SUBPART A — GENERAL

1. APPLICABILITY

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

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

2. ENVIRONMENTAL AND SOFTWARE STANDARDS TO MEET TECHNICAL CONDITIONS

2.1 Environmental standards

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

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

2.2 Software standards

When the equipment includes airborne software
Unless otherwise stated ~~o~~in paragraph 3.1.3 of the specific ETSO, one acceptable means of compliance for the development of the airborne software is outlined in the latest revision of AMC 20-115 on software considerations in Airborne Systems and Equipment Certification.

Software level also called Item Development Assurance Level (IDAL) may be determined by using the guidance proposed in section 2.4. The applicant must declare the software level(s) to which the software has been developed and verified.

2.3 Airborne electronic hardware (AEH)

If the article contains a complex Application-Specific Integrated Circuit (ASIC) or complex programmable logic (e.g. Programmable Array Logic components (PAL), Field-Programmable Gate Array components (FPGA), General Array Logic components (GAL), or Erasable Programmable Logic Devices) summarised as Complex Electronic hardware to accomplish the function, develop the component according to EUROCAE/RTCA document ED-80/DO-254 'Design Assurance Guidance for Airborne Electronic Hardware', dated April 2000.

Supplemental guidance material for all other Airborne Electronic hardware (including boards, SEH, use of COTS devices) included in the ETSO article may be found in 'EASA CM-SWCEH-001 Development Assurance of Airborne Electronic Hardware' Issue 01 revision 01, dated March 2012.

Design Assurance Level also called Item Development Assurance Level (IDAL) for Airborne Electronic Hardware (AEH) may be determined by using the guidance proposed in section

2.4. The applicant must declare the Design Assurance level (s) to which the AEH has been developed and verified.

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).

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.

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

3. ADDITIONAL INFORMATION

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

3.2 The following addresses are provided below:

— EUROCAE documents may be purchased from:
European Organisation for Civil Aviation Equipment
102 rue Etienne Dolet, 92240 Malakoff, France
Telephone: +33 1 40 92 79 30; Fax +33 1 46 55 62 65;
(E-mail: eurocae@eurocae.net, website: www.eurocae.net)

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

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

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

— FAA Standards may be purchased from:
Superintendent of Documents, Government Printing Office

732N Capitol Street NW, Washington DC 20401, USA
(Website: www.gpoaccess.gov)

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

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

SUBPART B — LIST OF ETSOs (INDEX 1 AND INDEX 2)

Index 1

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

ETS0-C44c A1	Fuel Flowmeters
ETS0-C45b A1	Manifold Pressure Instruments
ETSO-C46a	Maximum Allowable Airspeed Indicator System
ETS0-C47a A1	Pressure Instruments — Fuel, Oil, and Hydraulic (Reciprocating Engine Powered Aircraft)
ETSO-C49b	Electric tachometer: Magnetic Drag (Indicator and generator)
ETSO-C53a	Fuel and Engine Oil System Hose Assemblies
ETSO-C54	Stall Warning Instruments
ETSO-C55a	Fuel and Oil Quantity Instruments
ETS0-C56b A1	Engine-driven Direct Current Generators/Starter generators
ETSO-C59	Airborne Selective Calling Equipment
ETSO-C62e	Aircraft Tyres
ESTO-C64a	Oxygen Mask Assembly, Continuous Flow, Passenger
ETSO-C65a	Airborne Doppler Radar Ground Speed and/or Drift Angle Measuring Equipment (for Air Carrier Aircraft)
ETSO-C68a	Airborne Automatic Dead Reckoning Computer Equipment Utilizing Aircraft heading and Doppler Ground Speed and Drift Angle Data (for Air Carrier Aircraft)
ETSO-C69c	Emergency Evacuation Slides, Ramps and Slide/Rafts Combinations
ETSO-C71	Airborne Static ('DC to DC') Electrical Power Converter (for Air Carrier Aircraft)
ETSO-C72c	Individual Flotation Devices
ETSO-C73	Static Electrical Power Inverter
ETSO-C76	Fuel Drain Valves
ETSO-C79	Fire Detectors (Radiation Sensing Types)
ETSO-C80	Flexible Fuel and Oil Cell Material
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ETSO-C87a	Airborne Low-range Radio Altimeter
ETSO-C88a	Automatic Pressure Altitude Reporting Code Generating Equipment
ETSO-C89	Oxygen Regulators, Demand
ETSO-C90d	Cargo Pallets, Nets and Containers

ETSO-C92c	Ground Proximity Warning, Glide Slope Deviation Alerting Equipment
ETSO-C95a	Mach Meters
ETSO-C96a	Anticollision Light Systems
ETSO-C97	Lithium Sulphur Dioxide Batteries
ETSO-C99	Protective Breathing Equipment
ETSO-C100b	Child restraint system
ETSO-C101	Overspeed Warning Instruments
ETSO-C102	Airborne Radar Approach and Beacon Systems for Helicopters
ETSO-C103	Continuous Flow Oxygen Mask Assembly (for Non-transport Category Aircraft)
ETSO-C105	Optional Display Equipment for Weather and Ground Mapping Radar Indicators
ETSO-C106 A1	Air Data Computer
ETSO-C109	Airborne navigation Data Storage System
ETSO-C110a	Airborne Passive Thunderstorm Detection Systems
ETSO-C112d	Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment
ETSO-C113	Airborne Multi-purpose Electronic Displays
ETSO-C114 A1	Torso Restraint Systems
ETSO-C115c	Flight Management Systems (FMS) using Multi-Sensor Inputs
ETSO-C116	Crew member PBE
ETSO-C117a	Airborne Windshear Warning and Escape Guidance Systems (Reactive Type) for Transport Aeroplanes
ETSO-C118	TCAS I
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ETSO-C121b	Underwater Locating Device
ETSO-C123b	Cockpit Voice Recorders Systems
ETSO-C124b	Flight Data Recorder Systems
ETSO-C126a	406 MHz Emergency Locator Transmitter
ETSO-C127a	Rotorcraft, Transport Aeroplane, and Normal and Utility Aeroplane Seating Systems

