



The European Organisation for Civil Aviation Equipment
L'Organisation Européenne pour l'Équipement de l'Aviation Civile

MINIMUM OPERATIONAL PERFORMANCE SPECIFICATION FOR ALTIMETRY FUNCTION

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CHAPTER 1

GENERAL

1.1 PURPOSE AND SCOPE

This minimum operational performance specification covers altimetry function.

It is designed to ensure that compliant equipment for altimetry function will meet the performance standard required to support Reduced Vertical Separation Minima (RVSM) operation throughout the operational life of the system.

Chapter 1 of this document provides information required to understand the need for the equipment characteristics and tests defined in the remaining chapters. It describes typical equipment applications and operational objectives and is the basis for the performance criteria stated in Chapter 2 to Chapter 4. Definitions and acronyms essential to proper understanding of this document are also provided in Chapter 1.

Chapter 2 contains general design requirements.

Chapter 3 contains the minimum performance specification for the equipment, defining performance under standard operating conditions.

Chapter 4 describes the environmental test conditions and recommended test procedures to provide a laboratory means of determining the overall performance characteristics of the equipment that may be encountered in actual operations.

Chapter 5 describes recommended test procedures for demonstrating compliance with Chapters 3.

Appendices provide additional information as referenced by the chapters.

1.2 APPLICATIONS

Compliance with this minimum operational performance specification by manufacturers, installers and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended function(s) under all conditions normally encountered in routine aircraft operations.

Any regulatory application of this document in whole or in part is the sole responsibility of appropriate government agencies.

As the measured values of equipment performance characteristics may be a function of the method of measurement, standard test conditions and methods of test are recommended in this document.

1.2.1 Mandating and Recommendation Phrases

1.2.1.1 "Shall"

The use of the word "Shall" indicates a mandated criterion; i.e. compliance with the particular procedure or specification is mandatory and no alternative may be applied.

1.2.1.2 "Should"

The use of the word "Should" (and phrases such as "It is recommended that..." etc.) indicates that though the procedure or criterion is regarded as the preferred option, alternative procedures, specifications or criteria may be applied, provided that the manufacturer, installer or tester can provide information or data to adequately support and justify the alternative.

1.3 DESCRIPTION OF SYSTEM

An Air Data System provides all air data parameters to the aircraft based on pressure, temperature and airflow angle measurement.

This MOPS is only focused on the altimetry function of the air data system.

Altimetry function is the determination of aircraft altitude from static pressure. Altimetry performance shall enable the aircraft to comply with RVSM regulation. Other inputs to the function, e.g. SSEC, may be necessary to meet the required installed performance, but the SSEC determination is out of the scope of this MOPS.

The altimetry function can be hosted in one or more LRU depending on the aircraft air data system architecture. In the document this will be named: Altimetry Function Equipment (AFE).

1.4 COMPOSITION OF EQUIPMENT

The Altimetry function is supported by an AFE that can be composed of one or more LRU. Appendix A gives examples of potential AFE architectures.

Whatever the architecture, the AFE consists of the following:

1. One or more units equipped with an electrical connector and/or pneumatic fittings
2. Pressure cells
3. One or more electronic assemblies that perform the following functions:
 - Sensor functions (control of sensor cell and outputs)
 - Processing functions (acquisition, measurement control, calculation of absolute pressure parameters, correction of absolute pressure parameters, calculation of altitude)
 - Digital output
 - Power supply filtering and regulation.

1.5 ABBREVIATIONS AND DEFINITIONS

ABBREVIATIONS

ADIRU	: Air Data Inertial Reference Unit
ADC	: Air Data Computer
ADM	: Air Data Module
AFE	: Altimetry Function Equipment
ALT	: Altitude
ASE	: Altimetry System Error
ATP	: Acceptance Test Procedure
BITE	: Built In Test Equipment
°C	: Degree Celsius
CNS	: Communication Navigation Surveillance
DAL	: Design Assurance Level
DITS	: Digital Information Transfer System
EASA	: European Aviation Safety Agency
EMC	: Electromagnetic Compatibility
EMI	: Electromagnetic Interference
ESD	: Electrostatic Discharge / Electrostatic Sensitive Device
ETSO	: European Technical Standard Order
EUROCAE	: European Organisation for Civil Aviation Equipment
FAA	: Federal Aviation Administration
FAR	: Federal Aviation Requirement
FHA	: Functional Hazard Assessment
FMEA	: Failure Mode and Effects Analysis
hPa	: Hectopascal

I/O	: Input / Output
LRU	: Line Replaceable Unit
MOPS	: Minimum Operational Performance Specification
MTBF	: Mean Time Between Failure
MTBUR	: Mean Time Between Unscheduled Removal
P/N	: Part Number
PSSA	: Preliminary System Safety Assessment
RTCA	: RTCA Inc
RTCP	: Return to Calibration Period
RTCV	: Return to Calibration Value
RVSM	: Reduced Vertical Separation Minima
SAE	: SAE International
SSA	: System Safety Assessment
SSEC	: Static Source Error Correction
TBC	: To Be Confirmed
TBD	: To Be Defined
TSO	: Technical Standard Order

