U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Airworthiness Approval of Synthetic Vision Systems, Synthetic Vision Guidance Systems and Aircraft State Awareness Synthetic Vision Systems

Date: 01/27/2021 **AC No:** 20-185A
Initiated by: AIR-600

This advisory circular (AC) provides guidance for gaining airworthiness approval for synthetic vision technology in aircraft. Specifically, when followed in its entirety, it provides an acceptable means for complying with the airworthiness regulations contained in Title 14 of the Code of Federal Regulations (14 CFR) Parts 23, 25, 27, and 29 when installing a synthetic vision system (SVS), synthetic vision guidance system (SVGS), or aircraft state awareness synthetic vision system (ASA-SVS) in airplanes and rotorcraft. As vision system technology advances, applicants are encouraged to propose alternative methods to their Aircraft Certification Office (ACO) to integrate new and novel safety enhancing vision system functions into their aircraft. The FAA will evaluate alternative methods consistent with the FAA's safety continuum.

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback form at the end of this AC.

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CHAPTER 1. INTRODUCTION

1.1 Purpose

1.1.1 The Federal Aviation Administration (FAA) has consolidated all synthetic vision related guidance into this advisory circular (AC). This revised AC provides guidance on airworthiness approvals of synthetic vision systems (SVS) previously found in AC 20-167A. Additionally, this revised AC adds new guidance material for aircraft state awareness synthetic vision systems (ASA-SVS).

1.1.2 This AC complements existing guidance for flight guidance symbology, head-up displays (HUD), HUD equivalents, and visual display characteristics. For example, AC 25-11B, *Electronic Flight Deck Displays*, AC 25.1329-1C Change 1, *Approval of Flight Guidance Systems* and AC 23.1311-1C, *Installation of Electronic Display in Part 23 Airplanes*. For a complete listing of related regulations and guidance, refer to appendix E.

1.1.3 This AC is not mandatory and does not constitute a regulation. This AC describes an acceptable means, but not the only means, to install and obtain airworthiness approval for synthetic vision technologies. Applicants may propose alternate means. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

1.1.4 The SVS guidance in this document was originally created for Part 23 aircraft and documented in AC 23-26, *Synthetic Vision and Pathway Depictions on the Primary Flight Display*. The original version of AC 20-167 captured the guidance contained in AC 23-26 and expanded the guidance to 14 CFR Part 25, 27, and 29 aircraft. The SVGS and ASA-SVS guidance was developed primarily for Part 25 aircraft, however you may use the guidance for Part 23, 27, and 29 aircraft. As vision system technology advances, applicants are encouraged to propose alternative methods to their ACO to integrate new and novel safety enhancing vision system functions into their aircraft. The FAA will evaluate alternative methods consistent with the safety continuum.

1.2 Applicability

1.2.1 Applicants for a type certificate (TC), amended type certificate (ATC), or supplemental type certificate (STC) may use the guidance in this AC to install SVS, SVGS, or ASA-SVS and associated equipment.

1.2.2 This AC is for airplane and rotorcraft manufacturers, modifiers, and type certification engineers seeking certification or installation guidance for their visual display system. Sections 23.2600(a), 25.773, 27.773 and 29.773 also address vision systems using a transparent display surface located in the pilot's outside view, such as a head-up-display, head-mounted display, or other equivalent display. The FAA will evaluate alternative methods consistent with the FAA's safety continuum. Such "vision systems"

could include any SVS, SVGS or ASA-SVS when implemented on HUD or HUD equivalent display.

1.2.3 This AC does not address operational aspects of SVS, SVGS or ASA-SVS or any changes in aircraft operational capability that may result from their installation.

1.3 How to Use This Document

1.3.1 This AC is based on the technical standards referenced in RTCA DO-315A, *Minimum Aviation System Performance Standards (MASPS) for Enhanced Vision Systems, Synthetic Vision Systems, Combined Vision Systems and Enhanced Flight Vision Systems*; RTCA DO-359, *Minimum Aviation System Performance Standards (MASPS) for Synthetic Vision Guidance Systems*; and RTCA DO-371, *Minimum Aviation System Performance Standards (MASPS) for Aircraft State Awareness Synthetic Vision Systems*. RTCA DO-315A, RTCA DO-359, and RTCA DO-371 are copyrighted by RTCA, Inc. and used with permission. Purchase information is in appendix E.

1.3.2 RTCA DO-315B is the current version of the DO-315. However, when DO-315A was revised to DO-315B, RTCA Special Committee (SC)-213 added technical standards to the earlier version of the document for the use of SVS on instrument approaches with lower than standard minima. These additional standards, however, have been superseded by standards later published in RTCA DO-359, which contains the accepted technical standards for SVGS. To preclude reference to the superseded standards in DO-315B, the FAA will reference the earlier version of DO-315 within this AC. Any applicant attempting to certify an SVGS should reference RTCA DO-359 and not RTCA DO-315B.

1.3.3 When using FAA documents referenced in RTCA DO-315A, DO-359, and DO-371, the applicant should use the most current version of the FAA document cited.

1.3.4 This material does not alter regulatory requirements.

1.3.5 This AC describes system performance.

1.3.6 Appendix A outlines a sample flight manual supplement.

1.3.7 Appendix B addresses specific installation guidance for SVS on rotorcraft. Appendix C addresses additional Part 23 considerations for situational awareness only.

1.4 Definitions and acronyms

Definitions and acronyms are in appendix D.

1.5 Cancellation

AC 20-185, Airworthiness Approval of Synthetic Vision Guidance System, dated December 17, 2015 is canceled.

CHAPTER 2. VISION SYSTEMS OVERVIEW

2.1 Synthetic Vision Systems

2.1.1 Pursuant to 14 CFR 1.1, Synthetic Vision means a computer-generated image of the external scene topography from the perspective of the flight deck that is derived from aircraft attitude, high-precision navigation solution, and database of terrain, obstacles and relevant cultural features. Synthetic Vision Systems are an electronic means to display a synthetic vision image of the external scene topography to the flight crew. Synthetic vision's key features can also be applied to synthetic vision guidance systems, which enable instrument approaches with lower decision altitudes, and aircraft state awareness synthetic vision systems, which improve the pilot's awareness of the aircraft's attitude and energy state.

2.1.2 SVS provides only a supplemental view of the external scene to provide the crew with awareness of terrain, obstacles, and relevant cultural features such as runways and airport environments. SVS cannot be used in lieu of natural vision. In most cases, the display of synthetic vision is through a primary flight display from the perspective of the flight deck (egocentric), or through a secondary flight display from the perspective correlating to outside the aircraft (exocentric, like a North Up Plan view of a moving map display). This AC addresses both perspectives. The elements of a typical installed SVS are listed below, with the generic SVS system diagram shown in Figure 1.

- Display (includes interface and installation).
- System interface.
- Database of terrain and obstacles.
- Sources providing the aircraft altitude, attitude, and position.

