

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

**Safety, Performance and Interoperability
Requirements Document Defining Takeoff
Minima by Use of Enhanced Flight Vision
Systems**

RTCA DO-374
October 5, 2018

Prepared by: SC-213
© 2018 RTCA, Inc.

Copies of this document may be obtained from

RTCA, Inc.

Telephone: 202-833-3353

Facsimile: 202-333-9434

Internet: www.rtca.org

Please visit the RTCA Online Store for document pricing and ordering information.

FOREWORD

This document was prepared by Special Committee 213 jointly with EUROCAE Working Group 79 and approved by the RTCA Program Management Committee (PMC) and EUROCAE Council on October 5, 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 develops consensus-based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

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

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

DISCLAIMER

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

This Page Intentionally Left Blank

EXECUTIVE SUMMARY

This document provides the minimum operational, safety, and performance requirements (SPR) and interoperability requirements by which takeoff operations using an Enhanced Flight Vision System (EFVS) can be safely conducted in natural visibilities lower than currently authorized. These takeoff minima and associated SPRs are established for the use of EFVS, treated as subsystems, which together with other subsystems including navigational aids and airport lighting and markings, meet the operational goal/intended function and achieve the levels of reliability, availability, and integrity consistent with other systems and subsystems used for the similar intended function and phase of flight. In this document, recommendations for EFVS takeoff minima are defined with various associated aircraft equipage, operational and interoperability requirements, and airport infrastructure. The visibility minima are defined in terms of natural visibility since in the event of a failure or failures, the PF uses a combination of the remaining functional elements, other aircraft subsystems, and available out-the-window natural vision cues (e.g., lights and/or markings of the runway) to mitigate the failure effects and conduct a safe, successful takeoff or rejected takeoff.

This Page Intentionally Left Blank

TABLE OF CONTENTS

1	INTRODUCTION.....	1
1.1	Purpose of This Document.....	1
1.1.1	Takeoff Minima by use of Enhanced Flight Vision Systems	1
1.1.2	ETOS Intended Function	3
1.1.3	Use of Document for Approvals	3
1.1.4	Background – Vision Systems Technologies.....	4
1.1.5	EFVS Takeoff System (ETOS) Concept	5
1.1.6	Relationship to Other Applications.....	6
1.2	Scope of the Document.....	7
1.3	Structure of This Document.....	7
1.3.1	Document Organization	7
1.4	Aircraft Equipment Information Vulnerabilities.....	8
1.5	References.....	9
1.5.1	ICAO.....	9
1.5.2	Society of Automotive Engineering (SAE) Documents	9
1.5.3	FAA Documents	10
1.5.4	EASA / TCCA	10
1.5.5	EUROCAE/RTCA Documents.....	10
2	APPROACH AND METHODOLOGY	13
2.1	Document Development Process	13
2.2	Methodology	13
2.2.1	Operational Services and Environment Definitio (O ^o ED)	13
2.2.2	Safety and Performance Requirements	13
2.2.3	Interoperability Requirements (Interop)	14
2.3	Key Terms.....	14
2.3.1	Use of Requirements and Recommendations and Key Words	14
2.3.2	Assumptions.....	15
2.3.3	Mitigation means	15
2.3.4	Requirements	15
2.3.5	Recommendations.....	16
3	SAFETY AND PERFORMANCE REQUIREMENTS (SPR).....	17
3.1	Introduction.....	17
3.1.1	OPA Process	17
3.1.2	OSA Process	17
3.1.2.1	Mitigation Means	18
3.1.3	SPR Process	18
3.2	Assumptions.....	19
3.2.1	General Assumptions	19
3.2.2	Environmental Assumptions	19
3.2.3	Other Assumptions.....	19
3.3	Operational Requirements.....	19
3.4	ETOS Requirements	21
3.4.1	Functional Requirements	21
3.4.1.1	Airport / ANSP Requirements	22
3.4.2	Performance Requirements	22
3.4.2.1	Integrity and Safety Requirements.....	23

3.5	Data Requirements	24
3.6	Recommendations and Design Considerations	25
3.7	Training Considerations	25
4	INTEROPERABILITY REQUIREMENTS	27
4.1	Purpose of Interoperability Requirements	27
4.2	Scope of Interoperability Requirements	27
4.2.1	ETOS Domains	27
4.2.1.1	Ownship Domain	27
4.2.1.2	Other Aircraft and Vehicles Domain	27
4.2.1.3	Ground Domain	27
4.3	ETOS Interoperability Requirements	27
4.3.1	Interop Data	28
5	MEMBERSHIP	29
APPENDIX A: OPERATIONAL SERVICES AND ENVIRONMENT DEFINITION		A-1
A.1	Introduction	A-1
A.2	Background – Aerodrome Operations	A-1
A.3	Background – Takeoff Operations	A-2
A.4	Roles and Responsibilities	A-4
A.4.1	Airport	A-4
A.4.2	Air Traffic Control – If Active	A-4
A.4.3	Flight crew	A-5
A.5	Intended Function	A-5
A.6	EFVS Takeoff - Concept of Operations	A-5
A.6.1	Impact on Phraseology	A-9
A.6.2	Airspace Characteristics	A-9
A.6.3	Partial and Mixed Equipage Consideration	A-9
A.6.3.1	Air Traffic Control – If Active	A-9
A.6.3.2	Cockpit	A-10
A.6.3.3	Air Traffic Control – Tower Not Active	A-10
APPENDIX B: OPERATIONAL PERFORMANCE ASSESSMENT		B-1
B.1	Introduction	B-1
B.1.1	Purpose	B-1
B.1.2	General Performance Requirements	B-1
B.1.3	Compliance testing	B-2
APPENDIX C: OPERATIONAL SAFETY ASSESSMENT (OSA)		C-1
C.1	Objectives / Scope	C-1
C.2	System Safety Overview	C-1
C.2.1	EFVS Environment	C-2
C.2.2	JHA Process	C-2
C.3.1	Hazard Assessment	C-2
C.3.2	System Safety Levels and Probabilities	C-3
C.3.3	Design Assurance Levels and Demonstration	C-3
C.3.4	Environmental Qualification	C-3
C.3.5	Safety Demonstration	C-3
C.3.5.1	Mitigations	C-3

