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Environmental Conditions and Test Procedures for Ground Based Equipment

RTCA DO-380
June 11, 2020

Prepared by: SC-135
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FOREWORD

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- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;

- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and

- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

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RTCA/DO-380

Environmental Conditions and Test Procedures for Ground Based Equipment

Section 1

Purpose and Applicability

Section 2

Definitions of Terms

Section 3

Conditions of Tests

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1 PURPOSE AND APPLICABILITY

1.1 Scope

This document defines a series of minimum standard environmental test conditions (categories) and applicable test procedures for ground based equipment. In this document ground based equipment includes stationary ground, mobile/portable ground, or sea-based equipment. The purpose of these tests is to provide a laboratory means of determining the performance characteristics of ground based equipment in environmental conditions representative of those which may be encountered in ground based operation of the equipment.

1.2 Purpose of the Procedures

The standard environmental test conditions and test procedures contained herein may be used in conjunction with applicable equipment performance standards as a minimum specification under environmental conditions, which can ensure a sufficient degree of confidence in performance during operations.

In each of the test procedures contained herein, the following phrase will be seen several times:

DETERMINE COMPLIANCE WITH APPLICABLE EQUIPMENT PERFORMANCE STANDARDS.

The "applicable equipment performance standards" referred to are either:

1. EUROCAE Minimum Operational Performance Specifications (formerly Requirements) (MOPS/MOPR).
2. RTCA Minimum Performance Standards (MPS) and/or RTCA Minimum Operational Performance Standards (MOPS).
3. SAE Minimum Performance Standards (MPS).
4. The manufacturers equipment specification(s), where applicable.

Some of the environmental conditions and test procedures contained in this document are not necessarily applicable to all ground based equipment. The selection of the appropriate and/or additional environmental conditions and test procedures is the responsibility of the writers (authors) of the performance standards for the specific ground based equipment.

Notes:

1. *There are several additional environmental conditions (categories), that specific ground based equipment may need to be evaluated against, that have not been included in this document. These include but are not limited to: electromagnetic pulse (EMP), atmospheric radiation, or projectile impact.*
2. *The procedures for testing ground based equipment for special environmental conditions that are usually uniquely related to that specific type of ground based equipment, should be the responsibility of the writer (author) of the performance standard for that specific equipment.*
3. *The International System of Units (SI) is usually used throughout this document as the primary values. In certain instances, however, when the primary values were derived in US units, these units are used as the primary values.*
4. *Subject to the provisions of Subsection 3.3, it is permissible to use more than one test article.*

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The words ground based equipment, as used within this document, have direct applicability to most ground based equipment. It is the responsibility of those who wish to apply the test conditions and procedures contained in this document to determine the applicability of these test conditions and procedures to a specific equipment intended for installation on, or within, a specific or general class or type of ground based equipment.

Minimum operational performance standards (MOPS) prepared by RTCA, Inc. for ground based equipment contain requirements that the equipment must meet to ensure reliable operation in actual installations. These equipment requirements must be verified in ambient and stressed environmental conditions. The MOPS typically contain recommended bench test procedures for ambient conditions, and refer to RTCA Document DO-380, "Environmental Conditions and Test Procedures for Ground based Equipment," for the stressed environmental testing. The test categories defined in DO-380 are intended to encompass the full spectrum of environmental conditions that ground based equipment may experience – from benign to very hostile.

The environmental conditions and test procedures defined herein are intended to determine only the performance of the ground based equipment under these environmental conditions and are not intended to be used as a measure of service life of the ground based equipment subjected to these tests.

Any regulatory application of this document is the sole responsibility of appropriate governmental (regulatory) agencies.

1.3 Historical Note, and General Guidance to Users

An example Unmanned Aircraft System (UAS) is unique in that it has airborne and ground based installations. The document is based on RTCA/DO-160()/EUROCAE ED-14() and addresses the ground based environments. DO-160()/ED-14() has been used as a standard for environmental qualification testing since 1975. It has been referenced in Minimum Operational Performance Specifications (MOPS) for specific equipment designs, and is referenced in FAA Advisory Circulars as a means of environmental qualification for TSO authorization. It has been subject to a continuous process of upgrade and revision as new needs arose within the aviation community, as improved test techniques have emerged, and as the realities of equipment operation of under actual environmental conditions has become better understood. DO-160()/ED-14() is used for the airborne installations for UAS. DO-380 is used for the ground based installations. Applicable MOPS for UAS may reference DO-160()/ED-14() or DO-380. It is intended that equipment previously tested to DO-160/ED-14 revision E or later, meets DO-380, if the environment in DO-380 is equivalent or less stringent. If a category that is present in DO-380, but not in DO-160/ED-14 revision E or later, and is required for the equipment, then this equivalency does not apply.

Environmental stresses can result from natural forces or man-made effects and may be mitigated by details of the equipment installation. The categories that have been developed over time reflect a reasonably mature understanding as to the severity of the stresses, the degrees of mitigation achievable in the design of an installation, and the robustness that must be designed into equipment in order to perform under the resultant stress. In order to fully reap the advantages of the maturity of this document, it is incumbent upon the designers of the installed equipment, as well as the designers of the host installation, to consider the categories defined herein as early in their programs as feasible. The categories defined within each environmental test procedure have proved to be a practical set of boundary conditions between the requirements of real-world installations and the performance of installed equipment.

2 DEFINITIONS OF TERMS, GENERAL

2.1 Scope

This section contains the definitions of general terms that are utilized throughout this document. The definition of terms specific to a particular section may be found in the appropriate section.

2.2 Equipment Temperature Stabilization

2.2.1 Not Operating

The equipment is considered temperature stabilized when the temperature of the functioning parts of the test item considered to have the longest thermal lag are within 3 °C of the specified test temperature. When temperature measurement of the largest internal mass is not practical, the minimum time considered applicable for temperature stabilization shall be three hours.

2.2.2 Operating

The equipment is considered temperature stabilized when the functioning parts of the test item considered to have the longest thermal lag do not vary by more than 2 °C per hour. When temperature measurement of the largest internal mass is not practical, the minimum time considered applicable for temperature stabilization shall be two hours.

2.3 Maximum Duty Cycle

When operation of an equipment is periodic, the maximum duty cycle is the relationship between the maximum length of time for which the equipment is designed to operate at its rated capacity and the length of time during which the equipment is not operating; or when the operating capacity is at a defined minimum. The maximum duty cycle shall be established by the equipment specification.

2.4 Not Operating

Not operating is that condition wherein no power is applied to the equipment unless otherwise defined in the individual equipment specification.

2.5 Controlled or Uncontrolled Temperature Locations

A controlled temperature location is defined as a space within a ground based equipment environment in which the temperature of the air is maintained by an environmental control system between +15C to +35C and the relative humidity of the air is less than 85%. An uncontrolled temperature location is defined as outside of this range.

2.6 Total Excursion

Total excursion means the total displacement from positive maximum to negative maximum.

2.7 Equipment

The term “equipment” includes the test items and all of the components or units necessary (as determined by the equipment manufacturer) for the equipment to properly perform its intended function(s). The equipment shall be representative of the production standard that will be utilized in service. Equipment Under Test (EUT) is used throughout the document to identify the hardware, component, or system under test.

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