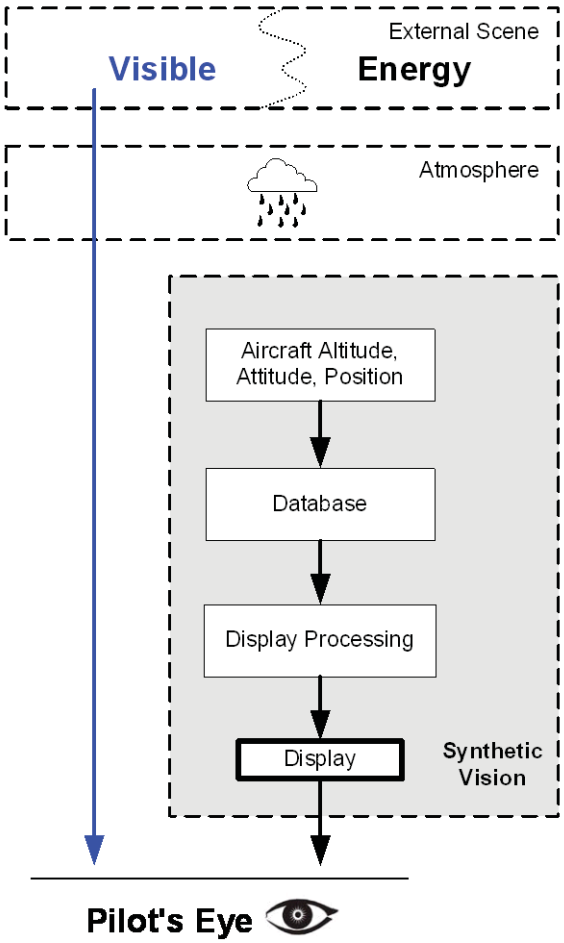

Figure 1. Synthetic Vision Diagram
(Dashed lines represent individual system boundaries. External scene visible image is not affected by SVS.)

2.1.3 RTCA DO-315A Section 1.2 provides a SVS overview, system description, and basic system architecture.

2.2 Synthetic Vision Guidance System

2.2.1 RTCA DO-359 describes SVGS as a combination of SVS and flight guidance displayed on the primary flight display (PFD), and high precision position assurance monitors. The SVGS flight instrument display provides a continuous, geo-spatially correct depiction of the external scene topography, including obstacles, augmented by the display of the runway of intended landing. The SVGS display is implemented on a head-down or head up PFD, designed to the guidance provided by AC 25-11B. SVGS goes beyond SVS by including additional symbology elements, integrity and performance monitors, and annunciations.

2.2.2 RTCA DO-359 Section 1.2 provides a SVGS overview, system description, and basic system architecture.

2.2.3 This AC provides guidance on achieving airworthiness approval for a SVGS capable of supporting operations to 150 ft Height Above Touchdown (HAT) on an Instrument Landing System (ILS) instrument approach procedure. Operators must obtain separate operational approvals from Flight Standards. Reference AC 120-118, *Criteria for Approval/Authorization of All Weather Operations (AWO) for Takeoff, Landing, and Rollout*, for guidance on obtaining an operational approval for SA CAT I ILS instrument approaches.

2.2.4 RTCA DO-359, *Minimum Aviation System Performance Standards (MASPS) for Synthetic Vision Guidance Systems*, May 18, 2015, provides the minimum performance standards for SVGS. Although RTCA DO-359 provides guidance for SVGS presentation on the Head Down Display (HDD), Head Up Display (HUD), or HUD equivalent display, and cites use on ILS, LPV or GLS based instrument approach procedures, this AC only provides airworthiness guidance to applicants for eligible SVGS for ILS instrument approach procedures.

2.3 Aircraft State Awareness Synthetic Vision System (ASA-SVS)

2.3.1 RTCA DO-371 describes ASA-SVS as a combination of perspective view synthetic terrain depiction and overlaid primary flight display symbology. The ASA-SVS flight instrument provides a continuous geospatially correct depiction of the external scene topography, including obstacles, augmented by the display of the runway of intended landing. The ASA-SVS provides the pilot with a virtual day Visual Meteorological Conditions (VMC) display irrespective of the outside conditions. It is intended to support the pilots' early recognition of non-navigation related divergence from the intended path and thereby reduce the risk of loss of control inflight (LOC-I).

2.3.2 The ASA-SVS, as described in RTCA DO-371, is intended for display full-time on the pilots' full color head down Primary Flight Displays (PFD). RTCA DO-371 also provides guidance for implementing an ASA-SVS on a HUD, or HUD equivalent display, to supplement the head down PFD ASA-SVS presentation. The DO-371 standards are not sufficient to replace the heads down PFD ASA-SVS with a HUD ASA-SVS. If the applicant intends to use a HUD ASA-SVS without a corresponding PFD ASA-SVS they should provide additional analysis showing the HUD, or HUD equivalent display implementation meets the ASA-SVS function.

2.3.3 RTCA DO-371 Section 1.2 provides an ASA-SVS overview, system description, and basic system architecture.

CHAPTER 3. AIRWORTHINESS PACKAGE CONTENTS

3.1 Airworthiness Package

This AC specifically addresses SVS with attitude displayed on the primary flight display (PFD), SVS with a head down display other than a PFD (such as a navigation display or multifunction display), SVGS, and ASA-SVS. The applicant is responsible for the following contents in the TC, ATC or STC package (for the purpose of this AC).

3.1.1 Intended function: RTCA DO-315A, DO-359 and DO-371 provide samples of statements of intended function for SVS, SVGS and ASA-SVS respectively. The sample statements of intended function in the RTCA documents are not an exhaustive list. The applicant should do their own analysis and ensure that any statements of intended function accurately reflect the SVS, SVGS or ASA-SVS application for airworthiness approval.

3.1.2 General operation: Chapter 4 of this document provides information on general operations and specific performance criteria for the SVS.

3.1.2.1 RTCA DO-315A section 2 provides SVS general system performance standards. RTCA DO-315A section 3 provides SVS detailed system standards.

3.1.2.2 RTCA DO-359 section 2 provides SVGS general standards. RTCA DO-359 section 3 provides SVGS standard performance standards.

3.1.2.3 RTCA DO-371 section 2 provides ASA-SVS general standards. RTCA DO-371 section 3 provides ASA-SVS minimum performance standards.

3.1.3 Performance Standards and Evaluation Criteria: The airworthiness package should include the performance criteria and an evaluation plan for the respective system. SVS performance evaluation is addressed in Chapter 5 of this document. SVGS and ASA-SVS performance evaluation is addressed in section 4 of RTCA DO-359 for SVGS and section 4 of RTCA DO-371 for ASA-SVS.

CHAPTER 4. SYSTEM CRITERIA

4.1 SVS General Criteria and Performance Standards.

4.1.1 The proposed SVS should meet the SVS performance standards found in RTCA DO-315A and the additional SVS criteria in section 4.1.2. Use of RTCA DO-315A and AC 20-185A provides an acceptable performance baseline for SVS. The applicant may propose alternative standards for the SVS.