ETSO-C132	Geosynchronous Orbit Aeronautical Mobile Satellite Services Aircraft Earth Station Equipment
ETSO-C135a	Large Aeroplane Wheels and Wheels and Brake Assemblies
ETSO-C139	Aircraft Audio Systems and Equipment
ETSO-C141	Aircraft Fluorescent Lighting Ballast/Fixture Equipment
ETSO-C142a	Non-Rechargeable Lithium Cells and Batteries
ETSO-C144a	Passive Airborne Global Positioning System (GNSS) Antenna
ETSO-C145c	Airborne Navigation Sensors Using the Global Positioning System Augmented by the Satellite Based Augmentation System
ETSO-C146c	Stand-Alone Airborne navigation Equipment Using the Global Positioning System Augmented by the Satellite Based Augmentation System
ETSO-C147	Traffic Advisory System (TAS) Airborne Equipment
ETSO-C151b	Terrain Awareness and Warning System (TAWS)
ETSO-C154c	Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment
ETSO-C155a	Recorder Independent Power Supply
ETSO-C157a	Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment
ETSO-C158	Aeronautical Mobile High Frequency Data Link (HFDL) Equipment
ETSO-C159a	Avionics Supporting Next generation Satellite Systems (NGSS) = Iridium Phone
ETSO-C160a	VDL Mode 2 Communications equipment
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ETSO-C162a	Ground-Based Augmentation System Very High Frequency Data Broadcast Equipment
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ETSO-C175	Galley Cart, Containers and Associated Components
ETSO-C176	Crash Protected Airborne Recorder Systems Image Recorder
ETSO-C177	Crash Protected Airborne Recorder Systems CNS/ATM Recorder
ETSO-C178	Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers
ETSO-C179a	Rechargeable Lithium Cells and Lithium Batteries
ETSO-C184	Galley Equipment
ETSO-C190	Active Airborne Global navigation Satellite System (GNSS) Antenna
ETSO-C194	Helicopter Terrain Awareness and Warning System (HTAWS)
ETSO-C195a	Avionics Supporting Automatic Dependent Surveillance-Broadcast (ADS-B) Aircraft Surveillance
ETSO-C196a	Airborne Supplemental navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation
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ETSO-C200	Low-frequency Underwater Locating Device (ULD)

Index 2

ETSO-2C11e	Powerplant Fire Detection Instruments (Thermal and Flame Contact Types)
ETSO-2C19b	Fire Extinguishers, Portable Water Type
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ETSO-2C36f	Airborne ILS Localizer Receiving Equipment Operating within the Radio Frequency Range 108-112 Megahertz
ETSO-2C40c	VOR Receiving Equipment Operating within the Radio Frequency Range of 108-117.95 Megahertz
ETSO-2C41d	Airborne Automatic Direction Finding (ADF) Equipment
ETSO-2C48a	Carbon Monoxide Detector Instruments
ETSO-2C63c	Airborne Weather and Ground Mapping Pulsed Radars
ETSO-2C66b	Distance measuring Equipment (DME) Operating within the Radio Frequency Range 960-1215 Megahertz

ETSO-2C70b	Liferafts (Reversible and Non-reversible)
ETSO-2C75	Hydraulic Hose Assembly
ETSO-2C78	Crewmember Oxygen Mask
ETSO-2C93b	Airborne Interim Standard Microwave Landing System Converter Equipment
ETSO-2C104a	Microwave Landing System (MLS) Airborne Receiving Equipment
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ETSO-2C503	Helicopter Crew and Passenger Immersion Suits for Operations to or from Helidecks Located in a Hostile Sea Area
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ETSO-2C513	Tow Release
ETSO-2C514	Airborne Systems for Non-Required Telecommunication Services (in Non-Aeronautical Frequency Bands) (ASNRT)

ETSO-C44c A1

Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: FUEL FLOWMETERS

1 — Applicability

This ETSO gives the requirements which fuel flowmeters that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

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

2.2 — Specific
None.

3 — Technical conditions

3.1 — Basic
3.1.1 — Minimum performance standard
Standards set forth in **Appendix 1.**

3.1.2 — Environmental standard
The Fuel Flowmeter must be tested in accordance with SAE AS407C *'Fuel Flowmeters'* from July 1, 2001, unless otherwise specified by Appendix 1 to this ETSO, SAE AS1055D *'Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components'* (sections 4 and 5) from June 1997, and the applicable environmental test procedure as specified by paragraph 2.1 of CS-ETSO, Subpart A, unless otherwise specified by Appendix 1 to this ETSO.

3.1.3 —Software
If the equipment design includes a digital computer, see CS-ETSO, Subpart A, paragraph 2.2, for software development.

