

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036-5133
U.S.A.

**Minimum Aviation System Performance
Standards (MASPS)
for
Aircraft State Awareness Synthetic Vision
Systems**

RTCA DO-371
January 9, 2018

Prepared by: SC-213
© 2017, RTCA, Inc.

Copies of this document may be obtained from

RTCA, Inc.
1150 18th Street, NW, Suite 900
Washington, DC 20036, USA

Telephone: 202-833-9339

Facsimile: 202-833-9134

Internet: www.rtca.org

Please visit the RTCA Online Store for price and ordering information

FOREWORD

This document was prepared by Special Committee 213 (SC-213) and approved by the RTCA Program Management Committee (PMC) on January 9, 2018.

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 functions as a Federal advisory committee, and 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.

PROPRIETARY DISCLAIMER

This publication makes references to written material or systems that are protected by copyrights and/or patents. RTCA offers no opinion on the validity of the proprietary claims of the specified holder(s) of copyrights and/or patents. Neither does RTCA endorse or warrant the product of specific manufacturers or holders of copyrights and/or patents. RTCA has no economic stake in the use of any proprietary product.

Currently in preview, click buy full version

This Page Intentionally Left Blank

EXECUTIVE SUMMARY

RTCA/DO-371 was originally prepared by RTCA Special Committee 213 (SC-213). It was approved by the RTCA Program Management Committee on January 9, 2018. This document expands the previously defined DO-315A intended function of an SVS beyond that of supplemental view of the external scene to include enhanced aircraft attitude and energy state awareness and defines a system that is intended to be presented full-time on the pilots' full color Primary Flight Displays (PFD). This document has been harmonized with EUROCAE Working Group 79 (WG-79). This document is technically equivalent to ED-249.

This Page Intentionally Left Blank

TABLE OF CONTENTS

1	PURPOSE AND SCOPE.....	1
1.1	Introduction.....	1
1.1.1	Purpose.....	1
1.1.2	Structure of the Document.....	1
1.2	Introduction to Aircraft State Awareness Synthetic Vision System (ASA SVS).....	2
1.2.1	Aircraft State Awareness Synthetic Vision System Overview.....	2
1.2.2	Aircraft State Awareness Synthetic Vision System Elements and Block Diagram.....	4
1.3	Aircraft State Awareness Synthetic Vision System Operational Concept.....	5
1.4	Aircraft State Awareness Synthetic Vision System Intended Functions.....	6
1.5	Use of Key Words.....	6
1.6	Aircraft Equipment Information Vulnerabilities.....	6
1.7	Anticipated Future Growth.....	7
2	AIRCRAFT STATE AWARENESS SYNTHETIC VISION SYSTEM GENERAL REQUIREMENTS.....	9
2.1	ASA SVS General Requirements.....	9
2.1.1	ASA SVS Scene Depiction Requirements.....	10
2.1.2	ASA SVS Energy State Symbology Requirements.....	11
2.1.3	Display Content During Unusual Attitudes.....	12
2.1.4	Field of Regard.....	12
2.1.5	Display Minification.....	12
2.1.6	System Monitoring, Annunciation and Alerting.....	12
2.1.7	Terrain, Runway and Obstacle Databases.....	12
2.1.8	Database Assurance (DO-200B).....	13
2.2	Features of ASA SVS on a Head-Up Display.....	13
2.2.1	Additional Head-Up Display (HUD) Requirements.....	13
2.2.2	Monochrome HUD.....	14
3	AIRCRAFT STATE AWARENESS SYNTHETIC VISION SYSTEM MINIMUM STANDARD PERFORMANCE REQUIREMENTS.....	15
3.1	Display Elements.....	15
3.1.1	ASA SVS Scene Depiction.....	15
3.1.2	PFD Symbology.....	16
3.1.3	Display Characteristics.....	16
3.1.4	Display Performance.....	18
3.2	Databases.....	19
3.2.1	Runway Database.....	19
3.2.2	Obstacle Database.....	19
3.2.3	Database Assurance.....	19
3.3	Scene Position Data Sources.....	19
3.3.1	Altitude Source.....	20
3.3.2	Attitude Source.....	20
3.3.3	Heading/Track Source.....	20
3.3.4	GPS Source.....	20
3.3.5	Display Controls.....	20

3.3.6	Annunciations	20
3.4	Head Up Display	21
3.4.1	HUD Field of Regard.....	21
3.4.2	HUD Brightness/Contrast Controls	21
3.4.3	HUD Scene Removal	21
3.4.4	HUD Jitter.....	21
3.4.5	HUD SV Scene Error.....	21
3.4.6	HUD Scene Attitude Data Source.....	22
3.5	System Safety Objectives.....	22
3.5.1	System Safety Design Process	22
3.5.2	Design Assurance Levels and Demonstration.....	22
3.5.3	System Environmental Qualification	23
3.5.4	Built In Test	23
3.5.5	System Preventive Maintenance	23
3.6	Flight Data Recorder.....	23
4	SYSTEM PERFORMANCE DEMONSTRATION	25
4.1	Test Objectives.....	25
4.1.1	HUD Specific Criteria.....	25
4.2	Test Flight Phases	25
4.3	Brightness and Contrast	26
4.4	Test Conditions	26
4.5	Test Plan.....	27
4.6	Evaluation Matrix	28
5	MEMBERSHIP.....	31
	APPENDIX A - ACRONYMS AND DEFINITIONS	A-1
	APPENDIX B - REFERENCES	B-1
B.1	SAE Publications.....	B-1
B.2	RTCA Standards	B-1
B.3	EUROCAE Standards.....	B-2
B.4	FAA Regulations.....	B-2
B.5	FAA Orders and Standards	B-2
B.6	FAA Advisory Circulars (AC).....	B-3
B.7	EASA and ICAO Publications	B-3
	APPENDIX C: OPERATIONAL PERFORMANCE ASSESSMENT	C-1
	APPENDIX D: SYNTHETIC VISION AIRCRAFT STATE AWARENESS STANDARDS	
	RATIONALE	D-1
D.1.1	ASX SVS Scene Depiction (Section 3.1.1).....	D-1
D.1.1.1	Optical Flow (Section 3.1.1.1)	D-1
D.1.1.2	Depiction of Terrain and Runway of Intended Landing (Section 3.1.1.2).....	D-1
D.1.1.3	Color (Section 3.1.1.3).....	D-2
D.1.2	PFD Symbology (Section 3.1.2)	D-2
D.1.3.1	Behavior During Unusual Attitude (Section 3.1.3.1).....	D-2
D.1.3.2	Field of Regard (Section 3.1.3.2).....	D-3
D.1.4.1	Latency (Section 3.1.4.1)	D-4

