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Minimum Aviation System Performance Standards (MASPS) for Synthetic Vision Systems, Synthetic Vision Guidance Systems and Combined Vision Systems

RTCA DO-407
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Prepared by SC-213
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FOREWORD

This document was originally prepared by the RTCA Special Committee 213 Standards for Enhanced Flight Vision Systems and Synthetic Vision Systems (EFVS/SVS) jointly with EUROCAE WG-79. It was approved by the RTCA Program Management Committee and the EUROCAE Council on December 12, 2024.

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EXECUTIVE SUMMARY

RTCA DO-407/EUROCAE ED-326 was originally prepared by RTCA Special Committee 213 (SC-213)/ EUROCAE Working Group 79 (WG-79). It was approved by the RTCA Program Management Committee and EUROCAE Council on December 12, 2024. This document refines and expands the previously defined requirements for Synthetic Vision Systems (SVS), Aircraft State Awareness Synthetic Vision Systems (ASA SVS), Synthetic Vision Guidance Systems (SVGS), and Combined Visions Systems (CVS) for the head down displays (HDD) and head up display (HUD).

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1 PURPOSE AND SCOPE

1.1 Introduction and Purpose of Document

This MASPS provides high level system requirements for Synthetic Vision Systems (SVS), Aircraft State Awareness Synthetic Vision Systems (ASA SVS), Synthetic Vision Guidance Systems (SVGS) and Combined Vision Systems (CVS).

This document consolidates, clarifies, and expands from the previously defined DO-315, DO-315A, DO-315B, DO-359, and DO-371 intended functions for SVS, ASA SVS, SVGS, and CVS, and expands the intended function(s) in some circumstances.

For Enhanced Flight Vision Systems (EFVS) and Enhanced Vision Systems (EVS) intended functions, please reference DO-408 MASPS for Enhanced Vision Systems and Enhanced Flight Vision Systems.

Civil Aviation Authorities may use these performance standards to develop airworthiness criteria and approval processes for Synthetic and Combined Vision Systems.

This standard is a product of a joint RTCA/EUROCAE industry committee to set standards that can be utilized by EASA, FAA and other regulatory organizations. The standards of this MASPS are global in nature and have international implications. They are written primarily to meet and logically expand upon the definitions and operational applications as established in the U.S. and in Europe. However, the regulatory structure of other civil aviation authorities may contain terminology and operational concepts that differ, and therefore impact corresponding requirements.

This document identifies general system and sub-system performance, safety, and redundancy requirements for the use of synthetic and combined vision. The system and safety criteria provide the necessary guidance for the required level of safety for the operation.

Throughout the document, when the term Synthetic Vision (SV) is used, it is meant to be inclusive of SVS, ASA SVS and SVGS. When the term Enhanced Vision (EV) is used, it is meant to be inclusive of Enhanced Vision Systems (EVS) and Enhanced Flight Vision Systems (EFVS). When the term Combined Vision (CV) is used, it is meant to be inclusive of CVS with both SV and EV implementations. The term Vision Systems (VS) is meant to be inclusive and is a generic term referring to systems designed to provide images, i.e., enhanced vision systems (EVS), SVS and/or CVS.

The SVS and ASA SVS subsections describe a system where no additional credit with existing minima will be granted via the display systems described within. For “no additional operational credit” guidelines to apply, the applicant must be able to qualify the proposed installation’s intended function in terms that do not degrade safety or change the airplane’s existing operational capability or certification basis. This will be one of the key parameters to be scrutinized by the regulatory authorities during flight evaluations.

The SVGS subsection describes a system where operational credit may be provided upon installation certification and operational approval.

CVS may meet the intended function of an Enhanced Flight Vision System (EFVS). In addition, CVS may also meet the intended function of an SVGS. In addition, CVS may be a system with no additional capability with respect to existing minima.