3.1.4 — Airborne Electronic hardware
See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific
3.2.1 Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

4 — Marking

4.1 — General

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

4.2 — Specific

None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

APPENDIX 1

MINIMUM PERFORMANCE STANDARD FOR FUEL FLOWMETERS

1. General requirements

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

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

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

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

TABLE 1		
INSTRUMENT LOCATION	A	B
Heated Areas (Temp. Controlled)	–30 to 50 ºC	–65 to 70 ºC
Unheated Areas (Temp. Controlled)	–55 to 70 ºC	–65 to 100 ºC
Power Plant Compartment	–55 to 70 ºC	–65 to 100 ºC
Power Plant Accessory Compartment	–55 to 70 ºC	–65 to 100 ºC

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

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

2. Testing your fuel flowmeter

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

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

b. Sealing test Apply this performance test to any hermetically sealed components. Immerse the component in a suitable liquid such as water. Then reduce the absolute pressure of the air above the liquid to about 1 inch of mercury (Hg) (3.4 kPa). Maintain this absolute pressure for 1 minute, or until the liquid stops giving off air bubbles, whichever is longer. Increase the absolute pressure by 2½ inches Hg (8.5 kPa). If any bubbles come from the component case, consider it leakage and reject the component.

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

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

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

ETSO-C45b A1
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: MANIFOLD PRESSURE INSTRUMENTS

1 — Applicability

This ETSO gives the requirements which manifold pressure instruments that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures
2.1. — General
Applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 — Specific
None.

3 — Technical conditions
3.1 — Basic
3.1.1 — Minimum performance standard
Standard set forth in the SAE Aerospace Standard (AS) document: SAE AS 8042 from December 1, 1985, unless otherwise specified by Appendix 1 to this ETSO.

3.1.2 — Environmental standard
The Manifold Pressure Instruments must be tested according to Section 7 of SAE AS 8042 and the environmental test procedures as defined in CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software
If the Manifold Pressure Instruments includes a digital computer, see CS-ETSO, Subpart A, paragraph 2.2, for software development.

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 has been determined to be a major failure condition. The applicant must develop the system to at least the design assurance level commensurate with this failure condition.

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

4.2 — Specific
None.

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

APPENDIX 1

MINIMUM PERFORMANCE STANDARD
FOR MANIFOLD PRESSURE INSTRUMENTS

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

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

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

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

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

ETSO-C47a A1
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: PRESSURE INSTRUMENTS — FUEL, OIL, AND HYDRAULIC

1 — Applicability

This ETSO gives the requirements which fuel, oil, and hydraulic pressure instruments that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

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

2.2 — Specific
None.

3 — Technical conditions

3.1 — Basic
3.1.1 — Minimum performance standard
Standards set forth in the SAE Aerospace Standard (AS) document: SAE AS 408C *'Pressure Instruments — Fuel, Oil, and Hydraulic'* from July 1, 2001, unless otherwise specified by Appendix 1 to this ETSO.
3.1.2 — Environmental standard
Testing fuel, oil, and hydraulic pressure instruments must be in accordance with SAE AS408C section 7 and see CS-ETSO, Subpart A, paragraph 2.1, for environmental test procedures.

3.1.3 —Software
If fuel, oil, and hydraulic pressure instrument includes a digital computer, see CS-ETSO, Subpart A, paragraph 2.2, for software development.

3.1.4 Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.4.

3.2 — Specific
None.

3.2.1 — Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

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

4 — Marking

4.1 — General

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

4.2 — Specific

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

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

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

APPENDIX 1

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

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

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

AS408C	***modification:***
Title	Replace 'Pressure Instruments — Fuel, Oil, and Hydraulic (Reciprocating Engine Powered Aircraft)' Substitute: 'Pressure Instruments — Fuel, Oil, and Hydraulic'.
Section 1.1	Replace '… primarily for use with reciprocating engine powered transport aircraft, …' Substitute: '… for use with civil aircraft, ...'
AS408C section 7	***modification:***
Para 7.13	Use test conditions in SAE AS1055 Rev D, '*Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components'*, dated June 1, 1997, Sections 4 and 5. The following test conditions from the environmental standards mentioned in paragraph 3.1.2 above are added.
Para 7.14	Section 16, Power Input.
Para 7.15	Section 17, Voltage Spike.
Para 7.16	Section 18, Audio Frequency Conducted Susceptibility — Power Inputs.
Para 7.17	Section 19, Induced Signal Susceptibility
Para 7.18	Section 20, Radio Frequency Susceptibility.

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

ETSO-C56b A1
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: ENGINE-DRIVEN DIRECT CURRENT GENERATORS/STARTER GENERATORS

1 — Applicability

This ETSO gives the requirements which engine-driven direct current generators/starter generators that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures
2.1. — General
Applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 — Specific
None.

3 — Technical conditions
3.1 — Basic
3.1.1 — Minimum performance standard
Standards set forth in the SAE Aerospace Standard (AS) document: AS8020, *'Engine-Driven D.C. Generators/Starter Generators and Associated Voltage Regulators'*, dated January 1980 (and reaffirmed by SAE in August 1991).
3.1.2 — Environmental standard
See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software
If the Engine-Driven Direct Current Generator/Starter Generator and the associated voltage regulators include a digital computer, see CS-ETSO, Subpart A, paragraph 2.2, for software development.

3.1.4 — Airborne electronic hardware
See CS-ETSO, Subpart A, paragraph 2.3.
3.2 — Specific
None.

ETSO-C56b A1
Date: 12.07.2013

4 — Marking

4.1 — General

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

4.2 — Specific

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

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

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C87a
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AIRBORNE LOW-RANGE RADIO ALTIMETER

1 — Applicability
This ETSO gives the requirements which Airborne Low-range Radio Altimeter that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures
2.1 — General
Applicable procedures are detailed in CS-ETSO, Subpart A.
2.2 — Specific
None.

