 20-29 provides further guidance.<br><br>If a safety factor of 3.0 or more is used, it is acceptable to perform a standard static analysis to show compliance. The safety factor should be applied to the yield strength of the weakest component in the system (QRS, complex PCDS, and attachment load path). If a safety factor of less than 3.0 is used, both an analysis and a full-scale ultimate load test of the relevant parts of the system should be performed.<br><br>Note: The static load factor at installation level depends on the performance of the rotorcraft, but in any case it cannot be less than 2.5g. |
| 3.6.2<br>End of chapter | Complete the section with the following:<br><br>For fatigue tolerance substantiation of composite structure, AMC 20-29 provides further guidance. |

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| 3.6.4.1<br>End of chapter | Complete the section with the following:<br><br>Strength reduction factors such as environmental effects (see 3.6.4.3) of the cable can be included in the testing. Strength reduction factors that are used shall be established by individual tests. If separate strength reduction factors are used, they should not influence each other. |
| 4.1 | Replace the section with the following:<br><br>The arresting system shall be designed to sustain ultimate load without cable reel out. If not otherwise protected, engaging the arresting system shall not lead to an overload of the hoist equipment structure and shall reasonably protect human cargo on the hook. |
| 4.2 | Replace the section with the following:<br><br>The fairlead mechanism shall accommodate a 30-degree angle minimum in all directions from the vertical axis of the hoist. The fairlead mechanism shall be able to withstand a combination of angles not less than 30 degrees in all directions and with loads up to the static limit load without detrimental or permanent deformation or damage to the hoist or to the cable, and until ultimate load without failure. |
| 4.3 | Replace the section with the following:<br><br>The load shall be applied in any direction making the maximum angle with the vertical of the hoist axis, but not less than 30° (60° cone). The most critical fleet angle in the most critical direction shall be taken into account for the static strength substantiation (Limit and Ultimate Load).<br><br>Note: It may be necessary to substantiate greater angles than the hoist operational envelope, since the hoist might be installed at different angles on different airframes. |
| 4.6 | Replace the section with the following:<br><br>The hoist shall have the capability of performing an emergency quick release of the attached load in all operating conditions.<br><br>This QRS shall consist of a primary quick-release subsystem (PQRS) and a backup quick-release subsystem (BQRS).<br><br>The intention of the PQRS is an intentional, instantaneous release of NHEC or HEC in a pre-set sequence by the QRS that is normally in an emergency to prevent a significant reduction in the safety margins for continued safe flight and landing of the rotorcraft.<br><br>The following design features shall be considered:<br><br>• The PQRS, BQRS and their load-release devices and subsystems (such as electronically actuated guillotines) shall be separated (e.g. physically, systematically, and functionally independent).<br><br>• The controls for the PQRS shall be installed on the ETSO article at a location readily accessible to the hoist operator (e.g. the control pendant). Additionally, an independent means to control the PQRS shall be provided to the installer (for instance, to allow connection to a cockpit control).<br><br>• The control means for the BQRS shall be described in the installation manual. They may be less sophisticated than those of the PQRS (e.g. manual cable cutters).<br><br>• The PQRS shall release the external load in less than 5 seconds. The BQRS shall release the external load in less than 30 seconds. This time interval shall begin at the moment an emergency is declared and shall end when the load is released.<br><br>During HEC operations, both the PQRS and BQRS are required to have a dual activation device (DAD) for external cargo release. The switch design shall be evaluated by ground test. Additional safety precautions (such as the use of a lock wire) should be considered for a remote hoist console in the cabin. |
| 4.7 | Replace the section with the following: |

