

## CS-ETSO AMENDMENT 12 — CHANGE INFORMATION

EASA publishes amendments to Certification Specifications-European Technical Standard Orders (CS-ETSO) as consolidated text for each constituent European Technical Standard Order (ETSO) individually.

Consequently, except for the revision indication letter and revised issue date in the header of the ETSO, the consolidated text of each individual ETSO does not allow readers to see the detailed changes introduced by the amendment. To allow readers to see these detailed changes this document has been created. The same format as for publication of Notices of Proposed Amendments has been used to show the changes:

- deleted text is marked with ~~strike through~~;
- new or amended text is highlighted in grey;
- an ellipsis (...) indicates that the remaining text is unchanged in front of or following the reflected amendment.

## Changes to Subpart A

### SUBPART A — GENERAL

(...)

#### 2.1 Environmental standards

Unless otherwise stated in the paragraph 3.1.2 of the specific ETSO, the applicable environmental standards are contained in EUROCAE/RTCA document ED-14D Change 3/DO-160D 'Environmental Conditions and Test Procedures for Airborne Equipment', Change 3 dated December 2002, ~~or ED-14E/DO-160E~~ dated March 2005, ~~or ED-14F/DO-160F~~ dated March 2008, ~~or ED-14G/RTCA-DO-160G~~ dated December 2010 or ED-14G Change 1/DO-160G Change 1 dated January 2015.

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

(...)

#### 2.4 Failure conditions classification and development assurance

During the development of equipment, consideration should be given to failure conditions, the equipment should then be developed in accordance with their possible effects at system and aircraft level (see AMC CSxx.1309 for further guidance, for CS-23 aircraft further guidance can be found in FAA AC 23.1309-1E).

The equipment shall be developed according to, at least, the development assurance level appropriate to the failure condition classifications expected for the intended installation.

Where the effects at system or aircraft level are not known, due to non-availability of aircraft or system design data, assumed failure classifications may be used but at a minimum to the level required in the ETSO.

Classification of failure conditions at equipment level may change as a result of particular aircraft installation architecture and characteristics.

EUROCAE/SAE document ED-79A/ARP 4754A 'Guidelines for development of civil Aircraft and Systems' dated December 2010 may be used to assign the Development Assurance Level of the equipment, software and AEH. The document may be used as well as guidance to ensure a proper development, validation and verification of the ETSO and the functional equipment requirements.

## Changes to Index 1

<b>EASA ETSO Ref</b>	<b>Title</b>	<b>Last amended by</b>
ETSO-C1c	Cargo Compartment Fire Detection Instruments	CS-ETSO/Initial Issue
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-C10b	Aircraft Altimeter, Pressure Actuated, Sensitive Type	CS-ETSO/Initial Issue
ETSO-C13f	Life preservers	CS-ETSO/1
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-C16a	Electrically Heated Pitot and Pitot-Static Tubes	CS-ETSO/4
ETSO-C20	Combustion Heaters	CS-ETSO/Initial Issue
ETSO-C21b	Aircraft Turnbuckle Assemblies and/or Turnbuckle Safetying Devices	CS-ETSO/Initial Issue
ETSO-C22g	Safety Belts	CS-ETSO/Initial Issue
ETSO-C23d	Personal Parachute Assemblies	CS-ETSO/Initial Issue
ETSO-C25a	Aircraft Seats and Berths (Type I Transport 6g Forward Load)	CS-ETSO/Initial Issue
ETSO-C26ed	Aircraft Wheels and Wheel-Brake Assemblies (CS-23, 27 and 29 aircraft)	CS-ETSO/12
ETSO-C27	Twin Seaplane Floats	CS-ETSO/Initial Issue
ETSO-C28	Aircraft Skis	CS-ETSO/Initial Issue
ETSO-C30c	Aircraft Position Lights	CS-ETSO/Initial Issue
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-C43c	Temperature Instruments	CS-ETSO/Initial Issue
ETSO-C44c A1	Fuel Flowmeters	CS-ETSO/8
ETSO-C45b A1	Manifold Pressure Instruments	CS-ETSO/8
ETSO-C46a	Maximum Allowable Airspeed Indicator System	CS-ETSO/Initial Issue
ETSO-C47a A1	Pressure Instruments — Fuel, Oil, and Hydraulic (Reciprocating Engine-Powered Aircraft)	CS-ETSO/8
ETSO-C49b	Electric Tachometer: Magnetic Drag (Indicator and Generator)	CS-ETSO/Initial Issue
ETSO-C53a	Fuel and Engine Oil System Hose Assemblies	CS-ETSO/Initial Issue

<b>EASA ETSO Ref</b>	<b>Title</b>	<b>Last amended by</b>
ETSO-C54	Stall Warning Instruments	CS-ETSO/Initial Issue
ETSO-C55a	Fuel and Oil Quantity Instruments	CS-ETSO/7
ETSO-C56b A1	Engine-Driven Direct Current Generators/Starter Generators	CS-ETSO/8
ETSO-C59	Airborne Selective Calling Equipment	CS-ETSO/Initial Issue
ETSO-C62e	Aircraft Tyres	CS-ETSO/7
ETSO-C64ab	Oxygen Mask Assembly, Continuous Flow, Passenger	CS-ETSO/12
<del>ETSO-C65a</del>	<del>Airborne Doppler Radar Ground Speed and/or Drift Angle Measuring Equipment (for Air Carrier Aircraft)</del>	CS-ETSO/12
<del>ETSO-C68a</del>	<del>Airborne Automatic Dead Reckoning Computer Equipment Utilizing Aircraft Heading and Doppler Ground Speed and Drift Angle Data (for Air Carrier Aircraft)</del>	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-C79	Fire Detectors (Radiation Sensing Types)	CS-ETSO/Initial Issue
ETSO-C80	Flexible Fuel and Oil Cell Material	CS-ETSO/Initial Issue
ETSO-C85ab	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-C96a	Anticollision Light Systems	CS-ETSO/Initial Issue
ETSO-C97	Lithium Sulphur Dioxide Batteries	CS-ETSO/Initial Issue
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

<b>EASA ETSO Ref</b>	<b>Title</b>	<b>Last amended by</b>
ETSO-C105	Optional Display Equipment for Weather and Ground Mapping Radar Indicators	CS-ETSO/Initial Issue
ETSO-C106 A1	Air Data Computer	CS-ETSO/8
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-C113a	Airborne Multi-purpose Electronic Displays	CS-ETSO/11
ETSO-C114 A1	Torso Restraint Systems	CS-ETSO/8
ETSO-C115c	Flight Management Systems (FMS) using Multi-Sensor Inputs	CS-ETSO/8
ETSO-C116a	Crew Member Portable Protective Breathing Equipment	CS-ETSO/11
ETSO-C117a	Airborne Wind Shear Warning and Escape Guidance Systems (Reactive Type) for Transport Aeroplanes	CS-ETSO/Initial Issue
ETSO-C118	Traffic Alert and Collision Avoidance System I (TCAS I)	CS-ETSO/Initial Issue
ETSO-C119d	Airborne Collision Avoidance System II (ACAS II) Version 7.1 with Hybrid Surveillance	CS-ETSO/11
ETSO-C121b	Underwater Locating Device	CS-ETSO/8
ETSO-C123b	Cockpit Voice Recorder Systems	CS-ETSO/6
ETSO-C124b	Flight Data Recorder Systems	CS-ETSO/6
ETSO-C126b	406 and 121.5 MHz Emergency Locator Transmitter	CS-ETSO/11
ETSO-C127b	Rotorcraft, Transport Aeroplane, and Small Aeroplane Seating Systems	CS-ETSO/11
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-C139a	Aircraft Audio Systems and Equipment	CS-ETSO/11
ETSO-C141	Aircraft Fluorescent Lighting Ballast/Fixture Equipment	CS-ETSO/Initial Issue
ETSO-C142a	Non-Rechargeable Lithium Cells and Batteries	CS-ETSO/3
ETSO-C144a	Passive Airborne Global Navigation Satellite System (GNSS) Antenna	CS-ETSO/6
ETSO-C145c	Airborne Navigation Sensors Using the Global Positioning System Augmented by the Satellite-Based Augmentation System	CS-ETSO/6
ETSO-C146c	Stand-Alone Airborne Navigation Equipment Using the Global Positioning System Augmented by the Satellite-Based Augmentation System	CS-ETSO/6
ETSO-C147a	Traffic Advisory System (TAS) Airborne Equipment	CS-ETSO/12
ETSO-C151c	Terrain Awareness and Warning System (TAWS)	CS-ETSO/11
ETSO-C154c	Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment	CS-ETSO/7
ETSO-C155a	Recorder Independent Power Supply	CS-ETSO/8
ETSO-C157ab	Aircraft Flight Information Services-Broadcast (FIS-B) Data-Link	CS-ETSO/12

EASA ETSO Ref	Title	Last amended by
	<del>Systems and</del> Equipment	
ETSO-C158	Aeronautical Mobile High Frequency Data Link (HFDL) Equipment	CS-ETSO/7
ETSO-C159b	Next Generation Satellite Systems (NGSS) Equipment	CS-ETSO/11
ETSO-C160a	VDL Mode 2 Communications Equipment	CS-ETSO/8
ETSO-C161a	Ground-Based Augmentation System Positioning and Navigation Equipment	CS-ETSO/7
ETSO-C162a	Ground-Based Augmentation System Very High Frequency Data Broadcast Equipment	CS-ETSO/7
ETSO-C164	Night-Vision Goggles (NVG)	CS-ETSO/8
ETSO-C165a	Electronic Map Systems for Graphical Depiction of Aircraft Position	CS-ETSO/9
ETSO-C166b A2	Extended Squitter ADS-B and TIS-B Equipment Operating on the RF of 1090 Megahertz (MHz)	CS-ETSO/11
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
ETSO-C174 A1	Battery-Based Emergency Power Unit (BEPU)	CS-ETSO/8
ETSO-C175	Galley Cart, Containers and Associated Components	CS-ETSO/3
ETSO-C176	Aircraft Cockpit Recorder Systems	CS-ETSO/6
ETSO-C177a	Data Link Recorder <del>Systems</del> Equipment	CS-ETSO/12
ETSO-C178	Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers	CS-ETSO/8
ETSO-C179a	Rechargeable Lithium Cells and Lithium Batteries	CS-ETSO/7
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-C195ab	Avionics Supporting Automatic Dependent Surveillance-Broadcast (ADS-B) Aircraft Surveillance	CS-ETSO/12
ETSO-C196a	Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation	CS-ETSO/7
ETSO-C198	Automatic Flight Guidance and Control System (AFGCS) Equipment	CS-ETSO/8
ETSO-C200a	Low-Frequency Underwater Locating Device (ULD)	CS-ETSO/12
ETSO-C201	Attitude and Heading Reference Systems (AHRS)	CS-ETSO/11
ETSO-C202	Cargo Stopper Devices	CS-ETSO/11
ETSO-C203	Fire containment cover (FCC)	CS-ETSO/12
ETSO-C207	Aeronautical Mobile Airport Communication System (AeroMACS)	CS-ETSO/12

**New, revised or deleted ETSOs**

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Aircraft Wheels And Wheel-Brake Assemblies (CS-23, -27 and -29 aircraft)

### 1- Applicability

This ETSO gives the requirements which aircraft wheels and wheel-brake assemblies for CS-23, CS-27 and CS-29 aircraft that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with applicable ETSO marking. The requirements which transport aeroplane wheels and wheel-brake assemblies (CS-25 aircraft) must meet are contained in ETSO-C135.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in the appendix 1 to this ETSO.

The MPS is based, in part, on the Society of Automotive Engineers (SAE), Aerospace Recommended Practice (ARP) 5381, Minimum Performance Recommendations for Part 23, 27, and 29 Aircraft Wheels, Brakes, and Wheel-Brake Assemblies, dated October 2000.

Where applicable, instead of the referenced FAA documents/paragraph the corresponding Part, CS or ETSO document/paragraph shall be used, when available.

#### 3.2 - Specific

None.

### 4 - Marking

#### 4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2. In addition, the wheels must be legibly and permanently marked with the size of the wheel, and in lieu of the marking specified in 21.A.807(a), the following information shall be legibly and permanently marked on the major equipment components:

- (1) Name of the manufacturer responsible for compliance;
- (2) Serial number;
- (3) Part number;
- (4) Applicable ETSO number;

- (5) Rim size (this marking applies to wheels only);
- (6) Hydraulic fluid specification (this marking applies to hydraulic brakes only).

4.2- Specific  
None.

**5 - Availability of Referenced Document**

~~See CS-ETSO Subpart A paragraph 3.~~

Copies of SAE ARP5381 may be purchased from the Society of Automotive Engineers Inc., Department 331, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Copies also can be obtained through the SAE Internet website at: [www.sae.org](http://www.sae.org).