4.1.2 Following are additional notes to section 2 and 3 of RTCA DO-315A.

4.1.2.1 FAA documents referenced in DO-315A have been revised since the publication of DO-315A. The applicant should refer to the most recent version of the FAA documents referenced in DO-315A.

4.1.2.2 RTCA DO-315A discusses the implementation of SVS on Class 3 Electronic Flight Bags (EFB). The FAA no longer uses the Class 3 EFB definition. If incorporating SVS on an EFB, the applicant should follow the guidance in AC 120-76D, *Authorization for the Use of Electronic Flight Bags*.

4.1.2.3 Multiple vision system displays. If multiple displays show EVS, SVS, CVS information, or a combination (EVS on one and SVS on another), the orientation of the displays should be the same. If the alignment of the displays is not the same, the applicant should show that the non-alignment between the displays does not mislead the flight crew or cause confusion.

4.1.2.4 SVS on HUD or HUD equivalent display.

4.1.2.4.1 The SVS display must not distort the pilot compartment view, provide a distorted (i.e., non-conformal) view of the external scene, or interfere with the pilot's ability to safely perform any maneuvers within the operating limitations of the aircraft, including taxiing, takeoff, approach, and landing.

4.1.2.4.2 Providing complete guidance for SVS is complicated by many design variables available to manufacturers. Since synthetic vision displays can share many of the characteristics with a HUD or HUD equivalent display, applicants should use HUD, or HUD equivalent display guidance where appropriate.

4.1.2.5 SVS on a PFD.

4.1.2.5.1 Including a flight path vector or velocity vector to show the pilot the aircraft's trajectory relative to displayed terrain is recommended.

4.1.2.5.2 Pursuant to §§ 23.2600, 23.2600(a), 25/27/29.771, and 25/27/29.773, pilot tasks must not be degraded by the displayed imagery. Depending on the intended function of the display information, the imagery must not provide the pilot with misleading information regarding detection, accurate identification, and avoidance of terrain, obstacles, and other flight hazards. The FAA will evaluate alternative methods consistent with the FAA's safety continuum.

4.1.2.6 Terrain and Obstacle Database.

4.1.2.6.1 Terrain and obstacle database processing. The FAA recommends applicants use the guidance in AC 20-153B, *Acceptance of Aeronautical Data Processes and Associated Databases,* for terrain and obstacle databases, as well as any other databases used to create the SVS image. Applicants may propose other solutions.

4.1.2.6.2 RTCA DO-315A provides details on terrain databases resolution and accuracy. RTCA and the FAA have updated several of the TAWS standards since the publication of DO-315A. RTCA has published DO-367, *Minimum Operational Performance Standards for Terrain Awareness and Warning System Airborne Equipment*, and the FAA has published TSO-C151d. We encourage applicants to use these updated standards.

4.1.2.7 Display of Terrain and Obstacles.

4.1.2.7.1 If the intended function is "terrain awareness," the applicant should ensure the displayed terrain is consistent with the actual terrain. The display should provide a representation of the terrain in a manner that does not misrepresent the threat posed by the terrain, even if the displayed terrain does not match the actual terrain perfectly.

4.1.2.7.2 The display should adequately portray terrain awareness, even when the display is resolution or field-of-view limited. The pilot should be aware of less than 1:1 ratio of depiction. The pilot could be made aware of this ratio by training, the Airplane Flight Manual, symbology, or other means. Display suitability must be matched to the intended function.

4.1.2.7.3 The terrain depiction should include large bodies of water such as those depicted on Sectional Aeronautical Charts or Terminal Area Charts.

4.1.2.7.4 Runway Depiction. Runway elevations should be accurate at the approach ends and not just at the airport center.

4.1.2.7.5 Display of Obstacles. Obstacles displayed should be those deemed hazardous to the flight (or phase of flight). The applicant should provide procedures in the Instructions for Continued Airworthiness to ensure the most current obstacle database is installed. It is difficult to apply one

altitude value across a wide range of aircraft performance, from rotary wing to high performance fixed wing aircraft below which an obstacle would no longer be deemed hazardous. Generally, above 5,000 foot AGL, most obstacles are not tall enough to be hazardous. However, in the terminal area, even obstacles less than 1,000 foot AGL can be hazardous.

4.1.2.8 Features. If the SVS provides flight path guidance features, the features should complement (or correspond with) approved navigation system guidance.

4.2 SVGS General Criteria and Performance Standards.

4.2.1 SVGS should meet the performance standards in RTCA DO-359. The SVGS should also meet the SVS criteria in section 4.1 of this AC. Use of RTCA DO-359 and AC 20-185A together provides an acceptable performance baseline for the SVGS.

4.2.2 Additional Notes to section 2 and 3 of RTCA DO-359.

4.2.2.1 AC 120-118 provides guidance on receiving operational approval to use an SVGS to conduct an SA CAT I ILS instrument approach.

4.2.2.2 If the applicant implements SVGS only on a HDD, the aircraft should be capable of displaying the SVGS simultaneously on both the pilot and copilot's PFD.

4.2.2.3 The terrain, runway and obstacle database standards for the SVGS specified in RTCA DO-359, section 2.5 should support intended function, and the processes for their production and update should meet the standards in RTCA DO-200B, *Standards for Processing Aeronautical Data*, dated June 18, 2015. Navigation databases supporting creation of the SVS image should meet the standards in RTCA DO-201A, *Standards for Aeronautical Information*, dated April 19, 2000, or subsequent revisions. Terrain and obstacle databases supporting creation of the SVS image should use RTCA DO-276C, *User Requirements for Terrain and Obstacle Data*, dated September 22, 2015, section 4 to define data quality requirements (DQRs) adequate to support intended function. Airport map databases supporting the creation of the SVS image should meet the standards in RTCA DO-272D, User requirements for Aerodrome Mapping Information, dated September 22, 2015 or subsequent revisions.

4.2.2.4 Continued Airworthiness and Maintenance. Pursuant to 14 CFR 23.1529, 25.1529, 27.1529 and 29.1529, the applicant must develop instructions for continued airworthiness for maintaining the SVGS and its components. Other maintenance tasks may be developed as a result of the safety assessment, design reviews, manufacturer's recommendations and Maintenance Steering Group 3 (MSG-3) analyses that are conducted. These instructions include, but are not limited to removal and replacement,

troubleshooting, cleaning, maintenance procedures for the MEL relief and software loading/configuration control. Special consideration should be taken to consider the maintenance of databases used for SVGS operations and the impact of installed databases that have expired. The FAA will evaluate alternative methods consistent with the FAA's safety continuum.

4.3 **ASA-SVS General Criteria and Performance Standards.**

4.3.1 RTCA DO-371 section 2 provides general standards for ASA-SVS. RTCA DO-371 Section 3 provides minimum performance standards.

4.3.2 In addition to meeting the criteria of RTCA DO-371, the ASA-SVS should also meet all the criteria for a SVS found in section 4.1 of this AC.