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| | The purpose of the overload protection is to protect the aircraft, its occupants and the person being hoisted. It provides to the crewmembers the possibility to either stabilise the aircraft or to safely activate the PQRS and release the external load in less than 5 seconds after the declared emergency (i.e. crew detects snagging of the cable/hook), as requested in AMC 27/29.865.<br><br>The hoist shall be equipped with an overload protection capability, which needs to comply to the following requirements:<br><br>• The overload protection system shall be capable of reliably withstanding the dynamic loads and the sustained overloads, as defined by the hoist manufacturer. It shall be designed to hold any static load coming from the cable up to the static limit load.<br><br>• For dynamic overload events, the overload protection system may allow limited unspooling of the cable at lower loads, as long as the dynamic load holding capability does not fall below the maximum operational load with an adequate safety margin. An example for such dynamic load holding capability is the capability to absorb shock loads.<br><br>• The load shall be arrested within a maximum of 10 m during a dynamic cable unspooling event. Limited unspooling of the cable for functions other than overload protection could be also accepted (e.g. for cargo vibration reduction).<br><br>• If sustained overload resulting from an entanglement is still present after 5 seconds of cable unspooling, further unspooling is acceptable.<br><br>• The person(s) being hoisted shall also be reasonably protected against serious injury (see 5.1.9.1.2).<br><br>• An overload activation tolerance band shall be defined taking into account e.g. production and maintenance tolerances, variations due to the environment (e.g. temperature and humidity), and operations (i.e. length of cable paid out). The above-mentioned load holding requirements shall be met in the entire activation tolerance band.<br><br>• With regard to aging effects, all functional elements of the overload protection that are subject to aging effects leading to potential degradation of the overload protection shall be considered.<br><br>The corresponding tests in 5.1.9. provide the means of compliance for sustained overload and dynamic loads including demonstration that the person(s) being hoisted is (are) reasonably protected in the complete hoist envelope.<br><br>NOTE: The OLPD static holding capability should be adjustable in order to adapt it to the specific rotorcraft capability within the hoist operational envelope defined by the installer. |
| 4.9 | Replace the section with the following:<br><br>The hoist shall meet environmental test procedures per DO-160. For the DO-160 environmental standard, refer to Section 3.1.2 of the main part of the ETSO standard for acceptable ED-14/DO-160 revisions. The hoist shall meet all performance data included in Chapters 3.3, 3.4 and 4.1-4.7 under the below-stated environmental conditions.<br><br>The operator control pendant shall meet the applicable environmental requirements for outside environmental conditions. |
| 4.9.5 | Add to the end of the section the following:<br><br>Routing of electrical wires to the hoist interface shall include protection against chaffing or damage due to vibration introduced by the aircraft. |
| 4.9.21 | Replace the section with the following:<br><br>The hoist equipment (including pendants, controllers, cable, and interconnecting wires) shall meet the requirements per RTCA DO-160 Section 25, Category A. |

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| 4.9.23 | Replace the section with the following:<br>The intent of the endurance requirement is to validate the interval for time between overhaul (TBO) and total time (TT). This shall be accomplished by running a full TBO test, with margin, that simulates actual use in a heavy usage environment. (See Chapter 5.1.3) |
| 4.9.24 1st paragraph | Complete the section with the following.<br>This duty cycle testing is to show the robustness of the hoist system and is not considered to be a fatigue or endurance test in their own right. |
| 5.1.3 1st paragraph | Replace the paragraph with the following:<br>The hoist manufacturer shall perform endurance testing and provide a formal test report. The test results from this testing may be used by the hoist manufacturer to define the overhaul period (TBO and TT). |
| 5.1.3 3rd paragraph | Replace the paragraph with the following:<br>The test cycle may be made up of a series of hoist cycles and in any order to minimise test set-up. |
| 5.1.3 4th paragraph | Replace the paragraph with the following:<br>Testing for endurance (the ability of parts moving relative to each other to continue to perform their intended function) should be sufficient to show:<br>• that the assumptions used in demonstrating compliance with the required safety level are correct, and<br>• via a test that the equipment is free from design errors, specifically when there is the introduction of a new technology to reach a compliance demonstration for full life, either by a full TT test or by X% TT test supported by analysis.<br>Testing for performance can be included in endurance testing which should demonstrate the rates and responses required for proper system operation. |
| 5.1.3 Table 2 | Delete the table. |
| 5.1.4 | Replace the section with the following<br>The hoist manufacturer shall perform duty cycle testing and provide formal test report. |
| 5.1.5 | Delete the last sentence of the section |
| 5.1.7 | Replace the section with the following:<br>The mis-wrap detector shall be validated through test, and can be supported by analysis or simulations. |
| 5.1.8 before 1st paragraph | Complete the section with the following before the paragraph:<br>Jettison demonstrations, with different loading conditions, using the QRS shall be conducted. |
| 5.1.9.1 | Replace the section with the following:<br>The following tests shall be performed. |