## APPENDIX 1.

### MINIMUM PERFORMANCE STANDARD for aircraft wheels, brakes and wheel/brake assemblies for small airplanes and rotorcraft.

This appendix prescribes the Minimum Performance Standard (MPS) of SAE ARP5381, 'Minimum Performance Recommendations for Part 23, 27, and 29 Aircraft Wheels, Brakes, and Wheel-Brake Assemblies', dated October 2000, as modified in this ETSO.

Additions to and one deletion from the standard, are shown in italics as follows:

#### Additions:

1. Page 3, a new paragraph is added after 3.6:  
*Suitable Tire for Brake Tests,  $TT_{BT}$*   
 *$TT_{BT}$  is the rated tyre type and size.*  
 *$TT_{BT}$  is the tyre type and size that has been determined as being the most critical for brake performance and/or energy absorption tests. The  $TT_{BT}$  must be a tire type and size approved for installation on the wheel ( $TS_{WR}$ ). The suitable tyre may be different for different tests.*
2. Page 7, a new paragraph is added after 4.3:  
*Fire Protection: Except for small parts (such as fasteners, seals, grommets, and small electrical parts) that would not contribute significantly to the propagation of a fire, all solid materials used must meet the applicable flammability rules for the part and category of aircraft.*

#### Deletion:

1. Page 13, paragraph 5.3.3.2 is disregarded. Worn brake testing is not a requirement of Part 23, 27 or 29, so it cannot be included in this TSO.

### ~~FEDERAL AVIATION ADMINISTRATION STANDARD FOR AIRCRAFT WHEELS AND WHEEL BRAKE ASSEMBLIES DATED MAY 18, 1984~~

- ~~1. Purpose.  
This document contains minimum performance standards for aircraft landing wheels and wheel brake assemblies.~~
- ~~2. Design and Construction.  
(a) Design.  
(1) Lubricant retainers. Lubricant retainers must retain the lubricant under all operating conditions, prevent the lubricant from reaching braking surfaces, and prevent foreign matter from entering the bearings.  
(2) Removable flanges. All removable flanges must be assembled onto the wheel in a manner that will prevent the removable flange and retaining device from leaving the wheel if a tire should deflate while the wheel is rolling.  
(3) Adjustment. When necessary to assure safe performance, the brake mechanism must be equipped with suitable adjustment devices.  
(4) Water seal. Wheels intended for use on amphibious aircraft must be sealed to prevent entrance of water into the wheel bearings or other portions of the wheel or brake, unless the design is such that brake action and service life will not be impaired by the presence of sea water or fresh water.  
(5) Explosion prevention. Unless determined to be unnecessary, means must be provided to minimize the probability of wheel and tire explosions which result from elevated brake temperatures.  
(b) Construction.~~

- (1) Castings. Castings must be of high quality, clean, sound and free from blowholes, porosity, or surface defects caused by inclusions, except that loose sand or entrapped gases may be allowed when the serviceability of the casting has not been impaired.
- (2) Forgings. Forgings must be of uniform condition and free from blisters, fins, folds, seams, laps, cracks, segregation, and other defects. If strength and serviceability are not impaired, imperfections may be removed.
- (3) Rim surfaces. For wheels designed for use with a tire and inner tube combination, the surface of the rim between bead seats must be free from defects which would be injurious to the inner tube while mounting the tire or while in service.
- (4) Rim joints. For wheels designed for use with a tire and inner tube combination, joints in the rim surface and joints between rim surfaces and demountable flanges must be smooth, close fitting, and noninjurious to the inner tube while mounting the tire or while in service.
- (5) Rivets and bolts. When rivets are used, they must be well beaded over, and rivets and bolts coming in contact with the casing or tube must be smooth enough not to damage the tube or casing during normal operation.
- (6) Bolts and studs. When bolts and studs are used for fastening together sections of a wheel, the length of the threads for the nut extending into and bearing against the sections must be held to a minimum and there must be sufficient unthreaded bearing area to carry the required load.
- (7) Steel parts. All steel parts, except braking surfaces and those parts fabricated from corrosion resistant steel must be cadmium plated or zinc plated or have equivalent protection from corrosion.
- (8) Aluminium parts. All aluminium alloy parts must be anodized or have equivalent protection from corrosion. This protection must include protection for fuse plug holes, valve stem holes, and other passages.
- (9) Magnesium parts. All magnesium alloy parts must receive a suitable dichromate treatment or have equivalent protection from corrosion. This protection must include protection for fuse plug holes, valve stem holes, and other passages.
- (10) Bearing and braking surfaces. The bearing and braking surfaces must be protected during the application of finish to the wheels and brakes.
- (11) Fatigue. The construction of the wheel must take into account techniques used to improve fatigue resistance of critical areas of the wheels.

3. Rating.

(a) Each wheel design must be rated for the following:

- (1) S=Maximum static load in pounds (ref. FAR §§ 23.731(b), 27.731(b), and 29.731(b) of Title 14 Chapter 1).
- (2) L=Maximum limit load in pounds (ref. FAR §§ 23.731(c), 27.731(c), and 29.731(c) of Title 14 Chapter 1).

(b) Each wheel brake assembly design must be rated for the following:

- (1) KEDL=Kinetic energy capacity in foot-pounds per wheel brake assembly at the design landing rate of absorption.

4. Qualification Tests

The aircraft wheels and wheel brake assemblies required by the TSO must be tested as follows and the test data included in the applicant's test report required by the TSO.

4.1 Wheel tests.

To establish the S and L ratings for a wheel, test a standard sample in accordance with the following radial, combined, and static load tests:

(a) Maximum radial load test. Test the wheel for yield and ultimate loads as follows:

- (1) Test method. Mount the wheel with a suitable tire of proper fit installed, on its axle, and position it against a flat nondeflecting surface. The wheel axle must have the same angular orientation to the

nondeflecting surface that it will have to the runway when it is mounted on the aircraft and is under the maximum limit load. Inflate the tire to the pressure recommended for the S load with air or water. If water inflation is used, water must be bled off to obtain the same tire deflection that would result if air inflation were used. Water pressure may not exceed the pressure which would develop if air inflation were used and the tire deflected to its maximum extent. Load the wheel through its axle perpendicular to the flat nondeflecting surface. Deflection readings must be taken at suitable points to indicate deflection and permanent set of the wheel rim at the bead seat.

(2) Yield load. Apply to the wheel a load not less than 1.15 times the maximum radial limit load, determined under FAR §§ 23.471 through 23.511, or FAR §§ 27.471 through 27.505, or FAR §§ 29.471 through 29.511 of Title 14 Chapter 1, as appropriate. Apply the load with the wheel positioned against the nondeflecting surface, and the valve hole positioned at 90 degrees with respect to the line between the center of the wheel and the point of contact, then with the valve hole positioned at 180 degrees, 270 degrees, and 0 degrees from the nondeflecting surface. The 90 degree increments must be altered to other positions if the other positions are more critical. Three successive loadings at the 0 degree position may not cause permanent set increments of increasing magnitude. The permanent set increment caused by the last loading at the 0 degree position may not exceed 5 percent of the deflection caused by that loading or 0.005 inches, whichever is greater. The bearing cups, cones, and rollers used in operation must be used for these loadings. There must be no yielding of the wheel such as would result in loose bearing cups, air, or water leakage through the wheel or past the wheel seal, or interference in any critical areas.

(3) Ultimate load. Apply to the wheel a load not less than 2 times the maximum radial limit load for castings and 1.5 times the maximum radial limit load for forgings, determined under FAR §§ 23.471 through 23.511, or FAR §§ 27.471 through 27.505 or FAR §§ 29.471 through 29.511 of Title 14 Chapter 1, as appropriate. Apply the load with the same wheel positioned against the nondeflecting surface and the valve hole positioned at 0 degrees with respect to the line between the center of the wheel and the point of contact. The wheel must be able to support the load without failure for at least 3 seconds. The bearing cones may be replaced with conical bushings, but the cups used in operation must be used for this loading. If, at a point of loading during the test, it is shown that the tire will not successfully maintain pressure or if bottoming of the tire on the nondeflecting surface occurs, the tire pressure may be increased to no more than 2 times the rated inflation pressure. If bottoming of the tire continues to occur with this increased pressure, a loading block which fits between the rim flanges and simulates the load transfer of the inflated tire may be used. The arc of wheel supported by the loading block must be no greater than 60 degrees.

(4) If the radial limit load in paragraph 4.1(b) is equal to or greater than the maximum radial limit in paragraphs 4.1(a)(2) and (3), the test specified in paragraph 4.1(a)(2) and (3) may be omitted.

(b) Combined radial and side load test. Test the wheel for the yield and ultimate loads as follows:

(1) Test method. Mount the wheel, with a suitable tire of proper fit installed, on its axle, and position it against a flat nondeflecting surface. The wheel axle must have the same angular orientation to the nondeflecting surface that it will have to the runway when it is mounted on the aircraft and is under the combined radial and side load. Inflate the tire to the pressure recommended for the maximum static load with air or water. If water inflation is used, the water must be bled off to obtain the same tire deflection that would result if air inflation were used. Water pressure may not exceed the pressure which would develop if air inflation were used and the tire deflected to its maximum extent. For the radial load component, load the wheel through its axle perpendicular to the flat nondeflecting surface. For the side load component, load the wheel through its axle parallel to the flat nondeflecting surface. The side load reaction must arise from the friction of the tire or the loading block on the nondeflecting surface. Apply the two loads simultaneously, increasing them either continuously or in increments no larger than 10 percent of the loads to be applied. Alternatively, a resultant load equivalent to the radial and side loads may be applied to the axle. Deflection readings must be taken at suitable points to indicate deflection and permanent set of the wheel rim at the bead seat.

(2) Yield load. Apply to the wheel radial and side loads not less than 1.15 times the respective ground loads determined under FAR §§ 23.485, 23.497, and 23.499, or FAR §§ 27.485 and 27.497, or FAR §§ 29.485 and 29.497 of Title 14 Chapter 1, as appropriate. Apply these loads with the wheels positioned against the nondeflecting surface and the valve hole positioned at 90 degrees with respect to the line between the center of the wheel and the point of contact, then with valve hole positioned at 180 degrees, 270 degrees, and 0 degrees from the nondeflecting surface. The 90 degree increments must be altered to other positions if the other positions are more critical. Three successive loadings at the 0 degree positions may not cause permanent set increments of increasing magnitude. The permanent set increment caused by the last loading at the 0 degree position may not exceed 5 percent of the deflection caused by that loading, or 0.005 inches, whichever is greater. The bearing cups, cones, and rollers used in operation must be used in this test. There must be no yielding of the wheel such as would result in loose bearing cups, air or water leakage through the wheel or past the wheel seal, or interference in any critical areas. A tire and tube may be used when testing a tubeless wheel only when it has been demonstrated that pressure will be lost due to the inability of a tire bead to remain properly positioned under the load. The wheel must be tested for the most critical inboard and outboard side loads.

(3) Ultimate loads. Apply to the wheel radial and side load not less than 2 times for castings and 1.5 times for forgings the respective ground loads determined under FAR §§ 23.485, 23.497, and 23.499, or FAR §§ 27.485 and 27.497, or FAR §§ 29.485 and 29.497 of Title 14 Chapter 1 as appropriate. Apply these loads with the same wheel positioned against the nondeflecting surface and the valve hole positioned at 0 degrees with respect to the center of the wheel and the point of contact. The wheel must be able to support the load without failure for at least 3 seconds. The bearing cones may be replaced with conical bushings, but the cups used in operation must be used for this loading. If, at a point of loading during the test, it is shown that the tire will not successfully maintain pressure or if bottoming of the tire on the nondeflecting surface occurs, the tire pressure may be increased to no more than 2 times the rated inflated pressure. If bottoming of the tire continues to occur with this increased pressure, a loading block which fits between the rim flanges and simulates the load transfer of the inflated tire may be used. The arc of wheel supported by the loading block must be no greater than 60 degrees.

(c) Maximum static load test. Test the wheel for the maximum static load test as follows:

(1) Test method. Mount the wheel, with a suitable tire of proper fit installed, on its axle, and position it against a flat nondeflecting surface or a flywheel. The wheel axle must have the same angular orientation to the load surface that it will have to the runway when it is mounted on the aircraft and is under the maximum static load. Inflate the tire to the pressure recommended for the maximum static load „S“. The radial load must be applied to the wheel through the axle and perpendicular to the load surface. The side load, when required, must be applied through the wheel axle and parallel to the load surface. For the side load, the wheel axle must be rotated or yawed to the angle which will produce a side load component equal to 0.15 „S“ while the wheel is being roll tested.