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Compliance with these standards is recommended as one means of assuring that the system and each subsystem will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operations for the environments intended. One potential use of the MASPS is to support system application development. Additionally, the MASPS may be implemented by one or more regulatory documents and/or advisory documents (e.g., certifications, authorizations, approvals, commissioning, advisory circulars, notices, etc.) and may be implemented in part or in total. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

1.2 Scope of the Document

This document establishes the minimum SV and CV systems equipage standards to meet the operational, safety, performance, and interoperability aspects that are presented to the pilot on a Primary Flight Display (PFD), Head Up Display (HUD) used for primary flight reference (PFR), or a secondary display.

Certification guidance for PFD and HUDs are available elsewhere, e.g., AC 25-11B, SAE AS6296, and is not included in the scope of this document. The HUD is separately certified and will remain subject to all applicable rules and guidance for the category of aircraft and operation. This MASPS pertains only to those HUD items specific and unique to Synthetic and Combined Vision Systems. 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); however, this document may not contain all the appropriate HWD intended function requirements. HWD standards are available in SAE ARP6377 and SAE AS7377. If a HUD is used in place of a Head Down (HD) PFD, this document may not contain all the appropriate requirements to perform the Vision System's intended function.

This MASPS pertains to Parts 21, 23, 25, 27, and 29 aircraft. Additional requirements may be necessary for non-fixed wing aircraft, e.g., see DO-375 Minimum Aviation System Performance Standards (MASPS) for a Combined Vision Systems for Helicopter Operations. Specific installation and operational deployment issues associated with other vehicles, e.g., Urban Air Mobility (UAM) and Advanced Air Mobility (AAM), have not been considered fully at this time. This document may not contain all the appropriate requirements needed to perform the intended function on the UAM and AAM platforms.

When CVS is used to meet the intended function of an Enhanced Flight Vision System (EFVS) or Enhanced Vision Systems (EVS) it must comply with the detailed standards and system performance for EFVS and EVS as provided in DO-408.

1.3 Background

Vision System as used in the context of this document is an inclusive term referring to SVS, ASA SVS, SVGS, EVS, EFVS and CVS flight instrument display systems. Vision Systems (VS) provide a visual representation of the external environment through a combination of various databases and sensors and can be overlaid with primary flight information. Figure 1-1 provides a Vision System context diagramFigure 1-2 provides a notional Vision System block diagram.

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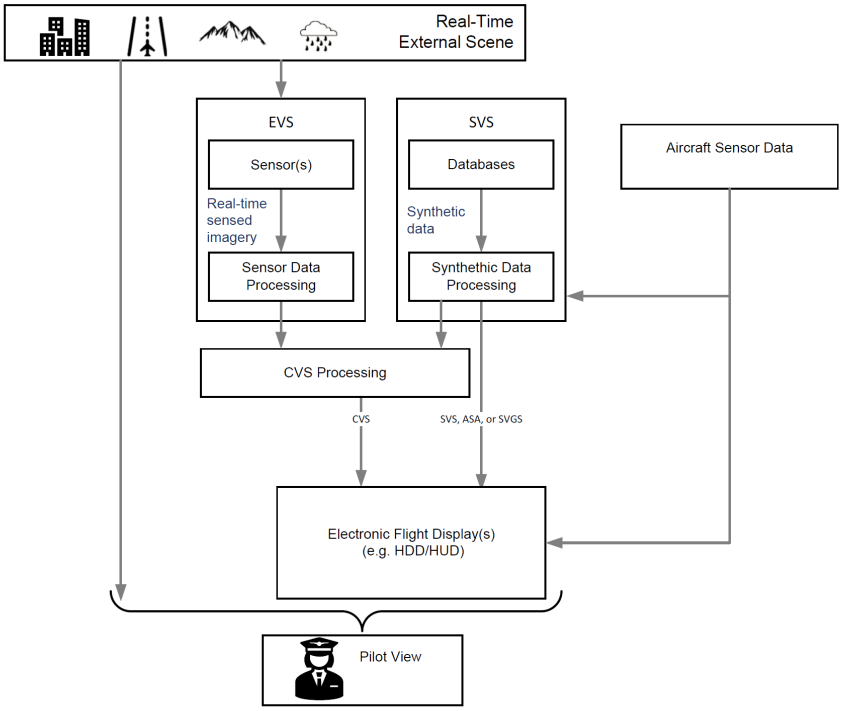