3 — Technical conditions
3.1 — Basic
3.1.1 — Minimum performance standard
Standards set forth in the EUROCAE ED-30, Minimum Performance Standards for Airborne Low-Range Radar Altimeter Equipment, dated March 1980 as modified by Appendix 1 to this ETSO.

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

Table 1

Low-Range Radio Altimeter Functional Class	Low-Range Radio Altimeter Class Description	Applicable requirements in ED-30
A	Approach and landing	2.1-2.8, 3.1.1, 3.2.1 (all), 3.3.1
B	Terrain Avoidance (ground proximity warning systems)	2.1-2.8, 3.1.2, 3.2.3 (all), 3.3.2

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

3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 Failure condition classification

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

4 — Marking

4.1 — General

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

4.2 — Specific

None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C87a
Date: 12.07.2013

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

1.0. ED-30 REQUIREMENT MODIFICATIONS

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

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

1.3. ED-30 Paragraph 2.5 (Failure Warning). Add the following sentence to the beginning of ED-30, paragraph 2.5, to clarify that a failure detection system is required: 'A failure detection system must be incorporated in the equipment to indicate to the pilot, and to any systems utilizing the radio altimeter data, of a failure of the radio altimeter to accomplish its intended function because of the following conditions: (1) Loss of power, and (2) Loss of signal or altitude sensing capability when within the manufacturer's stated operating altitude range.'

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

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

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

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

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

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

ETSO-C106 A1
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: AIR DATA COMPUTER

1 — Applicability
This ETSO gives the requirements which air data computers that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures
2.1 — General
Applicable procedures are detailed in CS-ETSO, Subpart A.
2.2 — Specific
None.

3 — Technical conditions
3.1 — Basic
3.1.1— Minimum performance standards set forth in the SAE Aerospace Standard (AS) AS 8002 *'Air Data Computer'*, dated April 1, 1985, as amended by this ETSO:

— Paragraph 4.2 of document AS 8002 shall be deleted and replaced by the following:
— Static source error correction (if applicable)
Unless otherwise noted, outputs may be corrected for static source errors of the specific aircraft model in which the computer is intended to be used.
— The tolerance of correction value produced from the correction profile (correction curve) residing in the computer shall be the sum of the following:
A — ± 15 % of theoretical value of correction or equivalent of ± 8.44 Pa (.0025 inch Hg) static pressure, whichever is greater.
B — Value of correction curve slope times the tolerance of independent variable programming the correction curve.
When testing corrected parameters (altitude, airspeed or Mach) the nominal value of the parameter at each test point indicated in Tables 1, 3 or 4 shall be adjusted to include the correction value with tolerance limits set per A and B above.
— Exception TABLE 3, CALIBRATED AIRSPEED: A looser tolerance of ± 6.5 km/h (3.5 knots) may be used at the 148 km/h (80 knots) reference point.

3.1.2 — Environmental standard
See Subpart A, paragraph 2.1.

3.1.3 —Software
See Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware
See CS-ETSO, Subpart A, paragraph 2.3

3.2 — Specific
None.

4 — Marking

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

4.2 — Specific
None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C112d
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: SECONDARY SURVEILLANCE RADAR MODE S TRANSPONDER

1 — Applicability
This ETSO gives the requirements which Secondary Surveillance Radar Mode S Transponder Equipment that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

Standards set forth in the EUROCAE ED-73E, 'Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders', dated May 2011.

3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne Electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 Failure condition classification

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

4 — Marking

4.1 — General

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

4.2 — Specific

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

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C114 A1
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: TORSO RESTRAINT SYSTEMS

1 — Applicability
This ETSO gives the requirements which torso restraint systems that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

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

2.2 — Specific
None.

3 — Technical conditions
3.1 — Basic
3.1.1 — Minimum performance standard
Standards set forth in the SAE Aerospace Standard (AS) document: AS 8043 *'Aircraft Torso Restraint System'*, dated March 1986.

3.1.2 — Environmental standards
(i) American Society for Testing Materials (ASTM) G23-81, Standard Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.
(ii) ASTM ~~D~~Bl17-73, Standard Method of Salt Spray (Fog) Testing.
(iii) ASTM D756-78, Standard Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions.

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

3.1.4 —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.
- AATCC Chart for Measuring Transference of Color and Standard Test Materials 8-1981 and 1071981 may be purchased from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.
- Federal Test Method Standard 191 Method 5906 may be purchased from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

ETSO-C115c
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

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

1 — Applicability

This ETSO gives the requirements which ~~Airborne Area Navigation Equipment~~ Flight Management Systems (FMS) using Multi-Sensor Inputs that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

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

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

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

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

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

3.2.1 Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

Design the system to the appropriate failure condition classification(s) as detailed in further guidance material dedicated to the different navigation specification (for instance RNP1, LPV, RNP AR…).

4 — Marking

4.1 — General

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

4.2 — Specific

None.

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

ETSO-C121b
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

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

1 — Applicability
This ETSO gives the requirements which Underwater Locating Device (Acoustic) (Self-Powered) that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

Standards set forth in the SAE AS8045A, Minimum Performance Standard for Underwater Locating Devices (Acoustic) (Self-Powered), dated August 2011.

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

Demonstrate the saltwater immersion tests in SAE Document AS8045A, section 5.13, using a seawater solution meeting the requirements of ASTM D1141-98, Standard Practice for the Preparation of Substitute Ocean Water, dated 2008.

3.2.1 — Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

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

4 — Marking

4.1 — General

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

4.2 — Specific

None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C155a
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: RECORDER INDEPENDENT POWER SUPPLY

1 — Applicability

This ETSO gives the requirements which Recorder Independent Power Supply that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

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

— rechargeable lithium cells and lithium batteries,

— digital flight data recorder,

— cockpit voice recorder,

— data link recorder,

— cockpit image recorder.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

Standards set forth in Section 5 of EUROCAE ED-112, Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems, dated March 2003.