CHAPTER 5. PERFORMANCE EVALUATION

5.1 SVS Performance Evaluation

5.1.1 Performance demonstration. Establishing aircraft system compliance with applicable FAA regulations typically includes bench testing, simulation flight testing, data collection, and data reduction to show that the proposed performance criteria can be met. Minimum performance standards necessitate an evaluation of the system used during anticipated operational scenarios. The performance evaluations should therefore include demonstrations of taxi, take-off, missed approaches, failure conditions, cross wind conditions, and approaches into specific airports as appropriate for the system's intended function.

5.1.2 This AC does not prescribe specific test procedures. The FAA recognizes that alternative methods can be used. Your test procedures must show compliance with the applicable regulations. System performance tests as they relate to operational capability are the most important tests. Subsystem tests are used to test subsystems during system buildup to ensure appropriate subsystem performance as it relates to overall system performance.

5.1.3 The applicant should use any of these four general verification methods as appropriate (refer to AC 25.1329-1C, AC 23.1309-1E, AC 27-1B, or AC 29-2C, as applicable):

5.1.3.1 Analysis. Demonstrate compliance using an engineering analysis.

5.1.3.2 Flight Test. Demonstrate compliance using an aircraft that is fully representative for the purpose of the test in terms of flight deck geometry, instrumentation, alerts, indications, and controls (in the air or on the ground).

5.1.3.3 Laboratory Test. Demonstrate compliance using an engineering bench representative of the final SVS/SVGS/ASA-SVS system being certified.

5.1.3.4 Simulation. Demonstrate compliance using a flight simulator.

5.1.4 The applicant should specify the individual verification methods in the certification plan. Confirm the appropriate certification office agrees with your plan before you begin. For extensions, features, and design decisions not explicitly specified in this AC, conduct human factors evaluations. Conduct these evaluations through analyses, bench, simulation, and/or flight testing, as appropriate.

5.1.5 The applicant should verify both the installed system and the individual system components meet the SVS criteria described in Chapter 4.

5.1.6 The applicant should demonstrate the system meets the performance criteria specified in Chapter 4 by flight test and other appropriate means, which can include use of a flight simulator. The flight test program assumes that the guidance system utilized to

satisfactorily position the aircraft has been separately tested and shown to fully perform its intended function. Testing and data collection to demonstrate this is not part of this document.

5.1.7 Airframe and equipment manufacturer based tests or analyses, as applicable, should be developed and conducted to validate the detailed system criteria. No specific test procedures are cited because alternative methods can be used. You can use alternate procedures if you can demonstrate that they provide all the required information. System performance tests as they relate to operational capability are the most important tests. Subsystem tests are added during system buildup to ensure appropriate subsystem performance as it relates to overall system performance.

5.1.8 The applicant should conduct an evaluation of the system used during anticipated operational scenarios.

5.2 SVGS Performance Evaluation

5.2.1 RTCA DO-359 section 4 provides system performance verification criteria.

5.2.2 In addition to the test conditions listed in DO-359 section 4.2.2, the applicant should also demonstrate their system in representative day and night VMC.

5.2.3 Where appropriate for the performance demonstration, the non-visual conditions can be achieved either by natural obscuration or by use of a visibility limiting device in front of the pilot.

5.2.4 The use of a simulator can be considered, provided the simulator was assessed to adequately conform with respect to the aircraft and the SVGS performance, and was assessed to be suitable for the required task.

5.2.5 The workload associated with using the SVGS to fly instrument approaches to a missed approach point of 150 feet HAT should be considered when showing compliance with 14 CFR 23.2610, 25.1523, 27.1523, 29.1523, and meeting the provisions of AC 23.1523, AC 25.1523, AC 27-1B, AC 29-2C as applicable to the aircraft in which the SVGS is being installed. The FAA will evaluate alternative methods consistent with the FAA's safety continuum.

5.3 ASA-SVS Performance Evaluation

RTCA DO-371 section 4 provides system performance verification criteria.

5.4 Preventive Maintenance.

Incorporate all appropriate maintenance requirements into the Instructions for Continued Airworthiness pursuant to 14 CFR 23.1529, 25.1529, 27.1529, or 29.1529, as applicable. The FAA will evaluate alternative methods consistent with the FAA's safety continuum.

5.5 **Environmental Testing.**

Follow the guidance in AC 21-16G, RTCA Document DO-160 versions D, E, F, and G, "*Environmental Conditions and Test Procedures for Airborne Equipment.*"

5.6 **Design Assurance.**

5.6.1 Sections 23.2500, 25.1309, 27.1309, and 29.1309 require applicants to design systems to ensure they perform their intended function. The applicant should use the guidance provided in the following ACs when accomplishing their system safety assessment and showing compliance with the above regulations as applicable.

- AC 20-174, *Development of Civil Aircraft and Systems*
- AC 23.1309-1E, *System Safety Analysis and Assessment for Part 23 Airplanes*
- AC 25.1309-1A, *System Design and Analysis*
- AC 27-1B, *Certification of Normal Category Rotorcraft*
- AC 29-2C, *Certification of Transport Category Rotorcraft*

5.6.2 Follow the guidance in AC 20-115D, *Airborne Software Development Assurance Using EUROCAE ED-12() and RTCA DO-178()* to develop software. The version should be current at time of application.

Follow the guidance in AC 20-152, *RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware*, to develop your airborne electronic hardware, if applicable. The version should be current at time of application.

APPENDIX A. SAMPLE AIRPLANE FLIGHT MANUAL (AFM) SUPPLEMENT

Note: Appendix A presents a sample for the AFM supplement for STC installations. This example may not be entirely applicable to airplane manufacturers when SVS, SVGS, or ASA-SVS are approved with the type certificate. The ACO will assist the applicant in developing an appropriate Rotorcraft Flight Manual Supplement (RFMS).

Installation Center/Repair Station Model XXX SVS/SVGS/ASA-SVS

123 Fourth Street Vision System

Anytown, USA

FAA-APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT

ABC MODEL XXX YYY VISION SYSTEM

AIRPLANE MAKE:

AIRPLANE MODEL:

AIRPLANE SERIAL NO.:

REGISTRATION NO.:

This document must be carried in the airplane at all times. It describes the operating procedures for the ABC Model XXX YYY vision system when it has been installed in accordance with <*manufacturer's installation manual number and date*>.

For airplanes with an FAA-Approved Airplane Flight Manual, this document serves as the FAA-Approved ABC Model XXX YYY Flight Manual Supplement. For airplanes that do not have an approved flight manual, this document serves as the FAA-Approved ABC Model XXX YYY Supplemental Flight Manual.

The information contained herein supplements or supersedes the basic Airplane Flight Manual dated <*insert date*> only in those areas listed herein. For limitations, procedures, and performance information not contained in this document, consult the basic Airplane Flight Manual.

FAA APPROVED

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Title
Office
Federal Aviation Administration
City, State

SAMPLE AIRPLANE FLIGHT MANUAL (Continued)

Installation Center/Repair Station Model XXX SVS/SVGS/ASA-SVS
123 Fourth Street Vision System
Anytown, USA

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SAMPLE AIRPLANE FLIGHT MANUAL (Continued)

Installation Center/Repair Station Model XXX SVS/SVGS/ASA-SVS

123 Fourth Street Vision System

Anytown, USA

SECTION 1 - GENERAL

<Include the appropriate statement to describe the equipment capability:>

SVS: The installed ABC Synthetic Vision System meets the FAA-accepted general criteria and performance standards specified in AC 20-185A for <*situation awareness*>.