Figure 1-1 Vision System Context

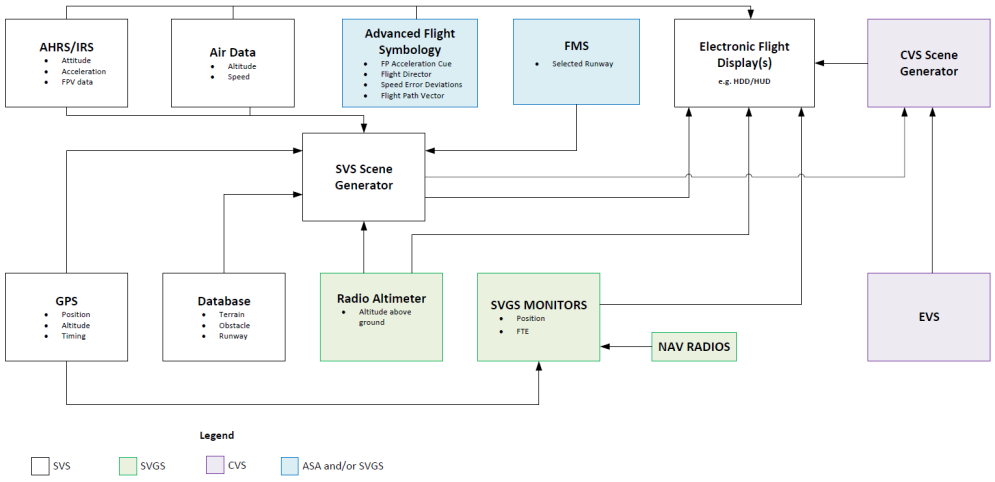


Figure 1-2 Notional Vision System Block Diagram

SVS as used in the context of this document is an electronic means to display a synthetic vision image of the external scene topography to the flight crew. SVS requires a terrain and obstacle database, a precision navigation position, and a display. This display may be a PFD, HUD, or secondary display. SVS is the foundation building block for ASA SVS, SVGS and CVS. Figure 1-2 provides a notional system diagram of SVS.

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ASA SVS is SVS on a PFD with two primary element enhancements beyond what is defined for SVS: enhanced external scene depiction and enhanced primary flight symbology. To achieve this intent, additional ASA features on an SVS PFD are required to be presented full-time in flight and to both pilots (if two pilots are required for the operation). ASA SVS instrument includes energy state cues, full color depiction of 3D terrain, and graphical elements to provide perception of aircraft motion. ASA SVS *features* may also be included on a HUD; however, because today's HUDs may be stowed and to date commercial HUDs are not full color,hence they do not currently meet the intended function of ASA SVS. ASA SVS features are common elements for SVGS.

Note: Although not specified in this document, ASA SVS may also include a roll and pitch recovery display element and/or additional PFD symbology elements such as pitch or a flight path limit, margin to stall, etc. that facilitate both recognition and proper control response to recover from flight upsets.

SVGS is a flight guidance display with high precision position assurance monitors that may allow operations on published instrument approaches that contain a lower set of approach minimums (Decision Altitude / Decision Height (DA/DH and visibility). The SVGS display may be implemented on the PFD or HUD. The SVGS display provides a representation of the approach environment, including the runway of intended landing, the surrounding topography and the relevant obstacles. SVGS flight guidance display technology reduces flight technical error (FTE) while it displays the correct flight path trajectory to the desired touchdown point. SVGS high precision position assurance monitors provide both position assurance and accurate rendering of the synthetic depiction throughout the SVGS approach.

Combined Vision System (CVS) is a combination of SV and EV systems on the HDD or HUD that includes both database-driven synthetic images and real-time sensor image depictions on the same display. CVS, when paired with a sensor qualified to meet the enhanced flight visibility requirement, may be used to meet the intended function of an Enhanced Flight Vision System (EFVS). In addition, CVS may also meet the intended function of an SVGS that allows operations on published instrument approaches that contain a lower set of approach minimums (DA/DH and visibility).