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| 5.1.9.1.1 | Replace the section with the following:<br><br>To show arresting capability after a sustained overload (e.g. entanglement / extreme manoeuvre), the hoist equipment including the overload protection device (OLPD) shall be able to arrest the cable in accordance with the following test. The OLPD activation point for the test shall be set at the most detrimental setting within the tolerance range.<br><br>The test sequence should be as follows:<br><br>1. Continuous pull with a speed of more than 2 m/s for 5 seconds. The load for the continuous pull must be between operational loads and limit load for the hoist equipment.<br>2. Deceleration of the cable to zero cable speed within 5 seconds by:<br>a. reducing the pulling tension through the test equipment. The tension must always be greater than or equal to the rated load;<br>or<br>b. increase of the cable tension through the hoist. The cable tension must always be below limit load.<br><br>The test shall be repeated 5 times. The OLPD may be reset after each pull (if reset function is available). After the completion of the test, the hoist equipment including the OLPD shall function normally. |
| 5.1.9.1.2 | Replace the section with the following:<br><br>The hoist equipment including the OLPD shall be able to arrest the load with a limited height loss after a shock load event.<br><br>The arresting capability shall be demonstrated by an instrumented drop test in accordance with the following criteria:<br><br>• Rated load solid block<br>• Free fall factor of 1 on 71 inches (180 cm)<br>• Height loss <197 inches (500 cm)<br>• For each hoisted person<br>○ maximum arresting force <1 798 lbf (8 kN)<br>○ A transient peak is acceptable. The force and duration shall be such that the person being hoisted is reasonably protected against serious injury (e.g. 12.5 kN for maximum of 30 ms)<br>○ Limit Load shall not be exceeded<br><br>The above test shall be repeated for a 101.2 kg solid block.<br><br>The above test must be repeated for a total of 5 times for each load level (rated load and 101.2 kg). The OLPD including the dampening device can be reset after each test, if a reset function is available. After each set of 5 tests the cable and OLPD can be replaced.<br><br>The most detrimental setting within the OLPD activation tolerance band must be tested.<br><br>The hoist must function normally (i.e. continues to lift at the rated load and speed) after completion of each set of 5 tests. |

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| 5.1.11 | Replace the section with the following:<br><br>Using a milliohm meter measure the bonding resistance between the hoist bonding location as indicated by the hoist manufacturer and the appropriate connector mounting block screw as indicated by the hoist manufacturer. Verify that the reading is compatible with the bonding requirements in Chapters 4.9.25 and 4.9.26. |
| 5.2 | Complete the section with the following:<br><br>The cable shall sustain limit and ultimate load conditions. The test shall be performed at the hoist (with the OLPD locked) or a mock-up representing all influencing factors of the installation on the hoist. The load attachment end of the cable shall be able to swivel freely. The cable shall be tested at its most critical length and most critical fleet angle if this influences the static strength characteristics.<br><br>The cable being tested shall represent the minimum manufacturing quality as specified by the cable manufacturer. This includes all foreseeable damage and manufacturing flaws which are not inspectable by scheduled maintenance or are allowed to remain in the cable. In addition, all material strength reduction factors shall be taken into account. |
| 5.2.1<br>Headline | Replace the headline of the section with the following:<br><br>Minimum Breaking (Rupture) Strength Test |
| 5.2.2<br>Headline | Replace the headline of the section with the following:<br><br>Cable Endurance and Fatigue Testing |
| 5.2.2<br>1st paragraph | Replace the paragraph with the following:<br><br>Fatigue and endurance testing of the hoist cable shall be conducted in laboratory tests. These tests shall be conducted to determine the suitability of the rescue hoist cable compared to several scenarios. |
| 5.2.2<br>2nd paragraph | Replace the paragraph with the following:<br><br>The manufacturer shall determine each hoist's maximum cable usage (MCU) which is a number used to determine the maximum number of hoist cycles, or maximum number of cable extensions, a cable can undergo in field usage before requiring replacement in order to preclude cable fatigue considerations. The manufacturer shall also determine and publish all inspection criteria related to the as-designed cable in the maintenance manual, and this inspection criteria shall be used in the following fatigue testing. |
| 5.2.2<br>end of chapter | Complete the section with the following:<br><br>In addition of the requirements of sections 3.6.2 and 5.1.5 of AS6342, section 5.2.2.1 and 5.2.2.2 are considered to be part of the cable fatigue testing. The cable bending and tension fatigue test should be performed to evaluate the fatigue life of the cable. The fatigue evaluation of the cable should be determined considering the effect of the worst of bending, tension or a combination of both applied simultaneously. The tests described in section 5.2.2.1 and 5.2.2.2 are not considered to generate the complete data set required for cable fatigue evaluation.<br>5.2.2.3, 5.2.2.4 and 5.2.2.5 are part of the cable endurance testing and in addition to the hoist endurance testing in section 4.9.23. and 5.1.3. |