SVGS: The installed SVGS meets the general criteria and performance standards specified in AC 20-185A for SVGS to be used for instrument landing system (ILS) approaches with a DH no lower than 150 feet HAT.

ASA-SVS: The installed ABC ASA-SVS meets the general criteria and performance standards specified in AC 20-185A for <*situation awareness*>.

SECTION 2 - LIMITATIONS

1. The system must utilize software version <*insert version identification*>.

2. Valid and compatible databases must be installed and contain current data. *<The terrain, runway, and obstacle database requirements must support the intended function applicable to the particular installation.>*

3. The <Insert model specific identification of the SVGS installed> meets the general criteria and performance specified in AC 20-185A, *Airworthiness Approval of Synthetic Vision System, Synthetic Vision Guidance System and Aircraft State Awareness Synthetic Vision System*. However, this does not constitute operational approval for use.

4. <*Specify any additional limitations applicable to the particular installation.*>

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SECTION 3 - EMERGENCY/ABNORMAL PROCEDURES

EMERGENCY PROCEDURES

No Change

ABNORMAL PROCEDURES

1. If ABC Model XXX YYY vision system information is not available or invalid, utilize remaining operational navigation equipment as appropriate.

2. If Loss of Integrity Monitoring message is displayed, revert to an alternate means of navigation appropriate to the route and phase of flight or periodically cross-check the GPS guidance to other, approved means of navigation.

SECTION 4 - NORMAL PROCEDURES

1. Normal operating procedures are outlined in the ABC Model XXX YYY Pilot's Guide.

2. System Annunciators <*applicable to installations with external annunciators*>.

3. System Switches <*applicable to installations with external switches*>.

4. Pilot's Display <*describe the pilot's display(s)*>.

5. Flight Director/Autopilot Coupled Operation <*describe any procedures for integrated flight director and/or autopilot system(s)*>.

6.<*Include any other normal operating procedures as necessary.*>

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SECTION 5 - PERFORMANCE

No Change

SECTION 6 - WEIGHT AND BALANCE

<Refer to revised weight and balance data, if applicable.>

SECTION 7 - SYSTEM DESCRIPTION

<Provide a brief description of the system, its operation, installation, etc.>

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APPENDIX B. SYNTHETIC VISION SYSTEMS INSTALLED IN ROTORCRAFT

B.1 **General.**

This appendix provides guidelines for the installation of SVS in rotorcraft as non-required safety enhancing equipment. To promote standardized installation of non-required safety enhancing equipment, a policy memorandum, PS-ASW-27, 29-10, Policy Statement Concerning Non-Required Safety Enhancing Equipment (NORSEE) in Rotorcraft, dated 5/29/2013, was published to address a means of compliance for the installation of non-required safety enhancing equipment. Contact your ACO for guidance. Also, refer to AC 27-1B and AC 29-2C for certification guidance.

B.2 **Applicability.**

There are unique aspects to rotorcraft that do not apply to fixed wing aircraft. Rotorcraft typically operate at altitudes much closer to the ground and obstacles than fixed-wing aircraft. Additionally, they are inherently unstable and, without a stabilization system, require hands-on control at all times accompanied by constant visual scans to keep the rotorcraft oriented correctly. There are advantages and disadvantages to presenting SVS information to the pilot. Particular issues of concern are the compelling nature of the display used in a VFR see-and-avoid environment, the presentation of misleading information relating to aircraft location relative to hazards (particularly in night operations), and the installation of SVS displays that interact with automated flight control systems and flight guidance systems.

B.3 **Airworthiness Approval.**

For rotorcraft, the applicant should accomplish all SVS/SVGS/ASA-SVS installations on the primary flight display (PFD) or navigation display through the TC/STC/ATC process.

B.4 **Design Considerations.**

The functional hazard analysis (FHA) developed for the system should define the hazards of presenting misleading information to the pilot, and loss of an SVS feature. The system should be designed accordingly. The hazard classification will be based on display location, intended function of the system features, and phase of flight. The hazard classification of misleading information for SVS on the primary flight displays will be higher than the classification of misleading information on a display outside the pilot's primary field of view. For example, the hazard classification of misleading information may be lower if the SVS is placed on ancillary displays not used for the display of flight information and not in the pilot's primary field of view. The intended function of the SVS/SVGS/ASA-SVS should be defined as it specifically applies for the rotorcraft application. If HTAWS or HTAWS-like features are incorporated, see TSO-C194 HTAWS, AC 27-1B, or AC 29-2C, MG-18 as appropriate for additional criteria.

APPENDIX C. ADDITIONAL CONSIDERATIONS FOR SYNTHETIC VISION SYSTEM USED FOR SITUATION AWARENESS ONLY

C.1 **Terrain Alerting.**

Any airplane equipment incorporating a synthetic vision system should also provide some type of terrain warning for pilots. The terrain warning feature should be incorporated on the Multifunction Display (MFD) or separate display unless the applicant can demonstrate that the feature is effective on the PFD. Synthetic vision systems on the PFD should provide adequate altitude and distance cues if used for terrain warning.

Applicants may use TSO-C151d, TAWS, Class A, B, or C, or TSO-C194 standards as applicable. Applicants may develop their own terrain warning system. However, the option of developing a terrain warning system is only available when there is not a specific carriage requirement for TAWS or HTAWS; it is not a substitute for any TAWS or HTAWS regulatory requirement. Applicants who want to develop their own terrain warning system should include:

- A one-minute caution and 30-second warning if the airplane's current flight path will collide with terrain.
- A 20 second caution and 10 second warning if the rotorcraft's current flight path will collide with terrain.
- Aural call-out for both the caution and the warning (CAUTION – TERRAIN, TERRAIN; WARNING – TERRAIN, TERRAIN).
- Terrain impact region highlighted on the moving map.
- A safety margin or buffer of at least 100 feet for cumulative errors in both the GPS altitude and terrain database.
- A terrain database/digital evaluation model (DEM) developed using the criteria in RTCA DO-200B, Standards for Processing Aeronautical Data, dated June 18, 2015.
- The synthetic vision display must not provide any information that is in conflict with or incompatible with either the terrain warning or terrain awareness functions of the TAWS or HTAWS.

C.2 **Moving Map Display that Corresponds to and Complements Synthetic Vision PFD Display.**

If there is a second complementary map view display, the second display should depict the same terrain, obstacles, or cultural features that appear on the PFD's synthetic vision display in a consistent manner and not cause confusion to the crew when comparing the same feature across displays. This display could be on the navigation display, but also be an MFD or a third separate display. Ideally, the TAWS or HTAWS or terrain alerting

system should be part of this display (unless incorporated into the PFD) so that hazardous terrain or obstacles are highlighted.