(2) Roll test. The wheel must be tested under the loads and for the distance shown in Table I. At the end of the test there must be no cracks on the wheel and no leakage through the wheel or past the wheel seal, and the bearing cups may not be loosened in the hub.

TABLE I

Category of Aircraft	Load Conditions	Roll Distance (miles)
Part 23	Maximum static load, „S“	1000
Parts 27 and 29	Maximum static load, „S“	250

(3) Reserved

TABLE II - Reserved

(d) Pressure test. Pressure test the wheel in accordance with the following:

(1) Overpressure test. The wheel must be hydrostatically tested to withstand without failure for at least 3 seconds application of an overpressure factor not less than 3.5 for Part 23 airplanes, and 3.0 for rotorcraft, times the rated inflation pressure determined by the applicant.

(2) Diffusion test. The tubeless tire and wheel assembly must hold the rated inflation pressure for 24 hours with no greater pressure drop than 5 percent. This test must be performed after the tire growth has stabilized.

#### 4.2 Wheel brake assembly test.

A sample of a wheel brake assembly design, with a suitable tire of proper fit installed, must meet the following tests to qualify the design for its kinetic energy ratings. The wheel of a wheel brake assembly must be separately tested under paragraph 4.1. The wheel brake assembly must be tested with the operating medium specified by the manufacturer.

(a) Dynamic torque tests. Test the wheel brake assembly on the suitable inertial brake testing machine in accordance with the following:

(1) Speed and weight values. For airplanes, select either Method I or Method II below to calculate the kinetic energy level which a single wheel and wheel brake assembly will be required to absorb. For rotorcraft, use Method I.

(i) Method I. Calculate the kinetic energy level to be used in the brake testing machine by using the equation:

$$KE = \frac{0.0443WV^2}{N}$$

where:

KE = Kinetic energy per wheel brake assembly (ft. lbs.);

W = Design landing weight (lbs.); V = Aircraft speed in knots. V must be not less than VSO the poweroff stalling speed of the

aircraft at sea level, at the design landing weight, and the landing configuration.;

N = Number of wheels with brakes. For rotorcraft, the manufacturer must calculate the most critical combination of takeoff weight and brake application speed to be used in the above equation.

(ii) Method II. The speed and weight values may be determined by other equations based on rational analysis of the sequence of events expected to occur during an accelerate-stop condition or an operational landing at maximum landing weight. The analysis must include rational or conservative values for braking coefficients of friction between the tire and runway, aerodynamic drag, propeller drag, powerplant forward thrust, and, if critical, loss of drag credit for the most adverse single engine or propeller due to malfunction. Do not consider the decelerating effects of propeller reverse pitch, drag parachutes, and powerplant thrust reversers.

(2) Test requirements. The wheel brake assembly must bring the inertial testing machine to a stop at the average deceleration, and for the number of repetitions specified in Table III without failure, impairment of operation, or replacement of parts except as permitted in paragraph 4.2(a)(3).

TABLE III

Category of Aircraft	Test
Parts 23	KEDL: 100 design landing stops at a deceleration selected by manufacturer but not less than 10 ft./sec. <sup>2</sup>
Parts 27 and 29	REDL: 20 design landing stops at a deceleration selected by manufacturer but not less than 6 ft./sec. <sup>2</sup>

(3) General Conditions.

(i) During landing stop tests (KEDL), one change of brake lining is permissible. The remainder of the brake assembly parts must withstand the 100 KEDL stops without failure or impairment of operations.

(b) Brake structural torque test. Apply load S and a torque load specified in paragraphs 4.2(b)(1) or (2), as applicable, for at least 3 seconds. Rotation of the wheel must be resisted by a reaction force transmitted through the brake or brakes by an application of at least maximum brake line pressure or brake cable tension in the case of a nonhydraulic brake. If such pressure or tension is insufficient to prevent rotation, the friction surface may be clamped, bolted, or otherwise restrained while applying the pressure or tension.

(1) For landing gears with only one wheel per landing gear strut, the torque load is  $1.2 SR$  where R is the normal loaded radius of the tire at rated inflation pressure under load S.

(2) For landing gears with multiple wheels per landing gear strut, the torque load is  $1.44 SR$  where R is the normal loaded radius of the tire at rated inflation pressure under load S.

(c) Overpressure hydraulic brakes. The brake with actuator piston extended to simulate a maximum worn condition must withstand hydraulic pressure for at least 3 seconds, equal to the following:

(1) For airplanes, 2 times the maximum brake line pressure available to the brakes.

(2) For rotorcraft, 2 times the pressure required to hold the rotorcraft on a 20 degree slope at design takeoff weight.

(d) Endurance tests hydraulic brakes. The hydraulic brake assembly must be subjected to an endurance test during which the total leakage may not exceed 5cc and no malfunction may occur during or upon completion of the test. Minimum piston travel during the test may not be less than the maximum allowable piston travel in operation. The tests must be conducted by subjecting the hydraulic brake assembly to:

(1) 100,000 cycles for airplanes, and 50,000 cycles for rotorcraft, of application and release of the average hydraulic pressure needed in the KEDL tests specified in paragraph 4.2(a)(2) except that manufacturers using Method II in conducting the tests specified in paragraph 4.2(a)(2) must subject the wheel brake assembly to the average of the maximum pressure needed in those tests. The piston must be adjusted so that 25,000 cycles for airplanes, and 12,500 cycles for rotorcraft are performed at each of the four positions where the piston would be at rest when adjusted for 25, 50, 75, and 100 percent of the wear limit; and

(2) 5,000 cycles for airplanes, and 2,500 cycles for rotorcraft at the maximum system pressure available to the brakes.

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Oxygen Mask Assembly, Continuous Flow, Passenger

### 1 - Applicability

This ETSO gives the requirements which new models of oxygen mask, continuous flow, passenger, that is designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Minimum Performance Standard

Standards set forth in the Society of Automotive Engineers (SAE), Inc, Document Aerospace Standard (AS) no AS 8025A, 'Passenger Oxygen Mask' dated 24 February 1988 (revised) January 1999, as modified in Appendix 1 of this ETSO.

#### 3.2 - Specific

None.

### 4 - Marking

#### 4.1 - General

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

#### 4.2 - Specific

The markings for each mask must, in addition to the requirements in the CS-ETSO Subpart A, be marked with the words 'Oxygen mask' and performance classification number as specified in SAE AS 8025 Paragraph 12.3. Additionally, the elastomer cure date (AS 8025A, paragraph 3.3.4), as well as a picture in accordance with AS8025A, paragraph 5.11, have to be marked on the article.

### 5 - Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3.

## APPENDIX 1.

## MPS FOR PASSENGER OXYGEN MASK ASSEMBLY, CONTINUOUS FLOW

The applicable standard is SAE AS8025A, Passenger Oxygen Mask, dated (revised) January 1999 and shall be modified as follows:

SAE AS8025A Paragraph	Action
Section 1, SCOPE	To be disregarded.
Paragraph 3.2, Deviations	To be disregarded.
Paragraph 3.3.1, General	Shall be revised: 'Construct the device, including packaging, of materials that will not contribute significantly to fire propagation and that comply with CS 25.853(a). Mask materials typically used should meet CS-25 Appendix F, Part I(a)(1)(ii) and/or Part I(a)(1)(iv).'
Paragraph 3.3.3, Cleaning and sterilization	Shall be revised: 'Cleaning and Sterilizing: The material of the oxygen mask shall permit cleaning and sterilizing without adverse effects, and without major disassembly. The cleaning method must be either manufacturer-recommended, or according to SAE ARP 1176, <i>Oxygen System Component Cleaning and Packaging</i> . Cleaning and sterilizing procedures shall be included in the CMM.'
Paragraph 3.3.4, Elastomer Components	The following sentence shall be added: 'Life limits and inspection procedures shall be included in the CMM.'
Paragraph 3.11, Identification Markings	To be Disregarded. Marking requirements are specified in paragraph 4 of this ETSO.
Paragraph 4.5.2	Flow indication must comply with AS 916B, <i>Oxygen Flow Indicators</i> , as applicable

# **European Aviation Safety Agency**

## **European Technical Standard Order**

**Subject:** AIRBORNE DOPPLER RADAR GROUND SPEED AND/OR DRIFT ANGLE MEASURING EQUIPMENT (FOR AIR CARRIER AIRCRAFT)

### **1 — Applicability**

This ETSO gives the requirements which airborne doppler radar ground speed and/or drift angle measuring equipment that is manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### **2 — Procedures**

#### **2.1 — General**

Applicable procedures are detailed in CS-ETSO Subpart A.

#### **2.2 — Specific**

None.

### **3 — Technical Conditions**

#### **3.1 — Basic**

##### **3.1.1 — Minimum Performance Standard**

Standards set forth in EUROCAE document MPS/WG7C/1-74 (RTCA DO-158), as amended and supplemented by this ETSO: In addition to paragraph 1.0, General Standards, of RTCA DO-158, all materials used except small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire, must be self-extinguishing when tested in accordance with applicable requirements of CS-25 Appendix F.

##### **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.

#### **3.2 — Specific**

None

### **4 — Marking**

#### **4.1 — General**

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

#### **4.2 — Specific**

None.

### **5 — Availability of Referenced Document**

See CS-ETSO Subpart A paragraph 3.

# **European Aviation Safety Agency**

## **European Technical Standard Order**

**Subject:** AIRBORNE AUTOMATIC DEAD RECKONING COMPUTER EQUIPMENT UTILIZING AIRCRAFT HEADING AND DOPPLER GROUND SPEED AND DRIFT ANGLE DATA (FOR AIR CARRIER AIRCRAFT)

### **1 — Applicability**

This ETSO gives the requirements which airborne automatic dead reckoning computer equipment utilizing aircraft heading and doppler ground speed and drift angle data that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### **2 — Procedures**

#### **2.1 — General**

Applicable procedures are detailed in CS-ETSO Subpart A.

#### **2.2 — Specific**

None.

### **3 — Technical Conditions**

#### **3.1 — Basic**

3.1.1 — Minimum Performance Standard Standards set forth in EUROCAE document MPS/WG7C/2-74, dated August 1974, „Airborne Automatic Dead Reckoning Computer Equipment Utilizing Aircraft Heading and Doppler Obtained Velocity Vector Data“. In addition to Chapter 4 of EUROCAE document MPS/WG7C/2-74, all materials used except small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire, must be self-extinguishing when tested in accordance with applicable requirements of CS-25 Appendix F.

#### **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.

#### **3.2 — Specific**

None

### **4 — Marking**

#### **4.1 — General**

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

#### **4.2 — Specific**

None.

### **5 — Availability of Referenced Document**

See CS-ETSO Subpart A paragraph 3.

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Survivor Locator Lights

### 1 - Applicability

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

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in Society of Automotive Engineers, Inc. (SAE), Aerospace Standard (AS) 4492, "Survivor Locator Lights," dated January 1995, reaffirmed November 18, 2004, as amended by Appendix 1 of this ETSO.

##### 3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

##### 3.1.3 – Computer Software

None

#### 3.2 - Specific

None.

### 4 - Marking

#### 4.1 - General

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

#### 4.2 - Specific

None.

- 5 - Availability of Referenced Document**  
See CS-ETSO Subpart A paragraph 3.

**APPENDIX 1**

**MPS FOR SURVIVOR LOCATOR LIGHTS**

The applicable standard is SAE AS4492, Survivor Locator Lights, dated January 1995, reaffirmed November 18, 2004 which shall be modified by adding the following:

- a) Locator light and battery pack must be constructed of materials that comply with CS-25, Appendix F, Part I (a)(1)(v) or Appendix F, Part I (a)(1)(ii) instead.
- b) Insulation on electrical wire connected to the locator light and battery pack must be self-extinguishing in compliance with CS 25.869(a)(4) respectively CS-25, Appendix F part I (a)(3).

# European Aviation Safety Agency

## European Technical Standard Order (ETSO)

**Subject:** Geosynchronous Orbit Aeronautical Mobile Satellite Services Aircraft Earth Station Equipment

### 1 - Applicability

This ETSO gives the requirements which Geosynchronous Orbit Aeronautical Mobile Satellite Services (AMSS) aircraft earth station equipment that is designed and manufactured on or after the date of this ETSO, must meet in order to be identified with the applicable ETSO marking.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in the Federal Aviation Administration standard "Geosynchronous Orbit Aeronautical Mobile Satellite Services Aircraft Earth Station Equipment".

This standard is based on RTCA document DO 210D 'MOPS for Geosynchronous Orbit Aeronautical Mobile Satellite Services (AMSS) avionics' Section 2.0 dated April 19, 2000 including Change 1, dated December 14, 2000, and Change 2, dated November 28, 2001, Change 3, dated September 19, 2006; and Change 4, dated March 24, 2015.