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| 5.2.2.1<br>1st paragraph | Replace the paragraph with the following:<br><br>A cyclic bending fatigue test shall be performed. The test configuration must be representative of the specific hoist design configuration (including diameter of sheaves and number of sheaves, the pressure of the crowder, and the internal routing of the cable such as number of bendings and reverse bendings) planned for certification.<br><br>One of the acceptable methods of testing for the determination of the bending fatigue characteristics of the cable is defined in MIL-DTL-83140B Figure 4, using the geometry and cable design required in this ETSO. |
| 5.2.2.1<br>Figure 1 | Delete the figure. |
| 5.2.2.1 2nd to 4th paragraph | Delete the paragraphs. |
| 5.2.2.1<br>5th paragraph | Replace the paragraph with the following:<br><br>The total travel of the wire rope in one direction shall ensure that the test portion of the cable runs through the entire hoist configuration from the storage drum to the cable output. The application of lubricant to the fatigue test sample in addition to the lubricant applied during manufacture of the cable shall not be permitted. |
| 5.2.2.1<br>6th paragraph | Delete the paragraph, including table 3. |
| 5.2.2.1<br>7th paragraph | Replace the paragraph with the following:<br><br>Following the fatigue testing described above, the test sample shall be inspected for damage and tested for minimum breaking strength. The minimum breaking strength shall be greater than the hoist's ultimate load (5.25 times the rated load). |
| 5.2.2.2<br>1st paragraph | Replace the paragraph with the following:<br><br>A cable sample representative of damage and flaws that could be encountered during manufacturing or in service shall be prepared with two end fittings identical to the cable assembly design requirements of the hook end and subjected to fluctuating cable loads between 1 to 2 g times the rated load in accordance with DIN EN14311-8 Section 5.2.2.3. The cable shall be tested for 75 000 test cycles (150 000 reversals) with one end of the cable attached to a free swivel. |
| 5.2.2.2<br>2nd paragraph | Replace the paragraph with the following:<br><br>Following the fatigue testing described above, the test sample shall be inspected for damage and tested for minimum breaking strength. The minimum breaking strength shall be greater than the hoist's ultimate load (5.25 times the rated load). |
| 5.2.2.3<br>headline | Replace the headline of the section with the following:<br><br>Unloaded Endurance Testing within Hoist |
| 5.2.2.4<br>headline | Replace the headline of the section with the following:<br><br>Loaded Endurance Testing within Hoist |
| 5.2.4 | Replace the paragraph with the following:<br><br>Cable robustness testing is intended to demonstrate the hoist load bearing wire rope (cable) robustness or resistance to catastrophic failure after unintended and incidental contact with ground objects and rotorcraft structure. The cable may sustain damage necessitating post-mission replacement but shall have residual structural integrity to safely complete the lift where the contact occurred, or safely return the HEC to the ground. The hoist manufacturer must test, and provide test results, for the scenarios identified below. |