C.3 **Minimums Audio Callout Capability.**

Applicants are encouraged to incorporate either a pilot selectable or automatic altitude alert with audio callout to remind pilots they are approaching minimums. Pilots may "see" the runway environment on their synthetic vision display and continue below minimums inadvertently because they were so intent on following the approach guidance. This scenario is similar to pilots fixating on a flight director and descending below minimums. Alerting pilots that they are nearing minimums reduces the opportunity for this situation to occur.

C.4 **Digital Evaluation Model (DEM) Resolution.**

The DEM resolution is one factor that determines how well the synthetic vision terrain depiction will match the terrain environment. National Aeronautics and Space Administration (NASA) experiments, documented in NASA/TP-2008-215130, *Aspects of Synthetic Vision Display Systems and Best Practices of the NASA's SVS Project* and NASA/TP-2007-214864, *Terrain Portrayal for Synthetic Vision Systems Head-Down Displays Evaluation Results*, have shown that a terrain resolution of 30 arc-seconds (with arc-seconds referenced to an equatorial measurement) "rounds off" the terrain peaks and fills in valleys. This makes the terrain appear less hazardous for the peaks than it is and potentially reduces some safety benefit. Conversely, for the valleys, the terrain appears higher and its depiction is therefore conservative. The same set of NASA experiments pointed out that even though pilots preferred terrain created using higher resolutions (one and three arc-seconds), a synthetic vision display using a 30 arc-second database could provide more situation awareness (and, therefore, safety) than the conventional instrument panel. Therefore, we had historically considered 30 arc-second resolution the minimum safety standard for synthetic vision displays. This allowed for the introduction of synthetic vision systems given the technology limitations. However, technology has surpassed the need to allow as low a minimum resolution. New systems should meet 15 equatorial arc-seconds or better. Current systems do very well at twice the resolution minimum, but we want to encourage applicants to use the highest resolutions available in unclassified databases. Applicants may also consider using very high-resolution databases near airports while reducing the resolution in the rest of the database. However, for systems intended to support low altitude operations, for example helicopter operations, the use of high-resolution databases for all phases of flight might be more appropriate. More importantly, applicants should clearly define the resolution and measuring units of the DEM used by their synthetic vision system in the Aircraft Flight Manual Supplement (AFMS) and the pilots' handbooks so that pilots can understand any visual limitation caused by resolution limits.

> **Note:** The DEM resolution needed on a synthetic vision display depends on the intended function of that display. Applicants need to consider how they are going to use the terrain database information for their synthetic vision

display, and this information should be given to the FAA at the beginning of a synthetic vision certification program. Common elevation references are average elevation, maximum elevation, and sometimes, the elevation of the geometric center of the area. As post-spacing increases, the difference between the DEM value and the actual elevation of a point within a cell may differ significantly. The elevations used for a synthetic vision display should be conservative; use the highest elevation for a given cell. This concept is identical to the current sectional charts labeling the highest elevation in the given quadrangle (square sector) of latitude and longitude.

C.5 **Aircraft Flight Manual Supplement (AFMS).**

The AFMS should contain limitations for pilots on use of the applicant's system. These limitations should be explained in detail. Warnings, cautions, and notes should also address the proper use and potential misuse of the display for terrain awareness and avoidance.

C.6 **SVS Unusual Attitude Recovery.**

Historically, the FAA required removal of all but essential flight information from the PFD in unusual attitudes. This "decluttering" was meant to aid pilots in recovering the aircraft. Therefore, the first synthetic vision systems removed the synthetic depiction and reverted to the traditional "blue-over-brown" display during unusual attitudes. Based on a past report, the FAA Civil Aeronautical Medical Institute (CAMI) observed little performance difference between recoveries with and without the synthetic depiction. Furthermore, there was a possibility pilots might be temporarily confused by the significant change to their primary attitude display. Therefore, applicants should consider leaving the synthetic vision depiction on the PFD for unusual attitude recovery.

C.6.1 An accurate, easy, quick-glance interpretation of attitude should be possible for all unusual attitude situations. Information to perform effective manual recovery from unusual attitudes using chevrons, pointers and/or permanent ground-sky horizon on all attitude indications is recommended.

C.6.2 Pilots should be able to initiate a recovery toward the correct horizon and altitude within one second of recognition.

Note: For example, a test scenario could include climbing with a large mountain or plateau in the background into a stall condition or descending into rising terrain with decreasing airspeed into a stall condition.

C.6.3 The artificial horizon line and/or other attitude-related symbology (for example, aircraft symbol and pitch ladder) should be very prominent and highly visible against all possible backgrounds, including the assignment of a level of priority over other symbology on the display commensurate with its importance.

APPENDIX D. DEFINITIONS AND ACRONYMS

D.1 Definitions

D.1.1 **Aircraft State Awareness Synthetic Vision System** (RTCA DO-371) – A display of perspective view synthetic terrain and overlaid primary flight display symbology that is intended to enhance perception of aircraft motion and to enhance attitude and energy state awareness.

D.1.2 **Appliance** (14 CFR 1.1) - Any instrument, mechanism, equipment, part, apparatus, appurtenance, or accessory, including communications equipment, that is used or intended to be used in operating or controlling an aircraft in flight, is installed in or attached to the aircraft, and is not part of an airframe, engine, or propeller.

D.1.3 **Approach Lighting Designators**

ALSF-I: Approach Light System with Sequenced Flashing Lights in ILS Cat I Configuration.

ALSF-II: Approach Light System with Sequenced Flashing Lights in ILS Cat II Configuration. The ALSF-II may operate as a SSALR when weather conditions permit.

MALSR: Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights.

SSALR: Simplified Short Approach Lighting System with Runway Alignment Indicator Lights.

MALSF: Medium Intensity Approach Lighting System with Sequenced Flashing Lights.

D.1.4 **Command Guidance** - Symbolic information that directs the pilot to follow a course of action to control attitude or thrust in a specific situation (for example, flight director).

D.1.5 **Conformal** (AC 25-11B) - Refers to displayed graphic information that is aligned and scaled with the outside view.

D.1.6 **Decision Altitude** (14 CFR 1.1) - A specified altitude in an instrument approach procedure at which the pilot must decide whether to initiate an immediate missed approach if the pilot does not see the required visual reference, or to continue the approach. Decision altitude is expressed in feet above mean sea level.

D.1.7 **Decision Height** (14 CFR 1.1) - A specified height above the ground in an instrument approach procedure at which the pilot must decide whether to initiate an immediate missed approach if the pilot does not see the required visual reference, or to continue the approach. Decision height is expressed in feet above ground level.

D.1.8 **Egocentric** - Used to define the view of a display image that correlates to inside the aircraft. One example is what the flight crew would see out the window from a forward facing perspective.

D.1.9 **Exocentric** - Used to define the view of a display image that correlates to outside the aircraft. One common exocentric view would be a North Up Plan view shown on moving map displays.

D.1.10 **Eye Reference Point (ERP)** - The point in the cockpit that allows for a finite reference enabling the precise determination of geometric entities that define the layout of the cockpit and displays.