1.4 Structure of the Document

Section 1 (the current section) provides an explanation of the scope and purpose of this document and introduces SVS, ASA SVS, SVGS and CVS.

Section 2 describes the approach and methodology used for the development of SVS, ASA SVS, SVGS and CVS MASPS.

Section 3 describes Minimum System Performance requirements for the SVS, ASA SVS, SVGS and CVS. These requirements begin with overall system-level standards followed by more detailed sub-system level requirements. The Section also includes the key assumptions made for the SVS, ASA SVS, SVGS and CVS.

Section 4 introduces the Interoperability Requirements applicable to the SVS, ASA SVS, SVGS and CVS.

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Section 5 describes the minimum system tests and compliance procedures that would verify that the SVS, ASA SVS, SVGS and CVS meet the intended function and the associated MASPS requirements.

The verification procedures specified in this document are intended to be used as one means of demonstrating compliance with the performance requirements. Although specific test procedures are cited, it is recognized that other methods may be used. These alternate procedures may be used if it can be demonstrated that they provide at least equivalent information. System performance tests as they relate to operational capability are the most important test. Subsystem tests are useful as subsystems are added during system buildup and to ensure continued subsystem performance as it relates to system performance.

Appendix A is reserved for an Operational Services and Environment Definition (OSED).

Appendix B is reserved for an Operational Performance Assessment (OPA).

Appendix C is reserved for a Collision Risk Model (CRM)/Comparative Analysis.

1.5 Relationship to ICAO Documents

The standards of this MASPS provide definitions, intended functions, and operational applications derived primarily from the constructs and regulations established under the US Code of Federal Regulations (CFR) and EASA certification specifications.

The International Civil Aviation Organization (ICAO) Annex 6 Parts I, II, and III provide basic information for Commercial Air Transport Aircraft, General Aviation, and Helicopters. The applicability of the Standards and Recommended Practices for flight operations includes Enhanced Flight Vision Systems equipment, HUDs, SVS and CVS. Additional information regarding low visibility operations can be found in the Manual of All Weather Operations Doc. 9365.

1.6 References

The table below lists EASA, FAA, ICAO and industry references and documents cited in this document.

Throughout this document references are made to either an applicable EASA or FAA document but not both even though the corresponding documents are essentially the same or very similar in content. Even though both appliable FAA and EASA references are not identified together elsewhere in this document, they are included below for completeness. Examples include EASA AMC 25-11 is similar to FAA AC 25-11B, EASA ETSO-C106A1 is similar to FAA TSO-C106A.

RTCA	EUROCAE	Title
DO-160G	ED-14G	Environmental Conditions and Test Procedures for Airborne Equipment
DO-178()	ED-12()	Software Considerations in Airborne Systems and Equipment Certification
DO-200B	ED-76A	Standards for Processing Aeronautical Data
DO-201B	ED-77A	User Requirements for Navigation Data
DO-254	ED-80	Design Assurance Guidance for Airborne Electronic Hardware
DO-272D	ED-99D	User Requirements for Aerodrome Mapping Information

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RTCA	EUROCAE	Title
DO-276C	ED-98C	User Requirements for Terrain and Obstacle Data
DO-315 DO-315A DO-315B	ED-179B	Minimum Aviation System Performance Standards (MASPS) for Enhanced Vision Systems, Synthetic Vision Systems, Combined Vision Systems and Enhanced Flight Vision Systems
DO-341		Minimum Aviation System Performance Standards (MASPS) for an Enhanced Flight Vision System to Enable All-Weather Approach, Landing and Roll-Out to a Safe Taxi Speed
DO-359		Minimum Aviation System Performance Standards (MASPS) for Synthetic Vision Guidance Systems
DO-367		Minimum Operational Performance Standards (MOPS) for Terrain Awareness and Warning Systems (TAWS) Airborne Equipment
DO-371	ED-249	Minimum Aviation System Performance Standards (MASPS) for Aircraft State Awareness Synthetic Vision Systems
DO-374		Safety, Performance and Interoperability Requirements Document Defining Takeoff Minima by Use of Enhanced Flight Vision Systems
DO-375	ED-255	Minimum Aviation System Performance Standards (MASPS) for a Combined Vision Systems for Helicopter Operations
DO-408	ED-327	Minimum Aviation System Performance Standards (MASPS) for Enhanced Vision Systems and Enhanced Flight Vision Systems

Other Documents

The table below lists EASA, FAA and other industry references sited in this document and other relevant documents.

