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Minimum Operational Performance Standards (MOPS) For Airborne Weather Radar Systems

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FOREWORD

This document was prepared by Special Committee 230 (SC-230) and approved by the RTCA Program Management Committee (PMC) on March 17, 2016. It supersedes RTCA DO-173, dated November 19, 1980; RTCA DO-220 dated September 21, 1993; and Change 1 to DO-220 dated June 23, 1995. Change 1 to DO-220A was also prepared by Special Committee 230 (SC-230). It was approved by the RTCA Program Management Committee (PMC) on August 17, 2018.

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EXECUTIVE SUMMARY

Since the last revision to DO-220, there have been many technological advances in the field of airborne weather radar. DO-220A incorporates updates and corrections to the previous version. In addition to modernizing the requirements and test procedures for the weather, ground mapping, and predictive windshear functions set out in its predecessors, SC-230 has added specifications for radar detection of turbulence and atmospheric threat awareness. Any of these functions may be implemented individually or in combination with any others. DO-220A has been designed such that the requirements and test procedures for each function are grouped into distinct sections to facilitate testing and showing of compliance.

Change 1 of this document implements the following changes:

Page	Section or Item	Description of Change
5	1.8 References	Updated instructions on where to find PWS and Turbulence datasets.
20 21	2.2.3.14 Windshear Alert Levels 2.2.3.15 Windshear Alerts and Icons	Clarified that PWS advisory alerts are optional.
22	2.2.3.16 Windshear Alert Inhibits	Approach inhibit region requirements are now different for warning vs. caution alerts. Allow the use of automatic range scaling for caution alerts. Updated associated test procedure.
23 47 59	2.2.3.20 Windshear Detection Flight Evaluation 2.4.3.3.20 Windshear Penetration Flight Evaluation 3.3.3.3.2 Penetration Flight Evaluation	Changed paragraph titles to Windshear Detection Flight Evaluation. Also changed references to penetration flights to windshear detection flights throughout (2.4.3.3.3, 2.4.4.1, 3.3.3.3.2.) Added Notes under 2.4.3.3.20 & 3.3.3.3.2, to explain nomenclature.
29	Table 2-5: Performance Test Requirements for Environmental Tests	Removed note 2 associated with humidity testing. The STC performance test associated with the Temperature Variation environment is now After, rather than During the condition. Performance tests during Op Shock are now After, rather than During the condition. Removed requirement for ATP after crash safety test. Performance tests during ESD are now After, rather than During the condition. Added a note (7) associated with ESD testing.

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1 PURPOSE AND SCOPE

1.1 Introduction

This document contains Minimum Operational Performance Standards for Airborne Radar Systems that may include any combination of the following functions: weather detection, ground mapping, forward-looking windshear detection, forward-looking turbulence detection, or atmospheric threat awareness capability.

These standards specify system characteristics that should be useful to designers, manufacturers, installers, and users of the equipment. The requirements defined in Subsection 2.1 and Paragraphs 2.2.1, 2.2.2, and 2.2.5 of this MOPS are applicable to both rotorcraft and fixed-wing aircraft. Paragraph 2.2.5 can be used to address the indication of turbulent conditions or microburst events ahead of the aircraft for rotorcraft. This document does not define the MOPS for forward-looking windshear or turbulence detection capability for rotorcraft.

Compliance with these standards is one means of assuring that the equipment will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operation. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

Section 1 of this document provides information needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections. It describes typical equipment operations and operational goals, as envisioned by the members of Special Committee 230, and establishes the basis for the standards stated in Sections 2 and 3. This section also contains definitions and assumptions essential to proper understanding of this document.

Section 2 contains the Minimum Performance Standards for the equipment. These standards specify the required performance under standard environmental conditions. Also included are recommended test procedures necessary to demonstrate equipment compliance with the stated minimum requirements.

Section 3 describes the performance required of installed equipment. Tests for the installed equipment are included when performance cannot be adequately determined otherwise.

Section 4 describes the operational performance characteristics for equipment installations and defines conditions that will assure the equipment user that the expected operational environment will allow safe and reliable operation of the equipment.

Appendix A, a normative appendix, describes the windshear database developed for the certification testing of airborne forward-looking windshear detection systems, and defines the test scenarios used for this testing. It also includes considerations associated with the use of the windshear test set-up

Appendix B, an informative appendix, includes plots associated with the windshear data sets.

Appendix C, a normative appendix, describes the analytical technique for evaluation of windshear missed events and nuisance alerts.

Appendix D, an informative appendix, contains historical information and derivations that may be useful to the radar designer.

The word “equipment” as used herein includes all components or units necessary (as determined by the equipment manufacturer or installer) for the equipment to properly perform its function. For example, the airborne radar "equipment" may include a radome, an antenna, antenna mounting, transmission line, a receiver/transmitter unit, a

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control/display unit, shock mounts, etc. In this illustrative example, all these components or units comprise the "equipment." It should not be inferred from the example that every equipment configuration will necessarily include (or be limited to) all these components or units. This will depend on the design chosen by the equipment manufacturer and the techniques of the installer.

Throughout this document, refer to the latest available revision of all reference material unless otherwise specified.

1.2 System Overview

A weather radar system is equipment that actively senses both meteorological and non-meteorological targets, depending on the operational mode. A weather radar system can be a valuable tool to help the flight crew make informed decisions and potentially avoid hazardous situations due to heavy/extreme precipitation, windshear, turbulence, or other atmospheric threats. The radar system may include various combinations of components such as a control panel, antenna mounting, antenna, display, receiver/transmitter, and associated software. Note that either the equipment manufacturer or another entity (e.g., integrator) may provide the controller.

Radar installations may include a dedicated display or may share a display with other aircraft systems. Most radar installations will share a multipurpose display such as an Electronic Flight Instrument System. For airborne radar systems with this architecture, the display requirements set forth in this document apply to the shared display device when used for displaying radar information.

1.3 Intended Function

The intended functions of the weather radar system described in this document fall into five general categories.

- Weather Detection
- Ground Mapping
- Forward Looking Windshear Detection
- Forward Looking Turbulence Detection
- Atmospheric Threat Awareness

The radar system manufacturer may choose to implement equipment providing these capabilities in any combination. If the system provides multiple functions simultaneously, for instance weather detection and windshear detection, then the minimum performance standards for each function should be met at all times.

The standards prescribed in this MOPS are thus grouped according to the corresponding intended function such that they can be applied to the functions implemented in the equipment.

Title 14 Code of Federal Regulations (14 CFR) or European Aviation Safety Agency (EASA) Certification Specification (CS) Sections 23.1309, 25.1309, 27.1309, and 29.1309 specify design requirements based on functional hazard categorizations. The latest revisions of Advisory Circulars AC 23.1309-1, 25.1309-1, AC 27-1, and AC 29-2 provide a basis for evaluation of the effects of the loss or malfunction of these functions.

Note: The effect of loss or malfunction should be considered at the aircraft level and at the equipment level as it may contribute to the aircraft level effect.