DEFINITIONS

Air Data Module	Equipment which, when connected to sources of aircraft electrical power and static air pressure, provides an output signal corresponding to the pressure sensed at the static air source. The signal is further processed by other equipment to derive, in particular, pressure altitude corrected for static source error; pressure altitude, baro-corrected; and pressure altitude reporting.
Altimetry System Error	The difference between the pressure altitude displayed to the flight crew when referenced to the International Standard Atmosphere ground pressure setting (1013.2 hPa /29.92 in.Hg) and free stream pressure altitude.
Pressure Altitude	Altitude from pressure measurement referenced to standard pressure (1013.25 hPa / 29.92 in.Hg)
Return to Calibration Period	The maximum permitted interval between accuracy checks of air data computers and air data modules that would ensure, with an acceptable level of confidence, that the RVSM budget error assigned to their pressure sensing equipment is not exceeded.
Return to Calibration Value	A permitted error limit for the output signal, both pressure altitude for an air data computer, and the sensed pressure value for an air data module, which, if exceeded, maintenance action is required and equipment recalibration. Since the permitted error is a function of altitude, RTCV will normally be a table of values.

1.6

REFERENCES

ARINC 429	Mark 33 Digital Information Transfer System (DITS)
ARP4761	Guidelines and Methods of Conducting the Safety Assessment Process on Civil Airborne Systems
AS8002A	Air Data Computer – Minimum Performance Standard
EUROCAE ED-12C	Software Considerations in Airborne Systems and Equipment Certification (see also RTCA/DO-178C)
EUROCAE ED-14G	Environmental Conditions and Test Procedures for Airborne Equipment (see also RTCA/DO-160G)
EUROCAE ED-79A	Guidelines for Development of Civil Aircraft and Systems (see also ARP4754A)
EUROCAE ED-80	Design Assurance Guidance for Airborne Electronic Hardware (see also RTCA/DO-254)
EUROCAE ED-140	Minimum Operational Performance Specification for Air Data Modules
FAR Part 91.180	Operations within airspace designated as Reduced Vertical Separation Minimum airspace.
EASA CS-ACNS	Certification Specifications and Acceptable means of compliance for Airborne Communication Navigation Surveillance

CHAPTER 2

GENERAL DESIGN REQUIREMENTS

2.1 INTRODUCTION

This chapter establishes the design considerations and general specification for the Altimetry function.

2.2 AIRWORTHINESS AND CERTIFICATION

The AFE shall not, under normal or fault conditions, impair the airworthiness of the aircraft in which it is installed.

2.3 CONTROLS

Controls, which are not to be adjusted in flight, shall not be readily accessible to flight personnel.

2.4 EFFECTS OF TESTS

Unless otherwise stated, the design of the equipment shall be such that, during and after the application of the specified tests, no condition exists which would be detrimental to the subsequent performance of the equipment.

2.5 SYSTEM, SOFTWARE AND HARDWARE DESIGN MANAGEMENT

Guidance may be found in document EUROCAE ED-79A "Guidelines for development of civil aircraft and systems".

2.5.1 Software Development Assurance

Software development processes shall follow the guidelines of document EUROCAE ED-12C "Software Considerations in Airborne Systems and Equipment Certification". A Software Design Assurance Level shall be declared taking account of the intended use of any AFE in the aircraft. In many cases, AFE provides primary data required for safe operation of the aircraft. Thus, Software Design Assurance Levels shall be compatible with the required system integrity as determined by the installer's System Safety Assessment process.

2.5.2 Hardware Design Assurance

Electronic hardware design processes shall follow the guidelines of document EUROCAE ED-80 "Design Assurance Guidance for Airborne Electronic Hardware". Hardware Design Assurance Levels shall be declared taking account of the intended use of the AFE in aircraft. In many cases, AFE provides primary data required for safe operation of the aircraft. Thus, the Hardware Design Assurance Level shall be compatible with the required system integrity as determined by the installer's System Safety Assessment process.

2.6 STATUS MONITORING

The AFE design shall provide data on the AFE status to support the aircraft system level requirement for fault detection. Input conditions and faults that prevent the equipment from satisfying the requirements of this document shall be indicated in a positive and conspicuous manner.

AFE status monitoring and reporting shall be developed to provide integrity monitoring of the functions provided by the equipment. The monitoring and reporting shall be sufficient to satisfy the safety objectives from the FHA and the derived safety requirements from the PSSA.

Development guidelines are provided in ED-79A and a safety assessment processes is detailed in ARP4761.

Pressure events that could derange or damage the pressure sensor when the equipment is powered should be recorded by the equipment for maintenance purposes.