3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

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

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

— RIPS location, Chapter 2-5.3.10: We don't require Chapter 2-5.3.10 as part of this ETSO. RIPS location must comply with applicable EASA requirements.

— Equipment Installation and Installed Performance (RIPS) Chapter 5-6.

— Other ED-112 requirements for installation, flight testing, aircraft maintenance, and others that do not pertain to MPS specific criteria.

3.2.1 — Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

4 — Marking

4.1 — General

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

4.2 — Specific

None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C160a
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: VDL MODE 2 COMMUNICATIONS EQUIPMENT

1 — Applicability
This ETSO gives the requirements which VDL Mode 2 Communications equipment that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

Standards set forth in the EUROCAE ED-92B, Minimum Operational Performance Standards for Aircraft VDL Mode 2 Physical, Link, and Network Layer, dated 21/03/2012. ED-92B is identical to RTCA DO-281B.

3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

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

4 — Marking

4.1 — General

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

4.2 — Specific

None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C164
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: NIGHT VISION GOGGLES (NVG)

1 — Applicability
This ETSO gives the requirements which Night Vision Goggles (NVG) that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures
2.1 — General
Applicable procedures are detailed in CS-ETSO, Subpart A.
2.2 — Specific
None.

3 — Technical conditions
3.1 — Basic
3.1.1 — Minimum performance standard
Standards set forth in the RTCA DO-275, Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment, dated 12/10/2001.
3.1.2 — Environmental standard
See CS-ETSO, Subpart A, paragraph 2.1.
3.1.3 —Software
See CS-ETSO, Subpart A, paragraph 2.2.
3.1.4 — Airborne electronic hardware
See CS-ETSO, Subpart A, paragraph 2.3.
3.2 — Specific
3.2.1 Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

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

4 — Marking

4.1 — General

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

4.2 — Specific

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

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C166b A1
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

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

1 — Applicability

This ETSO gives the requirements which Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz) that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

Standards set forth in the EUROCAE ED-102A, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B), dated December 2009, section 2.

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

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

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

Class A equipment includes Classes A0, A1, A1S, A2 and A3. This standard requires 1090 MHz airborne Class A equipment to include the capability of receiving both ADS-B and TIS-B

messages and delivering both ADS-B and TIS-B reports, as well as transmitting ADS-B messages. A receive-only Class of equipment is allowed.
Class B equipment includes Classes B0, B1, and B1S. Classes B0, B1, and B1S are the same as A0, A1, and A1S, except they do not have receive subsystems. Note that Classes B2 and B3 are not for aircraft use.

3.1.2 — Environmental standard

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

3.1.3 —Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 — Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

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

4 — Marking

4.1 — General

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

4.2 — Specific

Transmitting and receiving components must be permanently and legibly marked.

The following table explains how to mark components.

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

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

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C174 A1
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

Subject: BATTERY-BASED EMERGENCY POWER UNIT (BEPU)

1 — Applicability
This ETSO gives the requirements which Battery-based Emergency Power Units (BEPU) that are manufactured on or after the date of this ETSO must meet in order to be identified with applicable ETSO marking.

2 — Procedures

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

2.2 — Specific
None.

3 — Technical conditions
3.1 — Basic
3.1.1 — Minimum performance standard
Standards are given in **Appendix 1.**

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

3.1.2 — Environmental standard
As stated in **Appendix 1,** chapter 2, of this ETSO.

3.1.3 —Software
See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware
See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific
3.2.1 Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

4 — Marking

4.1 — General

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

4.2 — Specific

Product label shall indicate:

- battery capacity (e.g. 20 Amp-Hour (Ah)),
- nominal voltage,
- battery chemistry.

5 — Availability of referenced documents

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C174 A1
Date: 12.07.2013

APPENDIX 1

MINIMUM PERFORMANCE STANDARD
FOR BATTERY-BASED EMERGENCY POWER UNIT (BEPU)

CHAPTER 1: MINIMUM PERFORMANCE STANDARD UNDER STANDARD CONDITIONS

1 — PURPOSE

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

2 — GENERAL REQUIREMENTS

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

(a) Design the BEPU to minimize the risk of causing or spreading a fire.

(b) Storage batteries must be designed and installed as follows: Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge):

- at maximum regulated voltage or power,
- during a flight of maximum duration, and
- under the most adverse cooling condition likely to occur in service.

(c) Demonstrate the above conditions by test, unless your experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures do not present a problem.

(d) Systems like electronic circuits installed in the BEPU must be compatible with the battery chemistry.

(e) During a failure of the normal power source to the emergency electrical bus, the BEPU supplies emergency electrical bus loads without intervention by the flight crew. After re-establishment of the normal power source, the emergency bus loads revert automatically from the BEPU to the normal power source, and the BEPU automatically returns to charging mode. To prevent inadvertent recharging of the BEPU from the aircraft battery when a normal power source is not available, the BEPU shall not enter the recharge mode when the BEPU input (source) voltage is below 24VDC.

(f) Specify the value of voltage spikes occurring when the BEPU is switched on and off and between modes (if applicable).

(g) Any single component failure within the BEPU (either open or short) cannot result in an over voltage condition on the battery.

(h) The BEPU will not have any protection/provision that results in automatic removal of power from the emergency load.

(i) The BEPU will not discharge through the input side of the BEPU.