D.1.11 **Field of Regard (FOR)** (SAE ARP 5677) - The angular extent of the external world that is represented on a display.

D.1.12 **Field of View (FOV)** - The angular extent of the display that can be seen by either pilot with the pilot seated at the pilot's station. Refer to appropriate category of aircraft certification guidance for further information.

D.1.13 **Flare Guidance** - Provides explicit command guidance for the pilot to flare the aircraft.

D.1.14 **Flare Prompt** - The flare prompt advises the pilot when it is time to begin making the control inputs for the flare maneuver and transition to landing. A flare prompt does not provide command guidance to maneuver the airplane with regard to the rate or magnitude of manual inputs, alignment to runway heading nor touching down at a specific point on the runway.

D.1.15 **Flicker** (RTCA DO-315A) - High frequency luminance variations.

D.1.16 **Flight Path Angle Reference Cue** - Pilot selectable reference cue on the pitch scale displaying the desired approach angle.

D.1.17 **Flight Path Vector** - A symbol on the primary display (HUD, HUD equivalent, or PFD) that shows where the aircraft is actually going, the sum of all forces acting on the aircraft.

D.1.18 **Flight Visibility** (14 CFR 1.1) - The average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects can be seen and identified by day and prominent lighted objects can be seen and identified by night.

D.1.19 **Height Above Touchdown (HAT)** (Aeronautical Information Manual) – The height of the Decision Height or Minimum Descent Altitude above the highest runway elevation in the touchdown zone (first 3,000 feet of the runway). HAT is published on the instrument approach charts in conjunction with all straight-in minimums.

D.1.20 **Head Up Display (HUD)** (AC 25.1329-1C) - A transparent optical display system located level with and between the pilot and the forward windscreen. The HUD displays a combination of control, performance, navigation, and command information

superimposed on the external field of view. It includes the display element, sensors, computers and power supplies, indications, and controls. It is integrated with airborne attitude, air data, and navigation systems, and as a display of command information is considered a component of the flight guidance system.

D.1.21 **HUD Equivalent Display** (RTCA DO-315A) – A display with at least the following characteristics:

- A head-up presentation not requiring the transition of visual attention from head down to head up.
- Displays imagery and or/symbology conformal (as defined in SAE AS 8055) with the pilots external view.
- Permits simultaneous view of the imagery (if presented), aircraft flight symbology and the external view.
- Display characteristics and dynamics suitable for manual control of the aircraft.

D.1.22 **Instrument** (14 CFR 1.1) - A device using an internal mechanism to show visually or aurally the attitude, altitude, or operation of an aircraft or aircraft part. It includes electronic devices for automatically controlling an aircraft in flight.

D.1.23 **Instrument meteorological conditions (IMC)** (14 CFR 170.3) - Weather conditions below the minimums prescribed for flight under Visual Flight Rules (VFR).

D.1.24 **Jitter** (RTCA DO-315A) - High frequency positional oscillations.

D.1.25 **Latency** (AC 25-11B) - The time taken by the display system to react to a triggered event coming from an input/output device, the symbol generator, the graphic processor, or the information source.

D.1.26 **Minification** – Perceived visual compression effect stemming from the display of imagery with a wider field of view than the conformal field of view of the display device.

D.1.27 **Minification Factor** – Field of view of the imagery being displayed to the pilot divided by the conformal field of view of the display.

D.1.28 **Minimum Descent Altitude** (14 CFR 1.1) - The lowest altitude specified in an instrument approach procedure, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering until the pilot sees the required visual references for the heliport or runway of intended landing.

D.1.29 **Primary Flight Display (PFD)** - The displays used to present primary flight information.

D.1.30 $\mathbf{R_{max}}$**.** The maximum range the radar can detect.

D.1.31 **Situation Information** (AC 120-29A, *Criteria for Approval of Category I and Category II Weather Minima for Approach*) - Information that directly informs the pilot about the status of the aircraft system operations or specific flight parameters including flight path.

D.1.32 **Synthetic Vision** (14 CFR 1.1) - A computer-generated image of the external scene topography from the perspective of the flight deck that is derived from aircraft attitude, high-precision navigation solution, and database of terrain, obstacles and relevant cultural features.

D.1.33 **Synthetic Vision System (SVS)** (14 CFR 1.1) - An electronic means to display a synthetic vision image of the external scene topography to the flight crew.

> **Note:** "Topography" defined as maps or charts of natural and man-made features of a place or region especially in a way to show their relative positions and elevations, as applicable whenever deemed appropriate and practicable.

D.1.34 **Synthetic Vision Guidance System (SVGS)** (RTCA DO-359) - A guidance system which integrates a synthetic vision system scene depiction with additional functionality and display elements to support operations below standard precision approach operating minima. The additional display elements must include the runway of intended landing. Additional functions must include a flight path vector and flight path angle reference cue. An SVGS must meet the minimum requirements for reliability, availability, and integrity to be used for operational credit.

D.1.35 **Threshold Crossing Height (TCH)** (Pilot/Controller Glossary) - The theoretical height above the runway threshold at which the aircraft's glideslope antenna would be if the aircraft maintains the trajectory established by the mean ILS glideslope.

D.1.36 **Visual References** - Visual information the pilot derives from the observation of real-world cues, out the flight deck window, used as a primary reference for aircraft control or flight path assessment.

D.2 **Acronyms.**

Acronym	Phrase
AC	Advisory Circular
ACO	Aircraft Certification Office
AFMS	Aircraft Flight Manual Supplement
AGL	Above Ground Level
ASA-SVS	Aircraft State Awareness Synthetic Vision System
BIT	Built In Test
CAT	Category
CVS	Combined Vision System
DA	Decision Altitude
DEM	Digital Elevation Model

Acronym	Phrase
DH	Decision Height
DQR	Data Quality Requirements
DTED	Digital Terrain Elevation Data
EASA	European Union Aviation Safety Agency
EFB	Electronic Flight Bag
EFIS	Electronic Flight Instrument System
EMI	Electromagnetic Interference
EVS	Enhanced Vision System
FAA	Federal Aviation Administration
FHA	Functional Hazard Analysis
FMEA	Failure Mode and Effects Analysis
FOR	Field of Regard
FOV	Field of View
FTA	Fault Tree Analysis
GPS	Global Positioning Satellites
HAT	Height Above Touchdown
HDD	Head Down Display
HIRF	High Intensity Radiated Fields
HMI	Hazardously Misleading Information
HTAWS	Helicopter Terrain Awareness and Warning System
HUD	Head up Display
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LOC-I	Loss of Control Inflight
LPV	Localizer Performance with Vertical guidance
MASPS	Minimum Aviation System Performance Standards
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
MFD	Multi-Function Display
ND	Navigation Display
PFD	Primary Flight Display
RFM	Rotorcraft Flight Manual
RVR	Runway Visual Range
SA	Special Authorization
SSA	System Safety Analysis
STC	Supplemental Type Certificate
SVS	Synthetic Vision System
SVGS	Synthetic Vision Guidance System
TAWS	Terrain Awareness and Warning System

Acronym	Phrase
TC	Type Certificate
TCH	Threshold Crossing Height
TDZE	Touchdown Zone Elevation
TSO	Technical Standard Order
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

APPENDIX E. RELATED PUBLICATIONS

E.1 **Related Publications.**

E.1.1 FAA Documents:

E.1.1.1 Order 8110.4C, *Type Certification*.