| | |
|---|---|
| 5.2.4.1<br>4th sentence | Replace the sentence with the following:<br>The hoist cable may become damaged in such incident where the damage will be readily observable to the hoist operator or at post-flight inspection; however, the cable shall be of such construction as to provide robustness that it will not fail under load during the immediate rescue lift. |
| 5.2.4.1.1 | Replace the section with the following:<br>The static cable (i.e. not reeling in or out) shall suspend the rated load. The cable shall be dragged over the A36 or equivalent standard steel plate edge for a total distance reasonably expected to occur in service with a load hanging freely on the hoist (note: multiple strokes may be used). The plate surface roughness and edge diameter should represent a severe scenario expected to be found in a ship construction. The angle between the vertical axis of the hoist and the cable should be at a minimum 30°.<br>The force required to drag the cable shall be applied at least 1 foot (30 cm) higher than the edge. After exposure, damage is acceptable, if the cable damage is reliably detectable within a few hoist cycles, but the cable shall be able to support limit load without failure.<br>The test shall be repeated with a load corresponding to the OLPD activation point to simulate an entanglement. The distance the cable slides along the steel plate shall reflect a distance which can be reasonably expected in such an event. |
| 5.2.4.1.2 | Replace the section with the following:<br>The cable shall suspend a rated load below a A36 or equivalent standard steel plate edge. The plate surface roughness and edge diameter should represent a severe scenario expected to be found in a ship construction. The angle between the vertical axis and the cable should be at a minimum 30°. The cable shall be reeled in until achieving maximum speed (minimum cable reel-in length is 1.5 m) and then reeled out three times. After exposure, damage is acceptable, if the cable damage is reliably detectable within a few hoist cycles, but the cable shall be able to support limit load without failure. |
| 5.2.4.2.1<br>Last sentence | Replace the sentence with the following:<br>After testing the cable shall be demonstrated to support at least limit load without failure if cable damage is reliably detectable within a few hoist cycles. If no cable damage is detectable by operations or ramp maintenance personnel within a few hoist cycles, the cable shall be demonstrated to support ultimate load for at least 3 seconds without failure. |

## Table 2 — Additional definitions

| Term | Definition |
|---|---|
| Backup quick-release subsystem (BQRS): | The secondary or 'second choice' subsystem used to perform a normal or emergency jettison of external cargo. |
| Cable | The means to suspend the external load being lowered and raised. The cable can be made of metallic and/or other materials. |
| Dual actuation device (DAD): | This is a sequential control that requires two distinct successive actions (e.g. thumb movements) to be completed for actuation.<br><br>Examples of a DAD are the removal of a lock pin or opening of a guarded cover followed by the activation of a 'then free' switch for load release to occur or opening of a cover and activate an additional guarded switch with a distinguished separate thumb movement.<br>In this scenario, a simple covered switch does not qualify as a DAD. Familiarity with covered switches allows the operator to both open the cover and activate the switch in one motion. This has led to inadvertent load release.<br><br>Cover = a means to mask or cover a switch that can be either moved up or to the side (sometimes called a 'flip-guard')<br>Guard = fix activation protection around/for a switch or cover like a small wall, recess, lock pin or lock wire<br>Switch = lever or push button |
| Dynamic Load | A dynamic load is a load which occurs in a rapid manner, such as shock loads or vibration. |
| Emergency jettison (or complete load release) | The intentional, instantaneous release of NHEC or HEC in a pre-set sequence by the quick-release system (QRS) that is normally performed in an emergency to prevent a significant reduction in the safety margins to ensure continued safe flight and landing of the rotorcraft |
| Moving surface | A surface that is not fixed, such as heaving ships or water surface |
| Primary quick-release subsystem (PQRS): | The primary or 'first choice' subsystem used to perform a normal or emergency jettison of external cargo. |
| Quick-release system (QRS): | The entire release system for jettisonable external cargo (i.e. the sum total of both the primary and backup quick-release subsystem). The QRS consists of all the components including the controls, the release devices, and everything in between. |

| | |
|---|---|
| Serious injury | According to Annex 13 to the Convention on International Civil Aviation: Aircraft Accident and Incident Investigation. Ninth Edition - July 2001. Chapter 1 - Definitions:<br><br>Serious injury. An injury which is sustained by a person in an accident and which:<br>a) requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; or<br>b) results in a fracture of any bone (except simple fractures of fingers, toes, nose); or<br>c) involves lacerations which cause severe hemorrhage, nerve, muscle or tendon damage; or<br>d) involves injury to any internal organ; or<br>e) involves second- or third-degree burns, or any burns affecting more than 5 per cent of the body surface; or<br>f) involves verified exposure to infectious substances or injurious radiation. |
| Stowage position | This is typically the hoist and/or cable position used when hoisting operations are not being performed. |

## Table 3 — Additional list of acronyms

| Acronyms | Definition |
|---|---|
| AC | Advisory Circular (FAA) |
| AMC | acceptable means of compliance (EASA) |
| BQRS | Backup quick-release subsystem |
| CG | centre of gravity |
| CMR | certification maintenance requirements |
| CS | certification specification |
| DAL | design assurance level |
| ETSO | European Technical Standard Order |
| FMECA | Failure Modes Effects and Criticality Analysis |
| HEC | human external cargo |
| ICS | integrated communication system |
| kN | kilo Newton |
| MCU | Maximum Cable Usage |
| OLPD | Overload Protection Device |
| TT | Total Time |