(j) If the BEPU provides backup power to multiple loads, equip the BEPU with protection provisions that allow for the isolation and removal of excess load on any of its output feeders that draw more than its pre–determined maximum current. This will protect remaining loads in case of a load short circuit.

(k) The BEPU should not drain its battery power when the aircraft power is off.

(l) charge fully the battery before installation. Charge the battery every time the aircraft is powered up, regardless of cockpit switch position.

(m) The charging time from 20 % to 80 % capacity will be less than 3 hours.

(n) Specify the nominal current and the short time maximum current.

(o) Design the BEPU in such a way so that separation devices placed between input, output, and battery will enable the current flow from input to output, even when there is a malfunction with other BEPU components. The separation devices will prevent current flow in the direction from output (respectively the battery) to input, and from output to battery. See Figure A-2 at the end of this appendix. The minimum current rating of the separation devices must be greater than three times the continuous rated output current of the BEPU. Unless provided in the aircraft, design the BEPU to prevent output current greater than 30 milliamperes (mA) from flowing back to battery. The loss (breakdown) of voltage of such separation devices will exceed three times the BEPU rated voltage.

(p) The maximum output voltage ripple cannot exceed the limits stated in MIL-STD-704F. Note that this limit does not include the ripple already on the input line into the BEPU. (See Figure A-3 at the end of this appendix.)

(q) To preclude catastrophic effects of excess temperature, the BEPU will monitor battery temperature during battery–charging cycles, and remove power when over temperature limits are reached. Applications where excessive battery temperature cannot cause catastrophic events do not require monitoring.

(r) If the BEPU contains a battery heater device, a single-fault failure redundancy protection is required to prevent heater runaway.

3 — CAPACITY AND RELATED PARAMETERS

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

(a) BEPU capacity. Specify the value for the nominal capacity in Amp-Hours (Ah) based on a constant discharge current for 1.0 hour. During capacity testing, the output voltage cannot degrade below 20VDC.

(b) BEPU output voltage excursions. Provide graphs of output voltage versus time for the following conditions:

- complete discharge to low voltage dropout point after being fully charged~~.~~;
- complete discharge to low voltage dropout point after being charged to 72 % capacity. This (72 % capacity) represents a BEPU at the end of its life and 90 % state of charge.

(c) BEPU life. Declare the expected battery life based on the number of 100 % discharge cycles on the battery nameplate. Battery life is expired when 80 % of the capacity stated on the nameplate is reached.

(d) BEPU maximum current consumption. Specify the maximum current consumption (excluding external loads) of the BEPU. Maximum current includes charging, heating, and other functionalities performed by electronic circuits.

(e) BEPU output current. Specify the nominal current that can be delivered by the BEPU related to the nominal Ah rating specified in paragraph 3.a of this Chapter 1 'CAPACITY AND RELATED PARAMETERS', and the short time maximum current~~,~~ versus time, if necessary.

4 — MONITOR AND CONTROL

(a) Instrumentation, data read-outs~~,~~ and controls can be provided by support equipment instead of the BEPU.

(b) Design all instrumentation and data read-outs for easy interpretation to avoid misunderstandings.

(c) The BEPU can have (but is not limited to) the following optional controls:

- BEPU Off: Battery power is disconnected from all loads;
- BEPU Arm: Ready to engage power to the loads if aircraft power is lost. The BEPU should be in 'charging mode' unless there is a failure of the emergency bus~~.~~;
- BEPU On/Engage: Causes the battery to be applied to the loads. The BEPU should be in 'charging mode' unless during failure of the emergency bus.

(d) Provide a test function for pre-flight check, showing the system function and battery status. The battery is considered good with 80 % state of charge. We recommend an in-flight low battery warning indication. Perform a lamp test where the checked segments are lighted.

CHAPTER 2: MINIMUM PERFORMANCE STANDARD UNDER ENVIRONMENTAL TEST CONDITIONS

1 — GENERAL

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

2 — PERFORMANCE TESTS

The following environmental tests verify BEPU operations based on manufacturer specifications and requirements under extreme environmental conditions. If the manufacturer's specifications during these tests are different than those recorded under benign environmental conditions as specified in paragraph 3 of Chapter 1 of this Appendix,

the manufacturer will specify the modified rating and under what condition such ratings would occur. For the following tests determine compliance of the BEPU with the manufacturer's nominal ratings (unless otherwise specified) as referenced in paragraph 3 of Chapter 1 of this Appendix except when otherwise noted, charge the batteries to at least 80 % of manufacturer's rated capacity before conducting these tests:

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

For the applicable environmental test requirements see ETSO, Subpart A, paragraph 2.1:

(a) Section 4, Temperature and Altitude.

- Operating Low Temperature Test. You may use an internal battery heater for this test.
- Operating High Temperature Test.
- Altitude Test.
- Decompression Test.
- Overpressure Test.

(b) Section 5, Temperature Variation. Combine this test with Section 4 Testing Requirements.

(c) Section 6, Humidity.

(d) Section 7, Operational Shocks and Crash Safety. After this test, the equipment must remain in its mounting with no part of the equipment or its mounting becoming detached and free on the shock test table. Measure and record the BEPU capacity after completion.

NOTE: These tests may damage the equipment. Therefore, these tests may be conducted last.

(e) Section 8, Vibration. While the equipment is subjected to this test, ensure that all mechanical devices operate satisfactorily and that the mechanical construction remains undamaged.

(f) Section 9, Explosion Proofness. Required only if the BEPU contains components that are known to cause inductive arcing.

(g) Section 10, Water Proofness (if required).

(h) Section 11 Fluids Susceptibility (if required). Not mandatory for ETSO approval.