E.1.1.2 Order 8110.54A, *Instructions for Continued Airworthiness Responsibilities, Requirements, and Contents*.

E.1.1.3 AC 20-115D, *Airborne Software Development Assurance Using EUROCAE ED-12( ) and RTCA DO-178( ).*

E.1.1.4 AC 20-152, *RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware.*

E.1.1.5 AC 20-153B, *Acceptance of Aeronautical Data Processes and Associated Databases.*

E.1.1.6 AC 20-167B, *Airworthiness Approval of Enhanced Vision System, Combined Vision System, and Enhanced Flight Vision System Equipment.*

E.1.1.7 AC 21-16G, *RTCA Document DO-160 versions D, E, F, and G, "Environmental Conditions and Test Procedures for Airborne Equipment.*

E.1.1.8 AC 23-18, *Installation of Terrain Awareness and Warning System (TAWS) Approved for Part 23 Airplanes*.

E.1.1.9 AC 23.1309-1E, *System Safety Analysis and Assessment for Part 23 Airplanes.*

E.1.1.10 AC 23.1311-1C, *Installation of Electronic Display in Part 23 Airplanes.*

E.1.1.11 AC 25-11B, *Electronic Flight Displays*.

E.1.1.12 AC 25-23, *Airworthiness Criteria for the Installation Approval of a Terrain Awareness and Warning System (TAWS) for Part 25 Airplanes*.

E.1.1.13 AC 25.571-1D, *Damage Tolerance and Fatigue Evaluation of Structure.*

E.1.1.14 AC 25.629-1B, *Aeroelastic Stability Substantiation of Transport Category Airplanes.*

E.1.1.15 AC 25.1309-1A, *System Design and Analysis*.

E.1.1.16 AC 25.1329-1C, Change 1, *Approval of Flight Guidance Systems*.

E.1.1.17 AC 25.1523-1, *Minimum Flightcrew*.

E.1.1.18 AC 27-1B, *Certification of Normal Category Rotorcraft*.

E.1.1.19 AC 29-2C, *Certification of Transport Category Rotorcraft.*

E.1.1.20 AC 120-57A, *Surface Movement Guidance and Control System*.

E.1.1.21 AC 120-118, *Criteria for Approval/Authorization of All Weather Operations (AWO) for Takeoff, Landing, and Rollout*.

E.1.1.22 PS-ANM100-2001-00085, Subject: Current Heads Up Display (HUD) Certification Criteria - Working Paper.

E.1.2 RTCA, Inc. Documents

E.1.2.1 DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment.*

E.1.2.2 DO-178C, *Software Considerations in Airborne Systems and Equipment Certification*.

E.1.2.3 DO-200B, *Standards for Processing Aeronautical Data.*

E.1.2.4 DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*.

E.1.2.5 DO-276B, *User Requirements for Terrain and Obstacle Data*.

E.1.2.6 DO-309, *Minimum Operational Performance Standards (MOPS) for Helicopter Terrain Awareness and Warning System (HTAWS) Airborne Equipment.*

E.1.2.7 DO-315A, *Minimum Aviation System Performance Standards (MASPS) for Enhanced Vision Systems, Synthetic Vision Systems, Combined Vision Systems, and Enhanced Flight Vision Systems.*

E.1.2.8 DO-367, *Minimum Operational Performance Standards (MOPS) for Terrain Awareness and Warning Systems (TAWS) Airborne Equipmen.t*

E.1.2.9 DO-359, *Minimum Aviation System Performance Standards (MASPS) for Synthetic Vision Guidance Systems.*

E.1.2.10 DO-371, *Minimum Aviation System Performance Standards (MASPS) for Aircraft State Awareness Synthetic Vision Systems*.

E.1.3 SAE International Documents.

E.1.3.1 ARP 4101, *Flight Deck Layout and Facilities*.

E.1.3.2 ARP 4102, *Flight Deck Panels, Controls, and Displays*.

E.1.3.3 ARP 4103A, *Flight Deck Lighting for Commercial Transport Aircraft*.

E.1.3.4 ARP 4105C, *Abbreviations, Acronyms, and Terms for Use on the Flight Deck.*

E.1.3.5 ARP 4754A, *Guidelines for Development of Civil Aircraft and Systems.*

E.1.3.6 ARP 4761, *Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.*

E.1.3.7 ARP 5288, *Transport Category Airplane Head Up Display (HUD) Systems.*

E.1.3.8 ARP 5589, *Human Engineering Considerations for Design and Implementation of Perspective Flight Guidance Displays*.

E.1.3.9 ARP 5677, *Human Engineering Considerations for Airborne Implementation of Enhanced Synthetic Vision Systems.*

E.1.3.10 AS 8034C, *Minimum Performance Standard for Airborne Multipurpose Electronic Displays*.

E.1.3.11 AS 8055A, *Minimum Performance Standard for Airborne Head Up Display (HUD).*

E.2 **How to Get Publications.**

E.2.1 Order copies of 14 CFR, from the Superintendent of Documents, Government Printing Office, P.O. 979050, St. Louis, MO 63197-9000. For general information, telephone (866) 512-1800 or fax (202) 512-2104. You can order copies online at https://bookstore.gpo.gov/catalog/code-federal-regulations-cfrs-print. In the search bar at the top of the page, type in "14CFR". Alternatively, you can view a current, unofficial version of 14 CFR using the Electronic Code of Federal Regulations online at https://www.ecfr.gov/.

E.2.2 You can get copies of FAA ACs from the FAA website at https://rgl.faa.gov/ or www.faa.gov/regulations_policies/advisory_circulars/.

E.2.3 You can find a current list of TSOs on the FAA Internet website Regulatory and Guidance Library at https://rgl.faa.gov/. You will also find the TSO Index of Articles at the same site.

E.2.4 Order copies of RTCA documents from RTCA, Inc., 1150 18th St., NW, Suite 910, Washington, DC 20036, telephone (202) 833-9339, fax (202) 833-9434, or website: www.rtca.org.

E.2.5 Order copies of SAE documents from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA, telephone: (877) 606-7323, or website: http://www.sae.org.

E.2.6 Order copies of military documents from the DLA Document Services, Building 4/Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5098. Telephone (215) 697-2179. You can also order copies online at http:// http://quicksearch.dla.mil/.

APPENDIX F. ADVISORY CIRCULAR FEEDBACK INFORMATION

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by emailing this form to 9-AWA-AVS-AIR-DMO@faa.gov

Subject: AC 20-185A Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

☐ Other comments:

☐ I would like to discuss the above. Please contact me.

Submitted by: _____ Date: _____