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Minimum Operational Performance Standards (MOPS) for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

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FOREWORD

This document was prepared by RTCA Special Committee 159. It was approved by the RTCA Executive Committee on July 12, 1991.

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1.0 PURPOSE AND SCOPE

1.1 Introduction

This document contains minimum operational performance standards for airborne supplementary navigation equipment (2D and 3D) using GPS inputs. An airborne supplemental navigation system can be used as a primary navigation reference in an aircraft when an approved and operational sole means navigation system is available. Incorporated within these standards are equipment characteristics that should be useful to users, designers, manufacturers and installers of the equipment. This document defines performance, functions and features for a 2D system, which performs only lateral guidance, and a 3D system, which performs both lateral and vertical guidance. Equipment may be manufactured and tested to meet 2D or 3D requirements (or both) in the en route, terminal and approach modes or any combination thereof.

Section 1.0 of this document provides information and assumptions needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections. It describes typical equipment applications and operational goals and forms the basis for the standards stated in Sections 2.0 through 4.0. Comments pertaining to VOR/DME have been included for explanatory and tutorial purposes. Definitions are provided in Appendix A.

Section 2.0 contains the minimum operational performance standards for the equipment. These standards define required performance under standard operating conditions and stressed physical environmental conditions. It also details the recommended bench test procedures necessary to demonstrate compliance.

Section 3.0 describes the performance required of the installed equipment. Tests for the installed equipment are included when performance cannot be adequately determined through bench testing.

Section 4.0 describes the operational characteristics for equipment installations and defines conditions that will assure the operator that operations can be conducted safely and reliably in the expected operational environment.

Compliance with these standards by manufacturers, installers and users is recommended as one means of assuring that the equipment will satisfactorily perform its intended function(s) under conditions normally encountered in routine aeronautical operations.

The word "equipment" as used in this document includes all components or units necessary (as determined by the equipment manufacturer or installer) for the equipment to perform properly its intended function. For example, the airborne area navigation "equipment" may include: sensor(s), a computer unit, an input-output unit that interfaces with existing aircraft displays/systems, a control unit, a display, shock mount(s), etc. In the case of this example, all of the foregoing components or units comprise the "equipment." It should not be inferred from this example, however, that every area navigation equipment will necessarily include all of the foregoing components or units. This will depend upon the design used by the equipment manufacturer.

If the equipment implementation includes a computer software package, the guidelines contained in RTCA/DO-178A, *Software Considerations in Airborne Systems and Equipment Certification*, should be considered.

The equipment manufacturer should consider the criticality appropriate for installation certification in determining the level of software requirements as defined in RTCA/ DO-178A, equipment failure analysis and fault monitoring to be accomplished.

It is recognized that any regulatory application of these standards is the responsibility of appropriate government agencies.

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

1.2 System Characteristics

Area navigation is an application of the navigation process providing the capability to establish and maintain a flight path on any arbitrarily chosen course that remains within the coverage area of the type of navigation sources being used. The system providing this capability, herein referred to as RNAV equipment, is an airborne device or combination of devices whose fundamental purpose is to provide navigation information relative to a selected geographically located point (called a waypoint).

In practice, the lateral navigation information displayed to the pilot commonly takes the form of bearing and distance from present aircraft position to the defined waypoint, and deviation from a desired track proceeding to or from the waypoint. Supplemental information may also be supplied by some equipment to aid the pilot in various ways, but this information is peripheral to the basic function of the equipment.

Vertical navigation (VNAV) may also be implemented to aid in compliance with specified altitudes and altitude constraints at waypoints. The navigation accuracy of the RNAV equipment will permit navigation along the routes to be flown. The altitude referenced to be used for vertical guidance is barometric altitude, not geometric.

The capabilities of this equipment, if it is certified for terminal area and approach operations, must be compatible with navigation routes and procedures in the terminal area environment and should permit navigation along and within airspace allocated for RNAV non-precision approaches.

1.2.1 Waypoint Definition

A waypoint may be identified in several ways, i.e., by name, number or location. Waypoint location is necessary in the computation of navigation information and to minimize pilot workload during time-critical phases of flight. At a minimum, enough waypoints should be provided to define the current and next two legs in the en route phase of flight and to define an approach and missed approach. If the equipment is designed for long-range en route navigation only, waypoint definitions for approach and missed approach can be omitted.