(i) Section 12, Sand and Dust (if required).

(j) Section 13, Fungus Resistance (if required). Compliance by analysis is acceptable.

(k) Section 15, Magnetic Effect.

(l) Section 16, Power Input.

(m) Section 17, Voltage Spike. During and after this test, no failed parts must exist, including any degradation on component voltage and current ratings. No parasitic or transient mode switching can result from this test.

(n) Section 18, Audio Frequency Conducted Susceptibility — Power Inputs. Conduct by charging the BEPU when its capacity is between 0 % and 75 %. No parasitic or transient mode switching can result from this test.

(o) Section 19, Induced Signal Susceptibility. No parasitic or transient mode switching can result from this test.

(p) Section 20, RF Susceptibility. No parasitic or transient mode switching can result from this test.

(q) Section 21, Emission of RF Energy. Conduct while BEPU is being charged. Charge must be between 0 % and 75 % of capacity during this test.

(r) Section 22, Lightning Induced Transient Susceptibility. No parasitic or transient mode switching can result from this test.

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

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

(u) Section 25, Electrical Discharge.

CHAPTER 3: ELECTRICAL TEST PROCEDURES

1 — GENERAL

Electrical test procedures covered under environmental test conditions in Chapter 2 of this Appendix are conducted according to the test procedures outlined below.

2 — GENERAL TEST CONDITIONS

Unless otherwise specified, the following test conditions apply:

(a) Conduct all tests under conditions of ambient room temperature (except sections 4, 5 and 6) and ambient pressure and humidity as outlined in Section 1, Paragraph 3.

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

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

3 — SPECIFIC TEST CONDITIONS

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

(a) Lamp test: All segments lighted.

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

4 — ALIGNMENT, ADJUSTMENT AND CALIBRATION PRIOR TO TEST

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

5 — TEST EQUIPMENT

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

CHAPTER 4 : DESCRIPTION OF A BEPU

1 — GENERAL

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

2 — PARTS OF A BEPU

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

(a) An indicator/test switch gives information on the battery status of the BEPU before commencing flight.

(b) Figure A-1 block diagram illustrates the description of the BEPU functionality. It does not define a requirement.

(c) Figure A-2 depicts an example BEPU current flow.

(d) Figure A-3 depicts a recommended measurement of BEPU output voltage ripple.