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

##### 3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 - Computer Software  
See CS-ETSO Subpart A paragraph 2.2.

3.2 - Specific  
None.

### 3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4.

- (1) Failure of the function defined in paragraph 3.1.1 is a minor failure condition.
- (2) Loss of the function defined in paragraph 3.1.1 of this ETSO is a minor failure condition. Satellite communication is a supplemental service operation, with high frequency (HF) radio required for primary communication. The loss of satellite communication is mitigated by availability of HF communications.
- (3) AMSS equipment is intended for procedural airspace area operations. FAA determined the failure condition specified in paragraph 3.2.1 of this ETSO based on AMSS equipment operating as an approved long-range communication system (LRCS) in oceanic airspace area environments. Use of AMSS equipment in other operating environments (for example, high-density terminal/en route domestic airspace) may impact equipment performance and safety considerations.

## 4 - Marking

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

4.2 - Specific  
None.

5 - **Availability of Referenced Document**  
See CS-ETSO Subpart A paragraph 3.

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Traffic Advisory System (TAS) Airborne Equipment

### 1 - Applicability

This ETSO gives the requirements that new models of active traffic advisory system (TAS) airborne equipment that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with applicable ETSO marking. Equipment Classes are:

- Class A. Equipment incorporating a horizontal situation display that indicates the presence and relative location of intruder aircraft, and an aural alert informing the crew of a Traffic Advisory (TA).
- Class B. Equipment incorporating an aural alert and a visual annunciation informing the crew of a TA.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in RTCA Document No. RTCA/DO-197A, 'Minimum Operational Performance Standards for An Active Traffic Alert and Collision Avoidance System I (ACTIVE TCAS 1),' Section Two (2) September 12, 1994, with the exceptions listed in as amended by Appendix 1 of this document.

##### 3.1.2 - Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

##### 3.1.3 - Computer Software

See CS-ETSO, Subpart A, paragraph 2.2.

##### 3.1.4 - Electronic Hardware Qualification

See CS-ETSO, Subpart A, paragraph 2.3.

#### 3.2 - Specific

None

**3.2.1 - Failure Condition Classification**

See CS-ETSO, Subpart A, paragraph 2.4.

Failure of the function defined in paragraph 3.1.1 of this ETSO has been determined to be a major failure condition for malfunctions causing the display or annunciation of hazardously misleading information in airborne aircraft.

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

**4 - Marking****4.1 - General**

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

**4.2 - Specific**

~~The equipment class, as defined in paragraph 1, shall be marked.~~

None

**5 - Availability of Referenced Document**

See CS-ETSO Subpart A paragraph 3.

## APPENDIX 1.

### Changes to RTCA/DO-197A, “Minimum Operational Performance Standards for an Active Traffic Alert and Collision Avoidance System I (Active TCAS I)” applicable to Traffic Advisory System (TAS) airborne equipment.

*Note: This Appendix changes several sections of DO-197A that have been modified by DO-197A Change 1. However, the below changes adopt different requirements than those contained in DO-197A Change 1.*

#### 1.0 Changes Applicable to Both Class A and Class B Equipment.

##### 1.1 Receiver Characteristics.

##### 1.1.1 In-band Acceptance. In lieu of paragraph 2.2.2.1 of RTCA DO-197A, substitute the following requirement:

Given a valid transponder reply signal in the absence of interference or overloads, the minimum trigger level (MTL) is defined as the input power level that results in a 90% ratio of decoded to received replies.

The MTL over the frequency range of 1,087 to 1,093 MHz shall be no greater than -70 dBm.

##### 1.1.2 In-band Acceptance. In paragraph 2.4.2.2.1 of RTCA DO-197A, eliminate the following:

under Intruder Aircraft eliminate the last line: “Scenario C and D  $\geq$  -78 dBm.”

under Test Description Success:, eliminate the last sentence: “For scenarios C and D, the ratio of correctly decoded intruder replies to total input replies shall not exceed 10%.”

##### 1.2 Transmission Frequency. In lieu of paragraph 2.2.3.1 of RTCA/DO-197A, substitute the following requirement:

“The transmission frequency of Mode C interrogations shall be  $1,030 \pm 0.2$  MHz.”

##### 1.3 Transmitter RF Output Power. In lieu of paragraph 2.2.3.2 of RTCA/DO-197A, substitute the following requirement:

When transmitting at full (unattenuated) output power, the peak RF output power delivered to a quarter wave stub antenna shall be within the following limits:

- Maximum RF Power: 54 dBm (250W)
- Minimum RF Power: 50 dBm (100W)

In the event that antenna gain differs from that of a quarter wave stub antenna (3 dBi), the power limits shall be adjusted accordingly. These limits are based upon range and interference limiting requirements.

**Note: When transmitting at full (unattenuated) power, the RF power radiated at the pattern peak shall be within the following limits:**

- **Maximum EIRP: 57 dBm (500W)**
- **Minimum EIRP: 53 dBm (200W)**

**It is assumed that the peak gain of a typical quarter wave stub antenna is 3 dBi.**

**EIRP = Effective Isotropic Radiated Power.**

**Note: As an alternative to the above, an active TAS may choose to operate as a low power system at a fixed rate power product limit of 42 Watts per second, in which case the peak RF output power delivered to a quarter wave stub antenna shall not exceed 46 dBm (40W).**

##### 1.4 Transmitter Pulse Characteristics. In lieu of paragraph 2.2.3.5 of RTCA/DO-197A, substitute the following requirement:

ATCRBS interrogations from active TAS shall employ the Mode C format illustrated in Figure 2-1.

The rise and decay times may be less than shown in the following table, provided the sideband radiation does not exceed the spectral limits tabulated in this standard. The amplitude of P3 shall be within 0.5 dB of the amplitude of P1.

ACTIVE TAS MODE PULSE SHAPES (All values in Microseconds)

Pulse Designator	Pulse Duration	Duration Tolerance	Rise Time		Decay Time	
			Min	Max	Min	Max
P1, P3	0.8	+ 0.075	0.05	0.1	0.05	0.2

The pulse spacing tolerances shall be as follows:  
P1 to P3: 21 ± 0.10 microseconds

- 1.5 **Mode S Broadcast Reception.** In lieu of paragraph 2.2.4.2 of RTCA/DO-197A, substitute the following requirement:

The Active TAS shall have the capability to receive 1,030 MHz Mode S broadcast signals for the purpose of obtaining a count of TCAS interrogators in its vicinity. Mode S reception may reside in an associated Mode S transponder, or may be integral to the Active TAS equipment, in which case those functions necessary to receive and process Mode S broadcast signals for a TCAS count shall be implemented and tested in accordance with RTCA/DO-181A.

*Note: As an alternative to the above, an active TAS may choose to operate at a fixed rate power product limit of 42W/sec, in which case the requirement to obtain a count of TCAS interrogators for the purpose of interference limiting is eliminated.*

- 1.6 **Interference Limiting.** In lieu of paragraph 2.2.6 of RTCA/DO-197A, substitute the following requirement:

To assure that all interference effects from Active TAS equipment are kept to a low level, Active TAS equipment shall control its interrogation rate or power or both to conform to the following limits.

These limits are given in terms of:

RR = the Mode A/C reply rate of own transponder

NT = the number of airborne TCAS interrogators detected via Mode S broadcast receptions with a receiver threshold of -74 dBm.

The Minimum Active TCAS shall have the capability to monitor RR and NT and to use this information in interference limiting. Once each scan period, NT shall be updated as the number of distinct TCAS addresses received within the previous 20 second period.

The limits are as follows:

NT	K Upper Limit for $\sum_{k=1}^K P(k)$	
	If RR < 240	If RR > 240
	0	250
1	250	113
2	250	108
3	250	103
4	250	98
5	250	94
6	250	89
7	250	84
8	250	79
9	250	74
10	245	70
11	228	65
12	210	60

NT	K Upper Limit for $\sum_{k=1} P(k)$	
	If RR < 240	If RR > 240
13	193	55
14	175	50
15	158	45
16	144	41
17	126	36
18	109	31
19	91	26
20	74	21
21	60	17
>22	42	12

$P(k)$  = power (watts) of the kth interrogation each second. This is the total radiated power (after all losses in cabling and antenna). If the set of powers is not the same in each 1 second period, then  $\sum P(k)$  represents the average value.

K = total number of interrogations in a 1 second period.

**Note 1: RR = the Mode A/C interrogation reception rate of own transponder may be used instead of RR = the Mode A/C reply rate of own transponder.**

**Note 2: As an alternative to the above, an active TAS may choose to operate as a low power system at a fixed rate power product limit of 42W/sec, in which case the requirement to further interference limit based on RR or IR is eliminated.**

In lieu of paragraph 2.4.2.5 of RTCA/DO-197A, substitute the following:

This test verifies that Active TAS is able to monitor its own transponder reply rate and to derive a count of TCAS aircraft by listening to TCAS broadcast interrogations and, based on these values, adjust its transmit power-rate product to conform to the Active TAS interference limits.

Inputs:

Active TAS Aircraft

Aircraft Altitude = 8000 ft.

Altitude Rate = 0 FPM

Intruder Aircraft 1-22

Equipage = Active TCAS II

Range = Not Applicable

Relative Speed = Not Applicable

Altitude = Not Applicable

Altitude Rate = Not Applicable TCAS Broadcast Interrogation

Power = -50 dBm

ATCRBS Interrogation

Frequency = 1030 MHz

Type = ATCRBS Mode C

Power = -50 dBm

Rate

Scenario A = 230 per second

Scenario B = 250 per second

Conditions:

Active TAS initialized and operating at T = 0 seconds. Each of the 22 intruders is assigned a discrete address and transmits only TCAS broadcast interrogations and only at the following times and rates: Intruders 1-10 every 10 sec starting at T = 30 sec. Intruders 11-15 every 20 sec starting at T = 70 sec. Intruders 16-22 every 20 sec starting at T = 130 sec.

The timing of the TCAS broadcast interrogations and the ATRCBS interrogations are controlled to prevent overlap of each other.

#### Scenario Description

The test involves use of an ATRCBS transponder which supplies reply rate information to Active TAS. The transponder is interrogated in Mode C at a 230 per second rate in Scenario A and at a 250 per second rate in Scenario B. During each scenario, the value of Total Radiated Power per second from Active TAS is measured by summing the transmitter output powers of each Active TAS interrogation over a scan period, determining the average per second value and accounting for cable and antenna losses.

Success: The Total Radiated Power per second shall not exceed the following values:

#### Scenario A

250 watts/sec measured at T = 20 sec  
245 watts/sec measured at T = 60 sec  
158 watts/sec measured at T = 120 sec  
42 watts/sec measured at T = 180 sec

#### Scenario B

118 watts/sec measured at T = 20 sec  
70 watts/sec measured at T = 60 sec  
45 watts/sec measured at T = 120 sec  
12 watts/sec measured at T = 180 sec

**Note: For fixed rate power systems, total radiated power is constant and shall not exceed 42 watts/sec.**

1.7 **Active TAS Antenna System.** In lieu of paragraph 2.2.10 of RTCA/DO-197A, substitute the following requirement:

The equipment shall transmit interrogations and receive replies from at least one directional antenna mounted on the top or bottom of the aircraft.

1.8 **Pilot Advisory Functions.** In lieu of paragraph 2.1.5 of RTCA/DO-197A, substitute the following requirement:

TAS is an airborne traffic alert system that interrogates ATC transponders in nearby aircraft and uses computer processing to identify potential and predicted collision threats. The system is designed to protect a volume of airspace around the TAS equipped aircraft. The system will provide appropriate aural and visual advisories to assist the flightcrew in visually acquiring the threat aircraft when TAS predicts a penetration of the protected airspace. Traffic advisories indicate the relative positions of intruding aircraft that meet certain range and altitude criteria and are approximately 30 seconds from closest point of approach. They assist the flightcrew in visually acquiring the intruding aircraft. The system provides a traffic display (Class A systems only) and aural and visual alerts. These indicate the relative position and altitude of ATC transponder-equipped aircraft. Traffic advisories can be generated for aircraft with operative Mode S, Mode C or Mode A (non-altitude reporting) transponders. The TAS equipment is viewed as a supplement to the pilot who, with the aid of the ATC system, has the primary responsibility for avoiding collisions. The TAS system provides no indication of aircraft without operative transponders. For Class A systems, it shall ~~The interface between Active TAS and the pilot shall be based on the FAA Advisory Circular entitled "Airworthiness Approval of Traffic~~

~~Alert and Collision Avoidance Systems (Active TCAS I)". It shall however be acceptable for the TAS system to use shape as the only discriminate for traffic threat levels.~~

This will allow the use of a monochrome display representation of the TCAS symbology. ~~For Class A systems, it shall also be acceptable to provide a blinking TA symbol to allow further discrimination of the traffic alert symbol.~~

## 2.0 Changes Applicable Only to Class A Equipment.

### 2.1 Pilot Advisory Functions, Active TCAS I Pilot Interface and Aural Alert.

In lieu of paragraphs 2.1.5, 2.2.12 and 2.2.15 of RTCA/DO-197A, substitute the following requirements:

1. A traffic display shall be provided to indicate the presence and location of intruder aircraft. The traffic display may be combined with other aircraft displays. The traffic display shall provide the crew with the intruder's range, bearing, and, for altitude reporting intruders, relative altitude and vertical trend.

