RTCA, Inc.
1150 18th Street NW, Suite 910
Washington, DC 20036
USA

Minimum Operational Performance Standards (MOPS) for GNSS Aided Inertial Systems

RTCA DO-384
December 17, 2020

Prepared by: SC-159

FOREWORD

This document was prepared by Special Committee 159 (SC-159) and approved by the RTCA Program Management Committee (PMC) on December 17, 2020

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization develops consensus-based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- 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.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders and several advisory circulars.

Since RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U.S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

DISCLAIMER

This publication is based on material submitted by various participants during the SC approval process. Neither the SC nor RTCA has made any determination whether these materials could be subject to valid claims of patent, copyright or other proprietary rights by third parties, and no representation or warranty, expressed or implied is made in this regard. Any use of or reliance on this document shall constitute an acceptance thereof "as is" and be subject to this disclaimer.

This Page Intentionally Left Blank

EXECUTIVE SUMMARY

RTCA DO-384 was prepared by RTCA Special Committee 159 (SC-159). It was approved by the RTCA Program Management Committee on December 17, 2020.

The purpose of this document is to provide minimum operational performance standards (MOPS) for Global Navigation Satellite System (GNSS) aided inertial systems including GNSS-aided attitude heading reference systems. Previously, Appendix R in RTCA DO-229 (any revision) and RTCA DO-316 contained the only reference material for GNSS-aided inertial systems, but only covered inertial reference systems qualified per 14 CFR Part 121 Appendix G using a tightly-coupled integration intended for long-range operations such as the oceanic environment. This document provides performance standards for an expanded range of inertial sensor technologies and integrations from short-range, loosely coupled to long-range, tightly-coupled covering a wider range of operations. Additionally, this document includes GNSS-aided performance standards used for attitude, heading and velocity information which is not covered by RTCA DO-334.

This Page Intentionally Left Blank

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

This Page Intentionally Left Blank

1 PURPOSE AND SCOPE

1.1 Introduction

This document contains minimum operational performance standards (MOPS) for GNSS integrated with inertial reference systems (IRS) or attitude heading reference systems (AHRS). It is not meant to be a replacement or substitute for RTCA DO-334 (MOPS for Strapdown Attitude and Heading Reference Systems). A key assumption is that any AHRS used for compliance with the performance requirements in this MOPS first meets the performance standard described in RTCA DO-334. That is, RTCA DO-334 is the starting point for any AHRS used to comply with requirements in this MOPS.

RTCA DO-334 provides standards for strap-down AHRS equipment intended to output attitude (pitch, roll), heading, turn and slip information along with presenting this information to the pilot (see Figure 1-1) but does not provide detailed requirements for GNSS aiding. The 14 code of federal regulations (CFR) Part 121 Appendix G provides requirements for INS/IRS, but an AHRS (including those with air data computer inputs) is not presently accepted for navigation.

The 14 CFR 121 Appendix G requirements were developed in the 1970's primarily for self-contained oceanic long-range area navigation (RNAV) capability and pre-dates performance-based navigation concepts as well as GNSS. RTCA DO-229() (MOPS for GPS/SBAS Airborne Equipment) and RTCA DO-316 (MOPS for GPS/Aircraft Based Augmentation System Airborne Equipment) both include an Appendix R that describes tightly-coupled GPS/inertial requirements and tests intended for integrations with inertial sensors satisfying the 14 CFR Part 121 Appendix G requirements. This MOPS is intended to replace Appendix R in RTCA DO-316 (RTCA DO-229) and expand beyond tightly-coupled, 14 CFR Part 121 Appendix G compliant inertial integrations.

In this document, the term "shall" is used to indicate requirements. An approved design will comply with every requirement, which can be assured by inspection, test, analysis, or demonstration. The term "must" is used to identify items that are important but are either duplicated somewhere else in the document as a "shall", or are considered to be outside the scope of this document. The term "should" is used to denote a recommendation that would improve the equipment, but does not constitute a requirement. The term "may" is used to denote an optional implementation at the manufacturer's discretion.

The requirements in this document define minimum performance, functions and features for both GNSS-aided inertial references systems and enhanced attitude heading reference systems. Due to the wide range of possible capabilities, it is important for manufacturers using this MOPS to characterize the equipment's intended function and expected performance. There are three performance categories and three associated Sub-categories within this MOPS. The word "equipment", as used in this document, includes all components or units necessary (as determined by the equipment manufacturer) to properly perform the intended function.

Compliance with these standards by manufacturers, installers and users is recommended as one means of assuring that the equipment will satisfactorily perform its intended functions under conditions encountered in routine aeronautical operations. The regulatory application of these standards is the responsibility of appropriate government agencies. In the United States, the Federal Aviation Administration (FAA) plans to publish a Technical Standard Order (TSO) to reference the requirements and test procedures for each equipment category.

Section 1 of this document provides information and assumptions needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections.