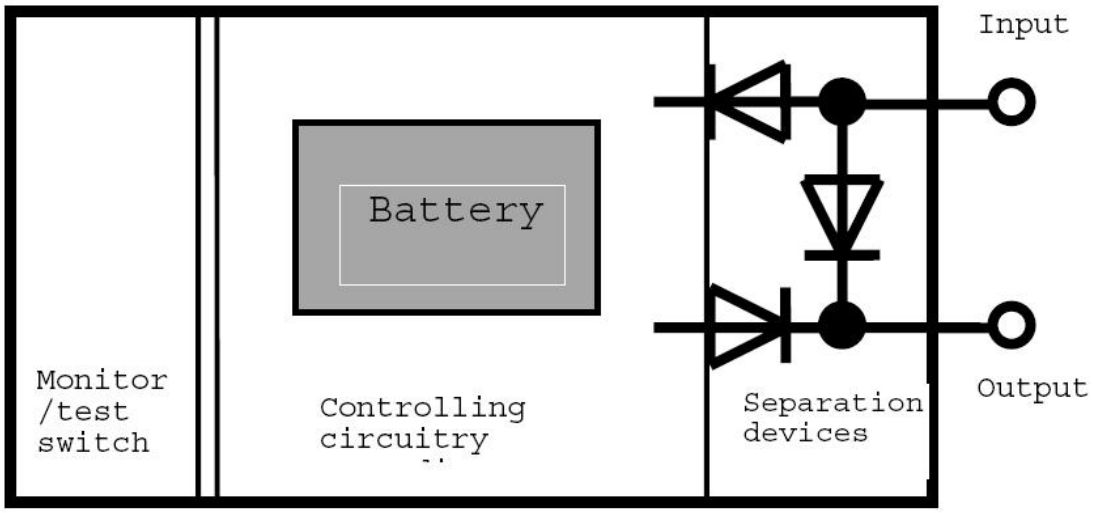

Figure A-1: BEPU Block Diagram

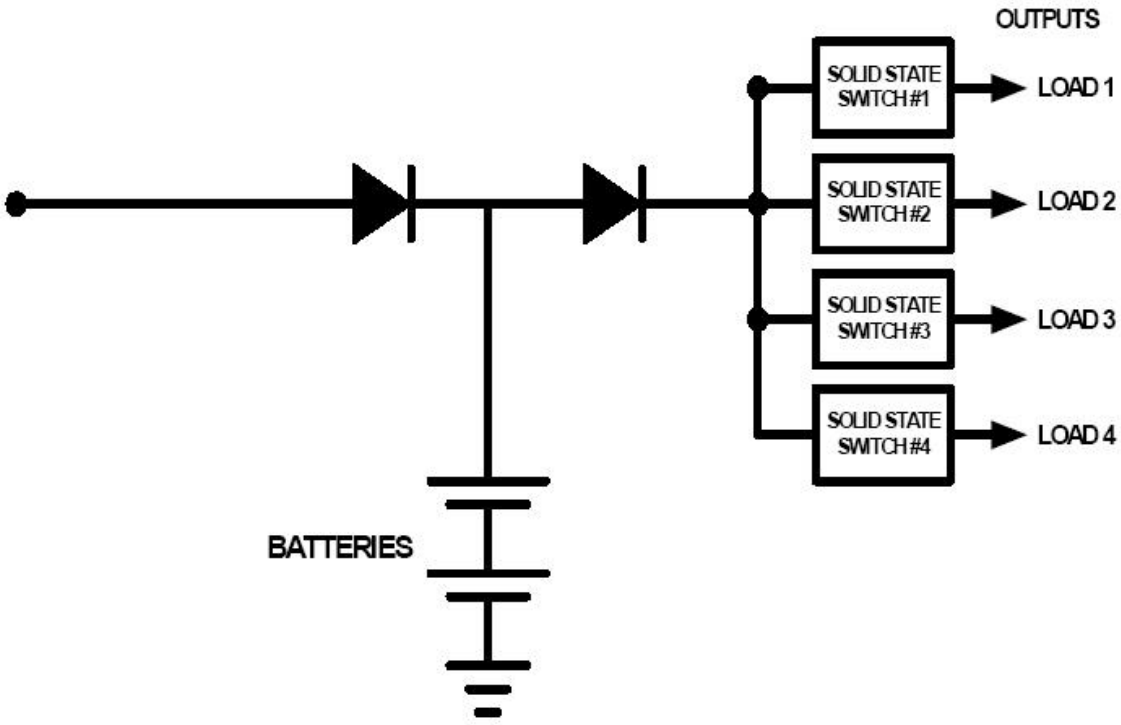

Figure A-2: An example BEPU Current Flow

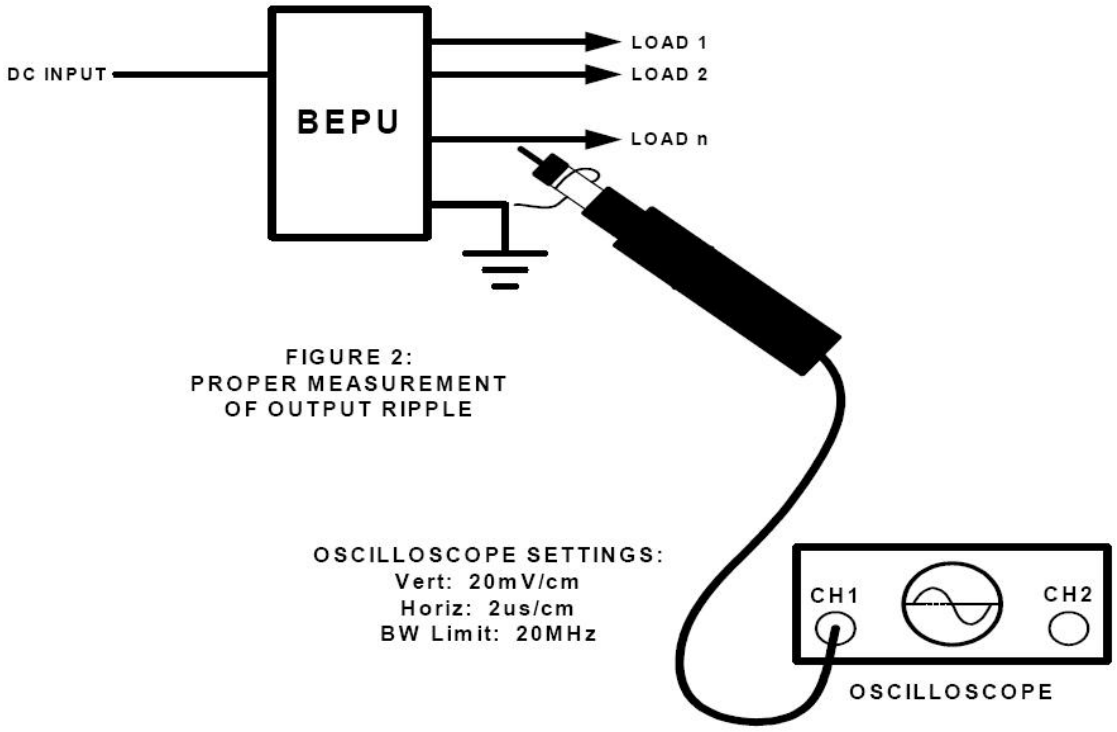

Figure A-3: Recommended Measurement of BEPU Output Voltage Ripple

ETSO-C178
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

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

1 — Applicability
This ETSO gives the requirements which Single Phase 115 VAC, 400 Hz Arc Fault Circuit Breakers that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

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

3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

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

4 — Marking

4.1 — General

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

4.2 — Specific

None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C198
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

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

1 — Applicability

This ETSO gives the requirements which Automatic Flight Guidance and Control System (AFGCS) Equipment that are manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard

Standards set forth in the RTCA DO-325, Automatic Flight Guidance and Control Systems and Equipment, dated 08/12/2010.

3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 Failure condition classification

See CS-ETSO, Subpart A, paragraph 2.4.

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

4 — Marking

4.1 — General

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

4.2 — Specific

None.

5 — Availability of referenced document

See CS-ETSO, Subpart A, paragraph 3.

ETSO-C200
Date: 12.07.2013

European Aviation Safety Agency

European Technical Standard Order (ETSO)

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

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

2 — Procedures

2.1 — General

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

2.2 — Specific

None.

3 — Technical conditions

3.1 — Basic

3.1.1 — Minimum performance standard
Standards set forth in the SAE document AS6254 Minimum Performance Standard for Low-Frequency Underwater Locating Devices (Acoustic) (Self-Powered), dated February 2012.

3.1.2 — Environmental standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 —Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 — Airborne electronic hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 — Specific

3.2.1 Failure condition classification
See CS-ETSO, Subpart A, paragraph 2.4.

Failure 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.