[Amdt ETSO/17]

# ETSO-2C520

406-MHz SATELLITE PERSONAL LOCATOR BEACON

## 1 Applicability

This ETSO provides the requirements that personal locator beacons (PLBs) intended to be carried by a person on board an aircraft and 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 Radio Technical Commission for Maritime Services (RTCM) Standard 11010.3 'Standard for 406 MHz Satellite Personal Locator Beacons (PLBs)', dated 25 June 2018.

#### 3.1.2 Environmental Standard

See RTCM 11010.3, Appendix A.

#### 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.

A classification of 'no safety effect' is acceptable for failures of PLBs that are not intended to be installed and not required to be approved by operational regulations.

#### 3.2.2 Embedded Batteries

Subpart A Section 2.7 applies only to PLBs that are intended to be attached to or stowed in an aircraft.

#### 3.2.3 Compliance Demonstration

The PLB shall have been issued with a COSPAS-SARSAT type approval certificate, which shall be provided as part of the compliance documentation.

In addition, the applicant shall provide a certificate from an independent test facility accredited to ISO/IEC 17025, with a scope covering the applicable requirements and test procedures, stating that the article complies with the electrical and environmental standards of RTCM 11010.3.

The applicant shall declare in the declaration of design and performance (DDP) the PLB generation, category, class and group, as defined in RTCM 11010.3, Section 1.5.

## 4 Marking

### 4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

### 4.2 Specific

See RTCM 11010.3, Section 4.5.

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/17]

# ETSO-2C521

## 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

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 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.

##### 3.2.2 Documentation

The applicant shall develop and make available to the aircraft operator the application operational data as defined in EUROCAE ED-273, Chapter 4.

## 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 Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/17]

# ETSO-2C522

## HELICOPTER TERRAIN AWARENESS AND WARNING SYSTEM (HTAWS) ADVANCED FEATURES

### 1 Applicability

This ETSO provides the requirements that helicopter terrain awareness and warning system (HTAWS) advanced features 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 Table 1 for the intended equipment class.

**Table 1 — Equipment class standards**

| Equipment class | Equipment type | Minimum Performance Standards |
|---|---|---|
| Helicopter Offshore Operations (HOFO) | Offshore Helicopter Terrain Awareness and Warning System (HTAWS) | EUROCAE ED-285 'Minimum Operational Performance Standard for Offshore Helicopter Terrain Awareness and Warning System (HTAWS)' dated March 2021. |

Table 2 describes the modes covered by this ETSO standard.

**Table 2 — HTAWS modes**

| | | Equipment class |
|---|---|---|
| | | HOFO |
| Mode | | |
| 1 | Excessive rate of descent | Required |
| 3A | Altitude loss during take-off | Required |
| 3B | Loss of airspeed during take-off | Required |
| 4A | Flight near terrain when not in landing configuration | Required |
| 4B | Flight near terrain when in landing configuration | Required |
| 5 | Excessive downward glideslope/glidepath deviation | ILS: Required<br>GLS/LPV: Optional |
| 7A | Airspeed versus total torque | Optional |
| 7B | Vortex ring state | Optional |
| N/A | Fixed altitude callout | Optional |
| N/A | Terrain display | Not covered* |
| N/A | Forward looking terrain avoidance (FLTA) | Not covered* |
| N/A | Radio altitude interface | Not covered* |
| * Local regulations on air operations may require additional modes as defined in ETSO-C194, 'Helicopter Terrain Awareness and Warning System (HTAWS)'. | | |

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 defined in paragraph 3.1.1 resulting in false warnings or an unannunciated loss of function is a major failure condition.

A loss of the function defined in paragraph 3.1.1 is a minor failure condition.

3.2.2 Documentation

The manufacturer of the offshore HTAWS shall document in its declaration of design and performance (DDP), installation and operator manuals the transition speed between the two-mode 4A alerts, and, when the corresponding modes are implemented, the intended helicopter type

for which the mode 7A and/or 7B alerts have been designed.

## 4 Marking

### 4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

### 4.2 Specific

None.

## 5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/17]