2. Two levels of intruder aircraft shall be displayed; those causing a TA, and other traffic. Other traffic is defined as any traffic within the selected display range and not a TA.

**Note: The use of TCAS threat levels as defined in DO-197A is an acceptable alternative to the requirements defined in this section.**

3. As a minimum, the traffic display shall depict the following information to aid in the visual acquisition of traffic and assist in determining the relative importance of each aircraft shown:

**Note: TCAS I symbology as defined in the FAA Memorandum titled 'Interim Guidance for Airworthiness Approval and Operational Use of Traffic Alert and Collision Avoidance System (TCAS I)' dated June 16, 1995 Advisory Circular entitled "~~Airworthiness Approval of Traffic and Collision Avoidance Systems (Active TCAS I)~~" is an acceptable alternative to the symbology requirements defined in this section.**

**In addition, the use of TCAS symbology with a monochrome display is also an acceptable means of depicting traffic information.**

- a. Symbolic differentiation among traffic of different relative importance. TA, other traffic (see i, j, k, l, & m below).
- b. Bearing
- c. Relative altitude (for altitude reporting aircraft only)
  - (1) Above or below own aircraft (+ and - signs)
  - (2) Numerical value
- d. Vertical trend of intruder aircraft (for altitude reporting aircraft only).
- e. Range. The selected range shall be depicted.
- f. The display must be easily readable under all normal cockpit conditions and all expected ambient light conditions from total darkness to bright reflected sunlight.
- g. The display shall contain a symbol to represent own aircraft. The symbol shall be different from those used to indicate TA and other traffic. The display shall be oriented such that own aircraft heading is always up (12 o'clock).

h. A ring shall be placed at a range of 2 NM from own aircraft symbol when a display range of 10 NM or less is selected. The ring shall have discrete markings at each of the twelve clock positions. The markings shall be of a size and shape that does not clutter the display.

i. Symbol fill shall be used to discriminate traffic by threat levels

j. The symbol for a TA is a filled rectangle, and, when appropriate, a data field and vertical trend arrow as described in m. & n. below.

k. The symbol for other traffic shall be an open rectangle, and, when appropriate, a data field and vertical trend arrow as described in m. below.

l. Overlapping traffic symbols should be displayed with the appropriate information overlapped. The highest priority traffic symbol should appear on top of other traffic symbols. Priority order is;

- 1) TA traffic in order of increasing tau, i.e., the time to closest approach and the time to coaltitude,
- 2) other traffic in order of increasing range.

m. A data field shall indicate the relative altitude, if available, of the intruder aircraft and shall consist of two digits indicating the altitude difference in hundreds of feet.

For an intruder above own aircraft, the data field shall be preceded by a "+" character.

For an intruder below own aircraft, the data field shall be preceded by a "-" character.

For coaltitude intruders, the data field shall contain the digits "00", with no preceding "+" or "-" character. The data field shall be wholly contained within the boundaries of the rectangular traffic symbol.

For TA traffic, (filled symbol), the data characters shall be depicted in a color that contrasts with the filled symbol color.

For other traffic, the data field shall be the same color as the symbol.

The height of the relative altitude data characters shall be no less than 0.15 inches.

n. A vertical arrow should be placed to the immediate right of the traffic symbol if the vertical speed of the intruder is equal to or greater than 500 fpm, with the arrow pointing up for climbing traffic and down for descending traffic.

The color of the arrow shall be the same as the symbol.

o. Neither a data field nor a vertical arrow shall be associated with a symbol for traffic which is not reporting altitude.

p. The display shall be capable of depicting a minimum of three intruder aircraft simultaneously. As a minimum, the display shall be capable of displaying aircraft that are within 5 NM of own aircraft.

q. The display may provide for multiple crew-selectable display ranges.

r. When the range of the intruder causing a traffic advisory to be displayed is greater than the maximum range of the display, this shall be indicated by placing no less than one quarter of the traffic advisory symbol at the edge of the display at the proper bearing. The data field and vertical trend arrow shall be shown in their normal positions relative to the traffic symbol.

s. The size of the traffic symbol shall be no less than 0.2" High.

4. "No bearing" advisories shall be presented for an intruder generating a TA when the intruder's relative bearing cannot be derived. The "no bearing" advisory shall be an alphanumeric display shown in tabular form. The display shall be in the form of "TA 3.6 -05", which translates to a TA at 3.6 nautical miles, 500 feet below. "No bearing" TA's against non-altitude reporting intruders shall include the range only, e.g. "TA 2.2", which translates to a non-altitude reporting, no bearing TA at 2.2 nautical miles. The advisory shall be centered on the display below the own aircraft symbol. The display shall include provisions to display at least two "no bearing" TA's.

5. Aural Alerts. Each TAS aural alert shall be announced in a high-fidelity, distinguishable voice.

a. The aural alert message "Traffic-Traffic", spoken once, shall be used to inform the crew of a TA.

b. All TAS aural alerts should be inhibited using the following order of precedence;

(1) Below 400 ±100 feet AGL when TAS is installed on an aircraft equipped with a radio altimeter.

(2) For aircraft without a radio altimeter, the aural annunciations shall be inhibited when the landing gear is extended.

**Note: When the TAS is installed on a fixed gear aircraft without a radio altimeter, the aural annunciations will never be inhibited.**

2.2 **Traffic Advisory Criteria.** Replace the second section in paragraph 2.2.14 of RTCA/DO-197A, with the following text:

The TAS equipment shall provide two levels of advisories: Other Traffic (OT), and Traffic Advisories (TA). TAs are issued based on either tau, i.e., the time to closest approach and the time to coalitude, or proximity to an intruder aircraft. The range tau is defined as the range divided by range rate and the vertical tau is defined as the relative altitude divided by the altitude rate.

2.3 **Display Overload.** In lieu of paragraph 2.2.17 of RTCA/DO-197A, substitute the following requirements:

If the number of targets exceeds the display capability, excess targets shall be deleted in the following order:

a. Other traffic beginning with the intruder at the greatest range.

b. TAs beginning with the intruder having the largest tau. Once a TA has been generated against an intruder, it cannot be removed as a TA until the TA criteria are no longer satisfied even though it may be dropped from the display.

**Note: This exception does not apply when TCAS I symbology and threat levels are used.**

3.0 **Changes Applicable Only to Class B Equipment.**

3.1 **Pilot Advisory Functions, Active TCAS I Pilot Interface, and Aural Alert.**

In lieu of paragraph 2.1.5, 2.2.12, and 2.2.15 of RTCA/DO-197A, substitute the following requirements:

1. A visual "Traffic" annunciation, shall be provided for the duration of the TA.

2. Aural Alerts. For aircraft without a radio altimeter, the aural annunciations shall be inhibited when the landing gear is extended.

**Note: When the TAS is installed on a fixed gear aircraft without a radio altimeter, the aural annunciation will never be inhibited.**

a. Aural alert messages shall be annunciated in threat priority sequence, greatest threat first.

- (1) Initial aural traffic advisories shall be spontaneous and unsolicited. The unsolicited annunciations shall be as follows: "Traffic-<X>O'Clock", spoken once, (where <X> is the clock position of the intruder, such as 1 o'clock, etc.). If surveillance bearing information is not available on the intruder, "Traffic, No Bearing", shall be annunciated.
- (2) The current relative bearing to intruder aircraft shall be annunciated as a traffic advisory update upon crew command. Additional information such as relative altitude, range of intruder, and vertical trend (i.e. climbing, descending) may also be annunciated.
- (3) The acceptability of these aural annunciations must be reviewed during flight test. The following factors, at a minimum, must be evaluated for acceptability: quantity of unsolicited annunciations, duration of annunciations, annunciation clarity, and volume. This evaluation shall occur under normal cockpit workload conditions during departure, cruise, and approach and landing phases of flight and should include evaluation of suitability in a normal air traffic control voice communication environment.
- (4) Control means shall be provided to request a traffic advisory update, mute a current aural advisory, and cancel/restore aural advisories (turning the equipment off is an acceptable means of providing the cancel aural advisories function). The default condition of the equipment at power on shall be aural advisories active.

b. All TAS aural alerts should be inhibited using the following order of precedence;

- (1) Below  $400 \pm 100$  feet AGL when TAS is installed on an aircraft equipped with a radio altimeter.
- (2) For aircraft without a radio altimeter, the aural annunciations will never be inhibited in flight but may be inhibited on the ground when the aircraft is equipped with a weight-on-wheels system.

3.2 **Traffic Advisory Criteria.** Replace the first and second sections in paragraph 2.2.14 of RTCA/DO-197A, with the following text:

The Active TAS equipment shall provide two levels of advisories: Other Traffic (OT), and Traffic Advisories (TA). Other traffic is defined as any traffic within the selected display range and not a TA. TAs are issued based on either tau, i.e., the time to closest approach and the time to coaltitude, or proximity to an intruder aircraft. The range tau is defined as the range divided by range rate and the vertical tau is defined as the relative altitude divided by the altitude rate.

3.3 **Display of intruders on the ground.** In lieu of paragraph 2.2.16 of RTCA/DO-197A, substitute the following requirements:

The Active TAS equipment shall provide logic to inhibit TAs of altitude reporting intruders which are on the ground. This logic shall be used when the TAS-equipped aircraft is below 1,700 feet AGL. The 1,700 foot threshold shall include hysteresis of + 50 feet.

Note: This represents a requirement for a capability within the Active TAS avionics. When Active TAS is installed on an aircraft which does not have a radio altimeter, there is not a requirement for this logic to function.

3.4 **Display overload.** In lieu of paragraph 2.2.17 of RTCA/DO-197A, substitute the following requirements: If the number of intruders exceeds aural memory storage capacity, excess intruders shall be deleted in the following order:

- a. Other traffic beginning with the intruder at the greatest range.
- b. TAs beginning with the intruder having the largest tau. Once a TA has been generated against an intruder, it cannot be removed as a TA until the TA criteria is no longer satisfied even though it has been dropped from the list of aural warnings.

# European Aviation Safety Agency

## European Technical Standard Order

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

### 1 - Applicability

This ETSO gives the requirements which Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

This standard 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.

Standards set forth in the Radio Technical Commission for Aeronautics (RTCA), Inc 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-358, inimum Operational Performance Standards (MOPS) for Flight Information Services-Broadcast (FIS-B) with Universal Access Transceiver (UAT), dated March 24, 2015. The standard applies to the equipment classes as defined in the following table 1.

Demonstrate the required functional performance under the test conditions as specified in RTCA/DO-267A Section 4 table 1.

Equipment Class	Equipment Name	Functionality	Test conditions
1	FIS-B Equipment using Universal Access Transceiver (UAT) and Interoperable with the Surveillance and	RTCA/DO-267A358 Sections 2.2. and 3, with amendments per Appendix 1 of this ETSO.	RTCA/DO-358, Sections 2.3 and 2.4.

Equipment Class	Equipment Name	Functionality	Test conditions
	Broadcast Services (SBS) Provider		
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 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 - 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 3.11 resulting in misleading weather or flight information is a minor failure condition.

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

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

3.2.2 - Manual

The applicant shall produce a manual 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 ownship location with respect to 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, Flight Service Station specialist, operator dispatch, or airline operations control 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-/near-term planning and decision making. The system lacks sufficient resolution and updating capability necessary for aerial maneuvering 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 maneuver the aircraft at minimum safe distances from hazardous weather. FIS-B information must not be used in lieu of a standard preflight briefing.'*

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.'*

**4 - Marking**

4.1 - General

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

4.2 - Specific

None

**5 - Availability of Referenced Document**

See CS-ETSO Subpart A paragraph 3.

**APPENDIX 1.**

**AMENDMENTS TO THE MINIMUM PERFORMANCE STANDARD FOR EQUIPMENT PROVIDING FIS-B VIA THE UNIVERSAL ACCESS TRANCEIVER**

This Appendix prescribes addendums to the MPS for aircraft FIS-B systems and equipment when using the Surveillance Broadcast Services system.