D.1.4.2	Flicker (Section 3.1.4.2)	D-4
D.1.4.3	Image Artifacts (Section 3.1.4.3)	D-5
D.2.1	Terrain Database (Section 3.2.1)	D-5
D.2.2	Runway Database (Section 3.2.2)	D-6
D.2.3	Obstacle Database (Section 3.2.3)	D-6
D.3.2	Attitude Source (Section 3.3.2)	D-6
D.3.4	GPS Source (Section 3.3.4)	D-7
D.3.5	Display Controls (Section 3.3.5)	D-7
D.3.6	Annunciations (Section 3.3.6)	D-7
D.4.1	HUD Field of Regard (Section 3.4.1)	D-8
D.4.2	HUD Brightness/ Contrast Controls (Section 3.4.2)	D-8
D.4.3	HUD Scene Removal (Section 3.4.3)	D-8
D.4.4	HUD Jitter (Section 3.4.4)	D-8
D.4.5	HUD Processing Error (Section 3.4.5)	D-9
D.4.5	HUD Scene Position Data Source (Section 3.4.6)	D-9

TABLE OF TABLES

Table 1-1: Terms for use in Performance Requirements and Test Procedures	6
Table 4-1: Evaluation Matrix	28
Table 4-2: Evaluation Matrix for HUD	29

TABLE OF FIGURES

Figure 1-1: ASA SVS PFD Illustration	3
Figure 1-2: HUD Illustration with ASA SVS Features	4
Figure 1-3: ASA SVS Functional Elements (Notional)	5

Currently in preview, click buy full version

This Page Intentionally Left Blank

1 PURPOSE AND SCOPE

1.1 Introduction

DO-315A addressed Enhanced Vision Systems (EVS), Synthetic Vision Systems (SVS), and Combined Vision Systems (CVS) technologies. This document identifies system and sub-system performance, safety and equipage requirements for the use of this technology under 14 CFR Part 25. These Minimum Aviation System Performance Standards (MASPS) may, in fact, also be applicable to non-Part 25 aircraft, but specific installation and operational deployment issues associated with these other vehicles have not been considered at this time. The performance standards for this SVS-only expanded functionality are updated from DO-315A. This document does not address EVS, CVS or Enhanced Flight Vision Systems (EFVS) or Synthetic Vision Guidance Systems (SVGS).

1.1.1 Purpose

This MASPS provides high level system requirements for an Aircraft State Awareness SVS (ASA SVS). This document expands the previously defined DO-315A intended function of an SVS beyond that of supplemental view of the external scene to include enhanced aircraft attitude and energy state awareness. This document defines a system that is intended to be presented full-time on the pilots' full color Primary Flight Displays (PFD).

Features of an ASA SVS may also be implemented on a Head-Up Display (HUD) or equivalent and standards for this are defined herein. If a HUD replaces the requirement for an HD PFD, this document may not contain all the appropriate requirements to perform the intended function and an additional assessment will need to be performed for compliance. Wherever the term HUD is used in this document, it is meant to be inclusive of a HUD equivalent type device such as a head worn display (HWD).

ASA SVS is intended to prevent the occurrence of spatial disorientation by supporting the pilots' continuous awareness of attitude, altitude, topography and energy state (speed, acceleration and altitude) related to the flight path and perceived motion of the aircraft. In addition to reducing the risk of controlled flight into terrain (CFIT) it is intended that an SVS meeting this MASPS will reduce the risk of loss-of-control inflight (LOC-I) accidents by preventing the attainment of any unusual (i.e., not normal) attitude and/or energy states that could result in a LOC-I.

***Note:** The Commercial Aviation Safety Team (CAST) chartered the ASA Joint Safety Analysis Team in 2010 to investigate LOC-I accidents and incidents in which the flightcrew lost awareness of the airplane's attitude and/or energy state. 274 intervention strategies (IS) were identified as mitigations to the standard problems observed in the LOC-I accident analysis. The CAST ASA Joint Safety Intervention Team reviewed the IS and developed 11 new safety enhancements (SE) including training, operations and design implementations. This MASPS was created in support of the desire to provide an industry standard for SE-200: Virtual day visual meteorological condition (VMC) displays (such as synthetic vision or an equivalent system) with energy state symbology cues. While SE-200 was identified as the highest rated design intervention in terms of risk reduction percentage, it is recognized that there exist many other impactful design interventions for reducing LOC-I that are not covered in this MASPS, e.g., Bank Alerting with Recovery Guidance (SE-201), Bank Angle Protection (SE-202), and Low Speed Alerting (SE-192).*

1.1.2 Structure of the Document

Section 1 provides an explanation of the scope and purpose of this document and introduces the ASA SVS.