Organization	Number	Title
ARINC	424-23	Navigation System Database
EASA	AMC 25.1302	Installed Systems and Equipment for Use by the Flight Crew
EASA	AMC 25.1309	System Design and Analysis
EASA	AMC 25.1322	Alerting Systems
EASA	AMC No. 1 to CS 25.1329	Flight Guidance System
EASA	AMC 25-11	Electronic Flight Deck Displays
EASA	AMC AWO.A.EFVS.104	EFVS display
EASA	CS AWO.A.SVGS .109	Annunciation of the synthetic vision guidance system's (SVGS) mode and status
EASA	CM-AS-009 Issue 01	Certification of aircraft systems with databases

Organization	Number	Title
EASA	CS-ACNS Issue 4	Airborne Communications, Navigation and Surveillance - Subpart C
EASA	CS-AWO Issue 2	Certification Specifications For All Weather Operations
EASA	ETSO-C106 A1	Air Data Computer
EASA	CS-AWO 236	Excess-deviation alerts
EASA	ETSO-C145e A1	Airborne Navigation Sensors Using The Global Positioning System Augmented By The Satellite Based Augmentation System
EASA	ETSO-C113b	Airborne Multipurpose Electronic Displays
EASA	ETSO-C146eA1	Stand-Alone Airborne Navigation Equipment Using The Global Positioning System Augmented By The Satellite Based Augmentation System
EASA	ETSO-C151d	Terrain Awareness and Warning System (TAWS)
EASA	ETSO-C87A	Airborne Low-Range Radio Altimeter
EASA	Regulation (EU) No 965/2012	ANNEX V (Part-SPA) Subpart E: Low Visibility Operations (LVO)
FAA	AC 120-118	Criteria for Approval/Authorization of All Weather Operations (AWO) for Takeoff, Landing and Rollout
FAA	AC 120-128D	Criteria for Approval of Category III Weather Minima for Takeoff, Landing and Rollout
FAA	AC 120-29A	Criteria for Approval of Category I and Category II Weather Minima for Approach
FAA	AC 20-115D	Airborne Software Development Assurance Using EUROCAE ED-12( ) and RTCA DO-178
FAA	AC 20-138D	Airworthiness Approval of Positioning and Navigation Systems
FAA	AC 20-152A	Development Assurance for Airborne Electronic Hardware
FAA	AC 20-153B	Acceptance of Aeronautical Data Processes and Associated Databases
FAA	AC 20-158A	The Certification of Aircraft Electrical and Electronic Systems for Operation in the High-intensity Radiated Fields (HIRF) Environment
FAA	AC 20-163	Displaying Geometric Altitude Relative to Mean Sea Level
FAA	AC 20-167A	Airworthiness Approval of Enhanced Vision System, Synthetic Vision System, Combined Vision System, and Enhanced Flight Vision System Equipment
FAA	AC 20-185A	Airworthiness Approval of Synthetic Vision Guidance Systems
FAA	AC 21-16G	RTCA Document DO-160 versions D, E and F, “Environmental Conditions and Test Procedures for Airborne Equipment”
FAA	AC 23-8C	
FAA	AC 23-18	Installation of Terrain Awareness and Warning System (TAWS) Approved for Part 23 Airplanes