1.1 RTCA/DO-267A. The applicable standard is RTCA/DO-267A Sections 2 and 3. We modified it as follows:

1.1.1 Page 19, 3.6.2.3, Reassembly of Linked Application Protocol Data Units (APDU) to Form an FIS-B Product File, Paragraph 3, Sentence 1, reads as follows:

Change from:

...Separate APDU sequences are maintained for each Product and ground station combination for which linked APDUs are transmitted.

To:

... Separate APDU sequences are maintained for each Product and *each Product File ID* or ground station combination for which linked APDUs are transmitted.

1.1.2 Appendix D, Page D-1, Paragraph 2, Sentence 1:

Change from:

... The APDU structure shall begin with an APDU Header consisting of data fields as shown in Table D-1.

To:

... The APDU structure shall begin with an APDU Header consisting of data fields as shown in Table D-1, except the UAT transmission of the APDU header does not include the 16 bit FIS-B APDU ID field.

1.1.3 Appendix D, Page D-1, Table D-1 FIS-B APDU Header Format, replace Header. Time rows as follows:

Change From:

Head Time	22 – 37 bits	Section D.4
Time Option Bits	2 bits	
Date (optional)	9 bits (if included)	
Month of Year	4 bits	
Day of month	5 bits	
UTC Time Hours	5 bits	
Time Minutes	6 bits	
Time Seconds (optional)	6 bits (if included)	

To:

Head Time	22 – 37 bits	Section D.4
Time Option Bits	2 bits	
Month of Year (optional)	4 bits (if included)	
Day of month (optional)	5 bits (if included)	
UTC Time Hours	5 bits	
Time Minutes	6 bits	
Time Seconds (optional)	6 bits (if included)	

1.1.4 Appendix D, Page D-1, amend the Segmentation Data Block entries and add a new Product File ID entry in Table D-1 to read as follows:

Change From:

Field	Number of Bits	Document Section
Product File Length	12 bits	
Number	12 bits	

Zero Padding Bits	0-7 bits to force octet alignment	Section D.6
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To:

Field	Number of Bits	Document Section
Product File ID	10 bits	ETSO-C157a Appendix 1 paragraph 1.1.9
Product File Length	9 bits	Section D.5.1
APDU Number	9 bits	Section D.5.2
Zero Padding Bits	0-7 bits to force octet alignment	Section D.6

1.1.5 Appendix D, Page D-3, Table D-2 Format of the FIS-B Product Descriptor, reads as follows:

Change from:

Geographic Locator (region) (optional)	20 bits (if present)	Section D.2.4
--	----------------------	---------------

To:

Geographic Locator (region) (optional)	20 bits (if present)	Section D.2.4
Latitude	7 bits	Section D.2.4
Longitude	8 bits	Section D.2.4
Extent	5 bits	Section D.2.4

1.1.6 Appendix D, Page D-15, Figure D-3, Block Reference Indicator Format, reads as follows:

Change from:

Byte #	Bit Number							
	7	6	5	4	3	2	1	0
0	Element Identifier	N/S	Spare		Block Number (MSb)			
1	Block Number							
2	Block Number (LSB)							

To:

Byte #	Bit Number							
	7	6	5	4	3	2	1	0
0	Element Identifier	N/S	Scale		Block Number (MSb)			
1	Block Number							
2	Block Number (LSB)							

1.1.7 Appendix D, Page D-15, Section 2.3.5.2.2 The Block Reference Indicator, after the "Hemisphere N/S" paragraph add new paragraph to read as follows:

"Scale: an encoded multiplier applied to the base size of the GBR block in both latitude and longitude dimensions. Values represented by the Scale encoding are either system or product specific. Any mathematical calculations that are needed to reduce a high-resolution product down to a lower-resolution 'scaled' product are left for the implementer to separately describe/document."

1.1.8 Appendix D, Page D-21, D.5, Segmentation Data Block, Sentence 5, reads as follows:

Change from:

...The Segmentation Data Block (if present) shall consist of two components, the Product File Length field and the APDU Number field.

To:

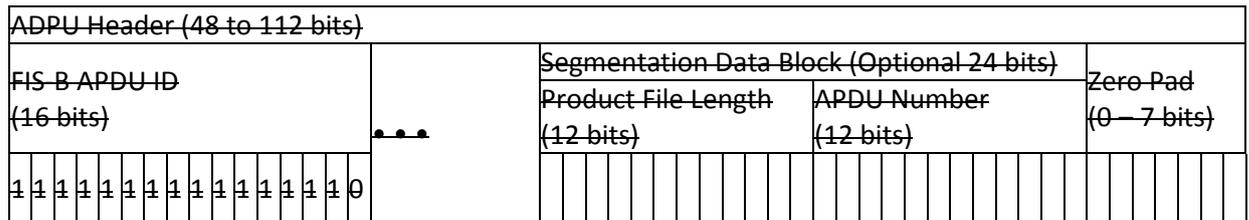
...The Segmentation Data Block (if present) shall consist of three components, the Product File ID field, Product File Length field and the APDU Number field.

1.1.9 Appendix D, Page D-21, supplement section D.5 with the following:

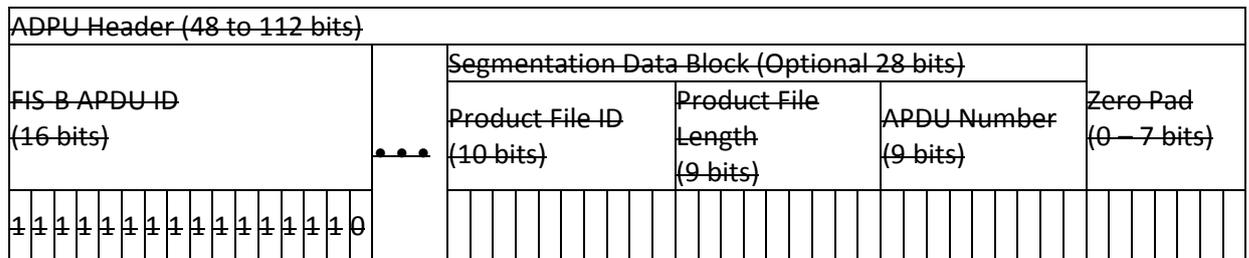
*The Product File ID Field contains a reference number to associate segmented APDUs with the appropriate Product File. Such a reference is necessary when broadcasting the same APDU segments for a Product File from multiple radio stations.*

1.1.10 Appendix D, Page D-23, Figure D-9 APDU Header Layouts, amend the optional Segmentation Data Block fields to read as follows:

Change from:



To:



1.1.11 Appendix D, Page D-23, Figure D-9 APDU Header Layouts, amend the APDU Header Time field text to read as follows:

Change from:

APDU Header Time (13 or 28 bits)

To:

APDU Header Time (13, 19, or 22 bits)

1.1.12 Appendix D, Page D-23, Figure D-9, APDU Header Layouts, add note to Option Flags table to read as follows:

“Note: A given APDU shall not have Time Flag #1 and Time Flag #2 set to one (1) within the same APDU Header.”

1.1.13 Appendix K, Page K-1, the last entry in Table K-1, reads as follows:

Change from:

The last entry in Table K-1 shows the encoding of the CC (Change Cipher) character as “011111.”

To:

The last entry in Table K-1 shows the encoding of the “|” character as “011111.”

1.1.14 Appendix K, Page K-1, new note at the bottom of the table, reads as follows:

“| = The change cipher character is not used by FIS-B (per MASPS), so there is no expected impact on legacy users.”

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Cargo Restraint Strap Assemblies

### 1 - Applicability

This ETSO gives the requirements which Cargo Restraint Strap Assemblies that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in the SAE AS 5385C, Cargo Restraint Straps - Design Criteria and Testing Methods, dated January 2007, as amended by Appendix 1 of this ETSO.

##### 3.1.2 - Environmental Standard

~~See Section 4 of SAE AS 5385C.~~

Cargo restraint strap assemblies must meet the minimum performance requirements of this ETSO at any time during the service life.

(1) The environmental degradation due to aging, ultra-violet (UV) exposure, weathering, etc. shall be determined, for any non-metallic materials used in the construction of cargo restraint strap assemblies.

(2) For textile performance, refer to SAE Aerospace Information Report (AIR) 1490B, Environmental Degradation of Textiles, dated December 2007, for available data when exposed to environmental factors. It shall be determined when the environmental effects of degradation on cargo restraint strap assemblies commensurate with the expected storage and service life become unacceptable for the minimum performance requirements.

NOTE: Environmental degradation data other than that documented in AIR1490B may be used if it can be substantiated and considered acceptable for the ETSO authorisation.

3.1.3 – Computer Software  
None.

3.1.4 - Electronic Hardware Qualification  
None.

3.2 - Specific

3.2.1 Failure Condition Classification  
N/A

#### **4 - Marking**

4.1 - General

Marking as detailed in CS-ETSO Subpart A paragraph 1.2. In addition, each Cargo Restraint Strap Assemblies shall be legibly and permanently marked in accordance with SAE AS 5385C, section 7.3 with the following:

(i) dates of manufacture and expiration per SAE AS 5385C, section 4.5.2. Format the dates per SAE AS 5385C, section 7.2.

(ii) the rated ultimate load in daN and lbf.

(iii) a unique identifier if required by SAE AS 5385C, section 4.5.2(b).

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

(1) each component that is easily removable (without hand tool), and

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

NOTE 1: any extra information listed in SAE AS 5385C, section 7, not specifically required in this paragraph, may be marked.

NOTE 2: Compliance with this ETSO does not necessarily indicate compliance with SAE AS 5385C. To make the cargo strap assembly as complying with SAE AS 5385C, the cargo strap assembly must be shown to meet the requirements of SAE AS 5385C in conformance with SAE AS 5385C, Para 7.1 and Note 8.

4.2 - Specific  
None.

#### **5 - Availability of Referenced Document**

See CS-ETSO Subpart A paragraph 3.

**APPENDIX 1.**  
**MINIMUM PERFORMANCE STANDARD FOR CARGO RESTRAINT STRAP ASSEMBLIES**

This Appendix prescribes the MPS for cargo restraint strap assemblies. The applicable standard is SAE AS 5385C “Cargo Restraint Straps – Design Criteria and Testing Methods”, dated January 2007 modified as follows:

<b>AS5385C Section</b>	<b>Action</b>
1	Disregard
2	Modify Paragraph 2. “REFERENCES” by disregarding the last sentence.
3	Modify Paragraph 3.6 to omit reference to D6 in the first sentence. Modify Figure 1. to disregard D6 end fitting  Disregard 3.14
4	Modify 4.4 to read as follows: The webbing, as used in the restraint strap assembly, i.e., including sewing and any treatment, shall meet the flammability test criteria of CS-25 Appendix F, Part I, paragraph (a)(1)(iv): it may not have a burn rate greater than 63.5 mm (2.5 in) per minute when tested horizontally with the apparatus and test procedures required in Appendix F, Part I, paragraph (b)(5) (see 5.8).  Disregard 4.5.4 and 4.9.1  Modify 4.5.1 by adding the following note: “NOTE: Environmental degradation data other than that documented in AIR490B may be used if substantiated by the Applicant and approved by the Agency.”
5	Disregard 5.9, 5.10 and 5.11 Modify 5.1 by adding the following note: “NOTE: Equivalent alternate methods must be approved by the Agency”.
6	Disregard
7	Apply per Paragraph 4 of this ETSO
8	Disregard
9	Disregard
10	Disregard

# European Aviation Safety Agency

## European Technical Standard Order (ETSO)

**SUBJECT:** Data Link Recorder Systems Equipment

### 1 – Applicability

This ETSO gives the requirements that new models of data link recorder 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

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific None

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in the applicable sections of EUROCAE document ED-112A 'Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems' dated March 2003 September 2013 that pertain to the data link recorder types as defined in table 1 below, except that compliance with ED-112 chapters 2-5, 3-4, 5-6 for the following exclusions: Chapters IV-1 and IV-6, and Sections 2-1.1, 2-1.5, 2-1.6, 2-1.11, 2-1.12, 2-3.1, 2-5, 3-1.1, 3-1.2, 3-1.3, 3-1.4, 3-1.5, 3-1.7, 3-4 and Annex IV-B, and all ED-112 requirements for installation, flight testing, aircraft maintenance are not required for this ETSO.