C.3.5.2 Additional possible mitigations beyond minimal set	C-5
C.3.5.3 Mitigations not considered to be acceptable at this time.....	C-6
C.4 Minimum Safety Requirements.....	C-6
C.4.1 Overall Objectives.....	C-6
C.4.1.1 Assumptions	C-7
C.5 ETOS-500 FHA: No lower than 500 ft visibility, Type 1/E Runway or better, at least 2 RVR Reporting	C-8
C.6 ETOS-1000 FHA: no lower than 1000 ft visibility	C-15
APPENDIX D: ACRONYMS	D-1
APPENDIX E: GLOSSARY	E-1

TABLE OF TABLES

Table 1-1: Summary of Visibility Minima Operation.....	3
Table 3-1: Operational Requirements	19
Table 3-2: ETOS Functional Requirements.....	21
Table 3-3: ETOS Performance Requirements.....	22
Table 3-4: ETOS Safety Requirements.....	23
Table A-1: Lowest Allowable Visibility Minima per Ops C078/C079	A-3
Table C-1: Hazard Assessment Effects, Probabilities and Design Assurance Levels	C-2
Table D-1: Acronyms	D-1
Table E-1: Glossary	E-1

TABLE OF FIGURES

Figure 1-1: Example Minimum ETOS-1000 Information Concept Overview	6
Figure 1-2: Example Minimum ETOS-500 Information Concept.....	6
Figure 2-1: Schematic of Requirements Relationships.....	16
Figure A-1: Example ETOS-1000 Concept.....	A-8
Figure A-2: Example ETOS-500 Concept.....	A-9

This Page Intentionally Left Blank

1 Introduction

This document is the minimum operational, safety, and performance requirements (SPR) and interoperability requirements (INTEROP) for Enhanced Flight Vision System (EFVS) associated with recommended takeoff minima.

Takeoff minima are established for the use of vision systems technologies, treated as subsystems, which together with other subsystems including navigational aids and airport lighting and markings, are used to accomplish the operational goal, achieve levels of reliability, availability, and integrity appropriate to the intended function and phase of flight. These levels are consistent with other systems and subsystems used for the same intended function and phase of flight.

Safety, performance, and interoperability requirements are derived from examination of the operation and the associated performance and safety analyses. The operation is outlined in the Operational Services and Environment Definition (OSED) in Appendix A. The Operational Performance Assessment (OPA) for this operation is established in Appendix B. Finally, the Operational Safety Assessment (OSA) is presented in Appendix C which analyzes the operational safety by considering potential hazards to which the flight crew and/or aircraft might be exposed during the EFVS takeoff operation and derives requirements in order to control the likelihood of the hazards and their effects. The assessment criteria are derived in whole or in part from applicable, existing guidance material which identifies airworthiness approval guidance for airborne systems used during a takeoff in low visibility weather conditions.

All material in this document was developed jointly by EUROCAE Working Group 79 (WG79) and RTCA Special Committee-213 (SC-213).

The requirements specified in this document are necessary to provide adequate assurance that the aircraft systems and other systems, when operating together, will perform their intended function – EFVS Takeoff – in an acceptably safe manner for the operations defined in the OSED. The system here includes the interaction and interoperability with ground and air navigation service provider elements.

1.1 Purpose of This Document

This document defines and allocates the set of minimum requirements for the end-to-end operational, safety, performance, and interoperability aspects for implementations of EFVS takeoff with recommended minima.

Allocation of these requirements is done by this SPR/INTEROP to the necessary domains of the aircraft with dependencies and assumptions, if necessary, to the airport operations, air navigation services providers (ANSP), and infrastructure level.

These requirements are intended to be used for approval processes including aircraft type design approval, aircraft operator operational approval, and (should they be necessary) Air Traffic Services (ATS) provider operational approval. Chapter 1.1.3 below provides more information on the use of this document for approvals.

In addition, this document provides guidance to determine the levels of design assurance and performance that are needed for each element (aircraft, operator, and, if applicable, ANSP—Air Navigation Service Provider and airport infra-structure level) to support the application.

1.1.1 Takeoff Minima by use of Enhanced Flight Vision Systems

An Enhanced Flight Vision System (EFVS) is an electronic means to provide a display of the forward external scene topography through the use of imaging sensors. The EFVS