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Organization	Number	Title
FAA	AC 23.1311-1C	Installation of Electronic Display in Part 23 Airplanes
FAA	AC 25-7D	Flight Test Guide for Certification of Transport Category Airplanes
FAA	AC 25-11B	Electronic Flight Displays
FAA	AC 25-23	Airworthiness Criteria for the Installation Approval of a Terrain Awareness and Warning System (TAWS) for Part 25 Airplanes
FAA	AC 25.773-1	Pilot Compartment View Design Considerations
FAA	AC 25.1302-1	Installed Systems and Equipment for Use by the Flightcrew
FAA	AC 25.1322-1	Flightcrew Alerting
FAA	AC 25.1329-1C	Approval of Flight Guidance Systems
FAA	AC 90-106B	Enhanced Flight Vision Systems
FAA	AC 90-107	Guidance for Localizer Performance with Vertical Guidance and Localizer Performance without Vertical Guidance Approach Operations in the U.S. National Airspace System
FAA	Order 8260.3D	United States Standard for Terminal Instrument Procedures (TERPS)
FAA	Order 8400.13	Procedures for the Evaluation and Approval of Facilities for Special Authorization Category I Operations and All Category II and III Operations
FAA	TSO-C87a	Airborne, Low-Range Radio Altimeter
FAA	TSO-C106a	Air Data Computer
FAA	TSO-C10c	Pressure Altimeter System Altimeter, Pressure Actuated, Sensitive Type
FAA	TSO-C113b	Airborne Multipurpose Electronic Displays
FAA	TSO-C145e A1	Airborne Navigation Sensors Using The Global Positioning System Augmented By The Satellite Based Augmentation System
FAA	TSO-C146e	Stand-Alone Airborne Navigation Equipment Using the Global Positioning System Augmented by the Satellite Based Augmentation System
FAA	TSO-C151d	Terrain Awareness And Warning System
FAA	TSO-C196b	
FAA	TSO-C210	Airborne Head Up Display
ICAO	Annex 6, Part I (with Amendment No. 48 and Corrigendum No. 1)	Annex 6 - Operation Of Aircraft - Part I - International Commercial Air Transport - Aeroplanes
ICAO	Annex 6, Part II (with Corrigendum No. 1)	Annex 6 - Operation Of Aircraft - Part II - International General Aviation - Aeroplanes
ICAO	Annex 6, Part III	Annex 6 - Operation Of Aircraft - Part III - International Operations - Helicopters
ICAO	Annex 10, Volume I,	Aeronautical Telecommunications, Volume I Radio Navigation Aids, 8th Edition, July 2023
ICAO	*ICAO AWO Manual Doc 9365*	Manual of All-Weather Operations
SAE	ARP4032B	Human Engineering Considerations in the Application of Color to Electronic Aircraft Displays

Organization	Number	Title
SAE EUROCAE	ARP4754A ED79B	Guidelines for Development of Civil Aircraft and Systems
SAE	ARP4761	Guidelines And Methods For Conducting The Safety Assessment Process On Civil Airborne Systems And Equipment
SAE	ARP5287	Optical Measurement Procedures for Airborne Head Up Display (HUD)
SAE	ARP5288	Transport Category Airplane Head Up Display (HUD) Systems
SAE	ARP5589	Human Engineering Considerations for Design and Implementation of Perspective Flight Guidance Displays
SAE	ARP5677	Human Engineering Considerations for Airborne Implementation of Enhanced Synthetic Vision Systems
SAE	ARP6023	Human Engineering Considerations for Implementing Enhanced SVS in Vertical Flight capable platforms
SAE	ARP6377	Human Engineering Considerations Associated with Design and Airborne Implementation of Head Worn Display (HWD) Systems
SAE	AS6296	Electronic Flight Instrument System (EFIS) Displays
SAE	AS7377 (WIP)	Minimum Performance Standard for Airborne Head Worn Display (HWD).
SAE	AS8034C	Minimum Performance Standard for Airborne Multipurpose Electronic Displays
SAE	AS8055	Minimum Performance Standard for Airborne Head Up Display (HUD)
FAA Commercial Aircraft Safety Team (CAST)	SE-200	Airplane State Awareness - Virtual Day - VMC Display

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