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

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

**Table 1: MPS Requirements per recorder type**

##### 3.1.2 - Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1

##### 3.1.3 - Computer Software

See CS-ETSO, Subpart A, paragraph 2.2

3.1.4 Electronic Hardware Qualification.  
See CS-ETSO, Subpart A, paragraph 2.3

3.2 - Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

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

**4 - Marking**

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

4.2 – Specific

~~4.2.1 Lettering~~

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

~~4.2.2 Marking recommendation~~

~~Marking in French: “ENREGISTREUR DE VOL NE PAS OUVRIR” is optional.~~

~~See EUROCAE document ED-112A 2-1.16.3.~~

**5 - Availability of Referenced Document**

See CS-ETSO, Subpart A, paragraph 3

# European Aviation Safety Agency

## European Technical Standard Order

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

### 1 - Applicability

This ETSO gives the requirements which Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance Applications (ASA) that are designed or manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in Section 2 of EUROCAE ED-194A, dated ~~January~~ June 2014/2012/ Radio Technical Commission for Aeronautics (RTCA) DO-317AB, dated June 17, 2014 ~~December 13, 2011~~, Minimum Operational Performance Standards for Aircraft Surveillance Applications System as modified by Appendix 1 of this ETSO.

Functional equipment classes for this ETSO are defined by the avionics equipment functionality they provide for one or more of the applications listed in Table 1. The ~~three~~four equipment functionalities are Cockpit Display of Traffic Information (CDTI) (Surface Only), CDTI, Airborne Surveillance and Separation Assurance Processing (ASSAP) and ADS-B Traffic Advisory System (ATAS) Annunciator Panel. Applicable performance standards for these classes are identified per equipment class in Appendix L of ED-194A/DO-317BA and are based on Section 2 of ED-194A/EDDO-317BA. The functional equipment classes are shown in the following table 1.

Application	Criticality		Equipment Classes			
	Loss of Function	Hazardous & Misleading Information Criticality Level	CDTI (Surface Only) (A)	CDTI (B)	ASSAP (C)	ATAS Annunciator Panel (D)
(1) Enhanced Visual Acquisition (EVAcq)	Minor	Major	Not Permitted	B1	C1	Not Applicable
(2) Basic Surface (Runways)	Minor	Major (> 80 Knots) Minor (< 80 Knots)	A2	B2	C2	Not Applicable
(3) Basic Surface (Runways + Taxiways)	Minor	Major (> 80 Knots) Minor (< 80 Knots)	A3	B3	C3	Not Applicable
(4) Visual Separation on Approach (VSA)	Minor	Major	Not Permitted	B4	C4	Not Applicable
(5) Basic Airborne (AIRB)	Minor	Major	Not Permitted	B5	C5	Not Applicable
(6) In-Trail Procedures (ITP)	Minor	Major	Not Permitted	B6	C6	Not Applicable
(7) ADS-B Traffic Advisory System (ATAS)	Minor	Major	Not Permitted	B7	C7	D7
(8) CDTI Assisted Visual Separation (CAVS)	Minor	Major	Not Permitted	B8	C8	Not Applicable

**Table 1 – ASA Functional Equipment Classes (per ED-194A/DO-317B)**

The in-trail procedures (ITP) application (item 6 in Table 1) supports a new separation standard in procedural airspace. ITP application enables aircraft that desire flight level changes in procedural airspace to achieve these changes on a more frequent basis, thus improving flight efficiency and safety. The ITP achieves this objective by permitting a climb-through or descend-through maneuver between properly equipped aircraft, using a new distance-based longitudinal separation minimum during the maneuver.

ASSAP equipment authorised under this ETSO must contain or support an interface to an ADS-B receiver. If the receiver is embedded in the equipment, it must meet ETSO-C154c, *Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on Frequency of 978 MHz* or ETSO-C166b, *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)*. If the receiver is not embedded, the installation manual must have a requirement to interface to an ETSO-C154c or ETSO-C166b approved ADS-B receiver.

If intended for installation on aircraft with traffic advisory system (TAS) or traffic alert and collision avoidance system (TCAS) equipment, ASSAP equipment authorised under this ETSO must contain or support an interface to equipment complying with ETSO-C147(), *Traffic Advisory System (TAS) Airborne Equipment*, ETSO-C118(), *Traffic Alert and Collision Avoidance System (TCAS) Airborne*

Equipment, TCAS I, or ETSO-C119(), Airborne Collision Avoidance System II (ACAS II). If the ASSAP equipment does not support this functionality, the installation manual must prohibit installation on an aircraft equipped with TAS or TCAS.

Class A and B equipment authorised under this ETSO must comply with ETSO-C165(a) *Electronic Map Systems For Graphical Depiction Of Aircraft Position* when implementing sSurface aApplications. This ETSO shall take precedence where it differs from ETSO-C165a. Databases used to support moving maps integrated with the SURF application must meet at least 5 meter accuracy and 1 meter resolution. Databases used to support moving maps integrated with the SURF application must meet EUROCAE ED-76/RTCA DO-200A Data Process Assurance Level 2 for state-provided data with Essential Integrity as defined in RTCA DO-272B.

Equipment authorised under this TSO may include or interface with airborne multipurpose electronic display equipment complying with ETSO-C113(a).

Equipment authorised under this ETSO must contain or support an interface to position sources that meet one of the following ETSOs: ETSO-C129(), ETSO-C145(), ETSO-C146(), ETSO-C196() or equivalent.

### 3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1. The system performance to be demonstrated during the environmental testing is defined in EUROCAE ED-194A/RTCA DO-317A section 2.4.

Explosion testing in accordance with EUROCAE ED-14( )/RTCA DO-160( ) section 9 is considered optional.

Electrostatic Discharge testing in accordance with EUROCAE ED-14( )/RTCA DO-160( ) section 25 is required for all equipment having control elements and are expected to be touched during operation.

### 3.1.3 – Computer Software

See CS-ETSO Subpart A paragraph 2.2.

### 3.1.4 - Electronic Hardware Qualification

See CS-ETSO Subpart A paragraph 2.3.

## 3.2 - Specific

### 3.2.1 Failure Condition Classification

See CS-ETSO Subpart A paragraph 2.4.

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

## 4 - Marking

### 4.1 - General

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

### 4.2 - Specific

None.

- 5 - Availability of Referenced Document**  
See CS-ETSO Subpart A paragraph 3.

**APPENDIX 1.**

**Amendment to ED-194A/DO-317B**

**A2.1 - Introduction**

This Appendix amends ED-194A/DO-317B to address specific issues raised since publication of the document.

**A2.2 - TCAS II Integration with TSAA**

TCAS integration is addressed in ED-194A/DO-317B section 2.2.4.5.3.3, titled 'TSAA Traffic Caution alerts on Correlated TCAS Tracks'. Replace the current section 2.2.4.5.3.3 with the following text:

*The TSAA application may be integrated with TCAS I, TCAS II, or TAS systems.*

*If an ADS-B/ADS-R/TIS-B track is correlated with a TCAS track, then the alerts shall (2223) only be presented from either the TSAA application or the TCAS system (i.e., not both).*

*If TSAA and TCAS II are installed on the same aircraft, TCAS II resolution advisories (RAs) shall (####) have priority over all other alerts.*

*If TSAA and TCAS II are installed on the same aircraft, TCAS II traffic advisories (TAs) shall (####) be generated for the TCAS tracks by the TCAS II TA function. TSAA may generate traffic alerts for ADS-B only traffic not correlated with a TCAS track.*

*TSAA alerts should take precedence over TCAS I or TAS traffic alerts (TAs) when the TCAS track is correlated with an ADS-B or ADS-R track; but, TCAS traffic alerts should take precedence over TSAA alerts when the TCAS track is correlated with a TIS-B track.*

**A2.3 - TCAS Validation of ITP Traffic**

TCAS validation of ITP traffic is addressed in ED-194A/DO-317B section 2.2.4.4.2.1, titled 'Validation of Traffic Position with TCAS Data'. Add the following text to the end of the second paragraph.

*ASSAP is not required to support ADS-R or TIS-B traffic for use with the ITP application.*

**A2.4 - TCAS Validation of CAVS Traffic**

TCAS validation of CAVS traffic is addressed in ED-194A/DO-317B section 2.2.4.6.2.1, titled 'Validation of Traffic Position with TCAS Data'. Remove all instances of the text '/ADS-R' from this section and add the following text to the end of the second paragraph.

*ASSAP is not required to support ADS-R or TIS-B traffic for use with the CAVS application.*

# European Aviation Safety Agency

## European Technical Standard Order (ETSO)

**Subject:** Low-Frequency Underwater Locating Devices (Acoustic) (Self-Powered)

### 1 — Applicability

This ETSO gives the requirements which Low-Frequency Underwater Locating Devices (Acoustic) (Self-Powered) that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 — Procedures

#### 2.1 — General

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

#### 2.2 — Specific

None.

### 3 — Technical conditions

#### 3.1 — Basic

##### 3.1.1 — Minimum performance standard

Standards set forth in the SAE document AS6254A Minimum Performance Standard for Low-Frequency Underwater Locating Devices (Acoustic) (Self-Powered), dated February December 6, 2012-2015.

##### 3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

##### 3.1.3 — Software

See CS-ETSO, Subpart A, paragraph 2.2.

##### 3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

#### 3.2 — Specific

The battery used in the ULD authorised under this ETSO must meet the minimum performance standard found in the applicable battery ETSO such as ETSO-C142a, Non-Rechargeable Lithium Cells and Batteries for ULD powered by Lithium primary batteries. Lithium powered ULD must also meet the requirements in Appendix 1 of this ETSO in addition to its battery meeting ETSO-C142a.

##### 3.2.1 Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

**4 — Marking**

4.1 — General

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

4.2 — Specific

None.

**5 — Availability of referenced document**

See CS-ETSO, Subpart A, paragraph 3.

## APPENDIX 1.

### Lithium Battery Containment Requirements

The Airframe Low Frequency ULD must provide the containment of any hazardous products of the failure of its internal lithium battery without additional external containment devices other than the mounting bracket. Include the following note in the installation instructions and in the DDP.

*Note: The ULD is intended to be mounted to the structure of the aircraft and provide a locating signal after a crash in water. **Placing the ULD inside a containment vessel will prevent it from performing its intended function of transmitting low frequency ultrasonic pulses to aid the location of the mishap aircraft.***

Sections 1.5, 1.6, 1.7 and 2 of RTCA/DO-347, Certification Test Guidance for Small and Medium Sized Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013, provide safety, design and qualification requirements and guidelines pertinent to designing safe batteries meeting CS-23, CS-25, CS-27 and CS-29 requirements and additional Special Conditions (SC) required for installation for the low frequency ULD on aircraft. Consider each of these requirements and guidelines when designing cells and batteries.

The requirements below include tests from RTCA/DO-347. Although written for rechargeable lithium batteries, EASA and the FAA consider these tests appropriate for demonstrating that non-rechargeable lithium batteries meet the SCs where indicated below. When conducting these tests and the test method states 'charge the battery in accordance with the manufacturer's instructions', use a battery with a 100 % state of charge instead.

- 1) Lithium Primary Batteries used in Airframe Low Frequency ULD must independently:
  - a. Meet the requirements in ETSO-C142a, Non-rechargeable Lithium Cells and Batteries, including the tests in Appendix 1, Table 2, and
  - b. Pass the following tests in RTCA/DO-347, Certification Test Guidance for Small and Medium Sized Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013, as follows:
    - (1) Section 2.3.7 Short-circuit Test of a Cell
    - (2) Section 2.3.9 Short-circuit Test with Protection Disabled (required only for multi-cell batteries)
    - (3) Section 2.3.10 Insulation Resistance Test

*Note: EASA published a [proposed special condition on 'Non-rechargeable Lithium Battery Installations'](#)<sup>1</sup> requiring each individual cell within a battery be designed to maintain safe temperatures and pressures (SC1) . The SC 2 addresses these same issues but at the battery level. SC 2 requires the battery to be designed to prevent propagation of a thermal event (i.e., self-sustained, uncontrolled increases in temperature or pressure) from one cell to adjacent cells.*

- 2) The Airframe Low Frequency ULD with a primary lithium battery by itself or installed in its mounting bracket must pass the Section 2.3.15 Thermal Runaway Containment Test in RTCA/DO-347, Certification Test Guidance for Small and Medium Sized Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013. Do not compromise the integrity of the ULD to instrument or trigger the internal battery. Induce thermal runaway with either a. or b. below then complete c.

<sup>1</sup> <https://www.easa.europa.eu/documents/public-consultations/proposed-special-condition-%E2%80%98non-rechargeable-lithium-battery>

- a. Perform step e. of test method RTCA/DO-347 2.3.15.1 in lieu of RTCA/DO-347 2.3.15.1 steps c. and d. Step b is not required to complete step e. Apply the heating element to the exterior of the Airframe Low Frequency ULD or heat the ULD in a test chamber for this test to maintain the integrity of the item under test. Use of a test chamber heated to just above the triggering temperature will facilitate more accurate measurements of the ULD case temperature during the runaway.
  - b. Alternate method to induce a thermal runaway  
In a cell closest to the center of the battery:
    - (1) Connect the terminals of a single electrically isolated cell to a power supply set to a constant voltage of at least 1.5 times the rated nominal cell voltage and charge with a current limit of I1 (or I<sub>max</sub> if less than I1) of a single cell (+/- 50mA).
    - (2) Monitor the battery voltage during charge and terminate the charge when the peak voltage is reached.
    - (3) Subject the cell to a direct short circuit of less than 5 mOhm.
    - (4) Install the battery into the ULD (and bracket, as necessary) prior to the onset of Thermal Runaway.
    - (5) Monitor and record the battery voltage and current, the ULD case temperature, the ULD bracket temperature and continue with RTCA/DO-347 2.3.15.2 step g.
  - c. For RTCA/DO-347 2.3.15.1 steps g. and h., monitor and record the test chamber temperature and the external temperature of the ULD. Verify post-test that the battery did in fact experience thermal runaway by observing the ULD contained decomposition products akin to those obtained from conducting this test on a bare battery.
- 3) The ULD or the ULD in its mounting bracket must contain all non-gaseous products of 2 above. O-ring residue is acceptable. If any gasses are emitted, they must be emitted through a consistent, repeatable location such as around the closure threads or through a venting port.
- Note 1: SC 3 of the [proposed special condition on 'Non-rechargeable Lithium Battery Installations'](#)<sup>2</sup> does allow explosive and toxic gases to be uncontained and not vented overboard if they do not accumulate in hazardous quantities.*
- Note 2: EASA and the FAA may impose additional special condition requirements for installation. Installers may use ETSO test data, including the battery containment test data as part of the certification package in showing compliance with an EASA or FAA installation special condition.*
- 4) The applicant shall document and make available to EASA and to the installer:
- a. The test results to include the nature and volume of any gasses emitted, maximum case temperature during a thermal runaway, and whether or not the mounting bracket was required to attain containment.
  - b. If venting occurs, the venting location so that installers may design and fabricate appropriate venting systems that will not interfere with the intended function of the ULD as described in the Note at the beginning of this Appendix.
  - c. If the applicant chooses to incorporate a venting port in the ULD and/or ULD mounting bracket, the interface in the installation instructions or drawing.

<sup>2</sup> <https://www.easa.europa.eu/documents/public-consultations/proposed-special-condition-%E2%80%98non-rechargeable-lithium-battery>

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- 5) Develop a means to prevent inadvertent opening of ULDs with failed batteries that may be under internal pressure. This may include voltage or external temperature checks prior to opening the device. The applicant shall include any appropriate cautions and warnings and document them in the installation and maintenance instructions.

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Fire Containment Covers (FCC)

### 1 - Applicability

This ETSO gives the requirements which fire containment covers (FCC) that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in the SAE International AS6453, Fire Containment Cover-Design, Performance, and Testing Requirements, August 2013, as amended by Appendix 1 of this ETSO.

##### 3.1.2 - Environmental Standard

The required performance under the test conditions specified in SAE AS6453 Section 4.6 and Sections 6.1.2 through 6.1.5 as modified in the appendix of this TSO shall be demonstrated.

##### 3.1.3 – Computer Software

None.

##### 3.1.4 - Electronic Hardware Qualification

None.

#### 3.2 - Specific

##### 3.2.1 Failure Condition Classification

N/A

### 4 - Marking

**4.1 - General**

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

**4.2 - Specific**

Each fire containment cover conforming to this Standard shall bear at least the following markings near the bottom edges on the two opposite long sides:

- 'FIRE CONTAINMENT COVER', in bold characters at least 150 mm (6 in) high,
- Substantiated protection time (e.g. 'Minimum protection duration 6 hours'),
- The IATA ULD ID (size) codes for the pallets and nets with which the FCC can be used.
- Expiration date in the format 'EXP YYYY-MM'.

In addition each fire containment cover conforming to this Standard shall bear the markings identified in SAE AS6453 Section 7.3 and Section 7.4 as amended in Appendix 1 of this ETSO.

**5 - Availability of Referenced Document**

See CS-ETSO Subpart A paragraph 3.

**APPENDIX 1.**

**MINIMUM PERFORMANCE STANDARD (MPS) FOR FIRE CONTAINMENT COVERS**

This Appendix prescribes the MPS for Fire Containment Covers. The applicable standard is SAE International AS6453, Fire Containment Cover – Design, Performance, and Testing Requirements dated August 2013 and modified as follows:

<b>AS6453 Section</b>	<b>Action</b>
1.1 – 1.2	Disregard
1.4	Disregard
1.7	Disregard
2	Disregard references to Japanese Airworthiness Standard Part 3 and Civil Aviation Agency of China Regulations CAAC CCAR-25 and CTSO C90
3.2	Disregard second sentence
4.1	Disregard
4.2.1	Disregard Note 4 and Note 6
4.3.1	Add to the end of the sentence “which is sufficiently flexible to allow the FCC to collapse with the fire load”.
4.3.3 – 4.3.6	Disregard
4.4	Disregard
4.5.3	Disregard
4.5.4	Disregard
4.5.6 – 4.5.8	Disregard
4.6.5	Disregard the phrase ‘as part of the required traceability code (see 7.2)’
4.6.7	Disregard
4.7	Disregard
5.1.1	Add ‘seams and corners’ after ‘The fire container cover’s material’.
5.1.1	Disregard references to CCAR-25 and JAS Part 3
5.1.2	Disregard
5.1.3	Disregard
5.2.2	Disregard references to CCAR-25 and JAS Part 3
5.2.4	Disregard
5.3.1	Disregard second sentence
5.3	Disregard
6.1.1.1	Disregard references to CCAR-25 and JAS Part 3
6.1.1.2.b	Disregard references to CCAR-25 and JAS Part 3
6.1.1.5	Add the following sentence to the end of this section ‘The FAA Aircraft Materials Fire Test Handbook includes an allowance for a brief ignition on the upper surface of the test specimen as long as the 400 degree F requirement is not exceeded.’

<b>AS6453 Section</b>	<b>Action</b>
6.1.1.6 – 6.1.1.7	Disregard
6.1.6	Disregard
6.2.1	Replace the words in the end of the second sentence 'paragraph 4.3.2 of the US DOT/FAA/AR-TN05/20 document (see reference [16] in Bibliography).' with the following, 'the bulk load fire scenario section of report US DOT/FAA/TC-TN12/11.'

# European Aviation Safety Agency

## European Technical Standard Order (ETSO)

**Subject:** Aeronautical Mobile Airport Communication System (AeroMACS)

### 1 — Applicability

This ETSO gives the requirements which Aeronautical Mobile Airport Communication System (AeroMACS) that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 — Procedures

#### 2.1 — General

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

#### 2.2 — Specific

None.

### 3 — Technical conditions

#### 3.1 — Basic

##### 3.1.1 — Minimum performance standard

Standards set forth in the EUROCAE ED-223, minimum operational performance standard (MOPS) for aeronautical mobile airport communication system (AeroMACS), dated October 2013.

Note: AeroMACS provides data link communication services over spectrum reserved for aeronautical mobile route services (AMRS). This includes aeronautical operational control (AOC) and non-safety of flight airline administrative communication (AAC) via data link while on the airport surface only. air traffic services (ATS) are excluded from this ETSO. AeroMACS is considered supplemental equipment to communication equipment required by the operating rules. AeroMACS is based on the Institute of Electrical and Electronics Engineers 802.16-2009 standard: Air interface for broadband wireless access systems and can only operate on the airport surface.

##### 3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

##### 3.1.3 — Software

See CS-ETSO, Subpart A, paragraph 2.2.

##### 3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific  
None.

3.2.1 Failure condition classification  
See CS-ETSO, Subpart A, paragraph 2.4.  
Failure of the function defined in paragraph 3.1.1 of this ETSO resulting in misleading data link communication is a minor failure condition. Loss of this function is a minor failure condition.

**4 — Marking**

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

4.2 — Specific  
None.

**5 — Availability of referenced document**  
See CS-ETSO, Subpart A, paragraph 3.

**Changes to Index 2**

**INDEX 2**

<b>EASA ETSO Ref</b>	<b>Title</b>	<b>Last amended by</b>
ETSO-2C11e	Power Plant Fire Detection Instruments (Thermal and Flame Contact Types)	CS-ETSO/Initial Issue
ETSO-2C19bc	Portable Water-Solution Type Hand Fire Extinguishers	CS-ETSO/12
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-2C63c	Airborne Weather and Ground Mapping Pulsed Radars	CS-ETSO/Initial Issue
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-2C78	Crew Member Oxygen Mask	CS-ETSO/3
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-2C128	Devices That Prevent Blocked Channels Used in Two-Way Radio Communications Due to Unintentional Transmissions	CS-ETSO/Initial Issue
ETSO-2C153	Integrated Modular Avionics (IMA) Platform and Modules	CS-ETSO/10
ETSO-2C169a	VHF Radio Communications Transceiver Equipment Operating within the Radio Frequency Range 117.975 to 137 Megahertz	CS-ETSO/6
ETSO-2C197	Information Collection and Monitoring Systems	CS-ETSO/7
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-C207**

**Date : 19.12.2016**

<b>EASA ETSO Ref</b>	<b>Title</b>	<b>Last amended by</b>
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-2C514	Airborne Systems for Non-Required Telecommunication Services (in Non-Aeronautical Frequency Bands) (ASNRT)	CS-ETSO/3
ETSO-2C515	Aircraft Halocarbon Clean Agent — Hand Held Fire Extinguishers	CS-ETSO/11

**New, revised or deleted ETSOs**

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Portable Water-Solution Type Hand Fire Extinguishers

### 1 — Applicability

This ETSO gives the requirements which new models of portable water-solution type hand fire extinguishers that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 — Procedures

#### 2.1 — General

Applicable procedures are detailed in CS-ETSO Subpart A.

#### 2.2 — Specific

None.

### 3 — Technical Conditions

#### 3.1 — Basic

##### 3.1.1 — Minimum Performance Standard

Standards set forth in the SAE Aerospace Standard document: AS245A AS-245B, 'Water Solution Type Hand Fire Extinguisher', dated November 1, 1948, revised December 15, 1956 and supplemented by this ETSO (revised) April 2004, as modified in Appendix 1 of this ETSO.

##### 3.1.2 — Environmental Standard

See CS-ETSO Subpart A paragraph 2.1

##### 3.1.3 — Computer Software:

None.

#### 3.2 — Specific

Following AS-245A paragraphs are supplemented as indicated:

§ 4.1.1: For both types, minimum tank capacity is one (1) liter.

§ 4.1.2: Burst pressure must be equal or greater than „b“ times Design pressure (see following table):

Design pressure is compatible with maximum pressure encountered in use of

extinguisher

and ensures a long service of equipment when charged.

§ 4.3.1: In case of water spray extinguishers, minimum discharge duration is of fifteen (15) seconds.

§ 4.3.2: In case of water spray extinguishers, minimum discharge horizontal distance is of one

and

half (1.5) metre.

§ 5.2: Proof pressure must be equal or greater than „p“ times Design pressure (see following table).

b“ and „p“ factors indicated depend on extinguisher type:

	b	p
Type I	2,7	1,5
Type II	2,4	1,2

none

#### 4 — Marking

##### 4.1 — General

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

Instead of optional serial number the date of manufacture has to be marked.

##### 4.2 — Specific

As specified in the SAE Aerospace Standard document AS245A AS245B paragraph 3.2.

#### 5 — Availability of Referenced Document

See CS-ETSO Subpart A paragraph 3

**APPENDIX 1.**

**MPS FOR PORTABLE WATER SOLUTION TYPE HAND FIRE EXTINGUISHERS**

The applicable standard is SAE AS245B, Water Solution Type Hand Fire Extinguisher, dated (revised) April 2004 shall be modified as follows:

<b>AS245B section</b>	<b>Action</b>									
Paragraph 4.1.2: Burst pressure	to be revised as follows: Burst pressure must be equal or greater than 'b' times Design pressure (see table 1 below). Design pressure is compatible with maximum pressure encountered in use of extinguisher and ensures a long service of equipment when charged.									
Paragraph 5. Individual Performance Requirements:	<p>to be revised as follows: All extinguishers, or extinguisher components shall be subject at a minimum to the following tests:</p> <p>Requirement to be added: proof pressure must be equal or greater than 'p' times Design pressure (see table 1 below).</p> <p>Table 1: 'b' and 'p' factors indicated depend on extinguisher type</p> <table border="1" data-bbox="786 1093 1241 1196"> <thead> <tr> <th></th> <th>b</th> <th>p</th> </tr> </thead> <tbody> <tr> <td>Type I</td> <td>2,7</td> <td>1,5</td> </tr> <tr> <td>Type II</td> <td>2,4</td> <td>1,2</td> </tr> </tbody> </table>		b	p	Type I	2,7	1,5	Type II	2,4	1,2
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