



ED-235A

MINIMUM AVIATION SYSTEM PERFORMANCE STANDARD FOR FOREIGN OBJECT DEBRIS (FOD) DETECTION SYSTEMS

LEGAL NOTICE

This document is the exclusive intellectual and commercial property of EUROCAE. It is presently commercialised by EUROCAE. This electronic copy is delivered to your company/organisation for internal use exclusively. In no case it may be re-sold, hired, lent, or exchanged outside your company. It may not be reproduced, in whole or in parts, without prior written permission by EUROCAE.

APRIL 2024
SUPERSEDES ED-235

FOREWORD

1. This document was developed by EUROCAE Working Group 83 'Airport Foreign Object Debris (FOD) Detection Systems' and was approved by the Council of EUROCAE on 09 April 2024.
2. This document supersedes ED-235 'Minimum Aviation System Performance Specification for Foreign Object Debris Detection Systems'.
The document has been updated to better reflect the technology available on the market and as such better reflect consequences on airfield operation.
This release also introduces Artificial Intelligence considerations as may be applicable to aviation systems, at the time of publication.
3. EUROCAE, an international non-profit organisation, is the European leader in the development of worldwide recognised standards for aviation. This is achieved by utilising the expertise from our members and stakeholders across the global aviation community.
4. EUROCAE, an international non-profit organisation, is the European leader in the development of worldwide recognised standards for aviation. This is achieved by utilising the expertise from our members and stakeholders across the global aviation community.
5. EUROCAE standards are developed following an open, transparent and consensus-based process, governed by process and quality management principles, which are clearly documented and is in line with the World Trade Organisation (WTO) Technical Barriers to Trade (TBT) Agreement, Annex 3 "Code of Good Practice for the Preparation, Adoption and Application of Standards".
6. EUROCAE standards and other deliverables are recommendations and best industry practices. EUROCAE is not an official body of the European governments. EUROCAE standards are intended to complement and support the regulatory and certification framework.
7. Whilst efforts are made during the standards-development process to avoid the inclusion of proprietary information and material, some of the elements of this document may be the subject of patent, copyright or other proprietary rights. EUROCAE shall not be held responsible for identifying any such rights. Trade names and similar terms used within this document do not constitute an endorsement by EUROCAE thereof.
8. Copies of this document may be obtained from:

EUROCAE

9 – 23 rue Paul Lafargue

93200 Saint-Denis

France

Telephone: +33 1 49 46 19 65

Email: eurocae@eurocae.net

Website: www.eurocae.net

TABLE OF CONTENTS

FOREWORD	i
TABLE OF CONTENTS	ii
TABLE OF FIGURES	iii
CHAPTER 1	GENERAL 1
1.1	Introduction 1
1.2	Purpose and Scope 1
1.3	Glossary of Defined Terms 1
1.4	Abbreviations 2
1.5	Reference Documents 3
1.6	Operational Context of FOD Detection System 3
1.6.1	Operational Environment 3
1.6.2	Operational objectives 3
1.6.3	FOD Detection System relationship with other subsystems 3
1.6.4	Training 4
1.6.5	Maintenance 4
1.7	Fundamental System Design Concepts 4
1.7.1	Modularity 4
1.7.2	Evolution 4
1.7.3	Use of Artificial Intelligence 4
1.7.4	External Interoperability 5
1.7.5	Compliance with Applicable Aerodrome Requirements 5
CHAPTER 2	SYSTEM DESCRIPTION 6
2.1	FOD Detection System Architecture 6
2.1.1	General 6
2.1.2	Basic Functional Elements of a FOD Detection System 6
2.1.3	User Interface 7
2.2	Additional Functions 8
2.2.1	Assistance for FOD Removal 8
2.2.2	Operational Statistics 8
2.2.3	Multiple User Positions 8
CHAPTER 3	SYSTEM PERFORMANCE 9
3.1	Performance Specifications 9
3.1.1	Basic Functions 9
3.1.2	Detection Performance 9
3.1.3	User interface 11
3.1.4	Data management, recording and archiving 11
3.2	External Interfaces 11
CHAPTER 4	TEST AND VERIFICATION 14
4.1	Introduction 14
4.2	Site Acceptance Testing Methodologies 14

4.2.1	Object Detection	14
4.2.2	Time to detection	14
4.2.3	Location accuracy.....	14
4.2.4	Detection of multiple objects	15
4.2.5	Rejection of aircraft and vehicles	15
4.2.6	False alert.....	15
4.2.7	Error condition reporting	15
4.2.8	User interface	16
4.2.9	External interface.....	16
4.2.10	Data recording	16
4.2.11	Periodic and on-going performance verification (customer systems tests)..	17
APPENDIX A	LIST OF REFERENCE TARGETS.....	18
APPENDIX B	LIST OF EUROCAE WG-83 MEMBERS.....	23
	IMPROVEMENT SUGGESTION FORM	25

TABLE OF FIGURES

Figure 2-1:	Generalised FOD Detection System Block Diagram.....	6
Figure 2-2:	Alert and Alarm Management.....	7

CHAPTER 1

GENERAL

1.1 INTRODUCTION

Foreign Object Debris (FOD) can be found on the aerodrome movement area, notably runways, taxiways and aprons, and poses both a safety risk and financial burden on aerodromes and for aircraft operators.

This document describes FOD Detection Systems and intends to provide technical requirements related to system performance. Part of this document also introduces the operational aspects.

1.2 PURPOSE AND SCOPE

This document is the Minimum Aviation System Performance Standard (MASPS) for Foreign Object Debris (FOD) Detection Systems, reflecting state of the art technology at the time of publication. It specifies system and equipment characteristics that should be used by designers, installers, manufacturers, service providers and users of systems intended for operational use at aerodromes. Functional requirements are used wherever possible to allow flexibility in the design of sub-system equipment.

This standard is produced based on existing and proposed products, methods and requirements that support FOD detection and processing. Adherence to this standard will facilitate operational implementation of a FOD Detection System at an aerodrome in accordance with the aerodrome's operational requirements.

This chapter outlines the purpose of a FOD Detection System within an aerodrome. It describes the rationale for the system, the expected operational objectives, and outlines the fundamental design concepts. It contains definitions of terms used in the document, lists of abbreviations and references to other documents.

Chapter 2 outlines the enabling functions of a FOD Detection System and defines associated external interfaces.

Chapter 3 specifies performance requirements for the principal enabling functions of a FOD Detection System.

Chapter 4 describes methodologies for the test and verification of FOD Detection System performance requirements specified in Chapter 3 and contains descriptions of the recommended generic test procedures needed to verify compliance at both the functional element and overall system level.

1.3 GLOSSARY OF DEFINED TERMS

The following terms are used in this document:

Aerodrome (ICAO Annex 14 SARPs)

A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Alert Report

A data record containing all relevant information about each FOD detected.

Apron (ICAO Annex 14 SARPs)

A defined area on a land aerodrome intended to accommodate aircraft for the purpose of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

Categorisation

A function that defines and groups items of FOD according to their characteristics (e.g., material, type, colour, size).

False Alert

An alert raised by the system when, at the moment of detection, there is no FOD on the monitored surface.

FOD

An inanimate object within the movement area which has no operational or aeronautical function and which has the potential to be a hazard to aircraft operations.

FOD Alarm

A system event intended to initiate activities following the FOD Alert, with the purpose of removing the FOD. This event is triggered by the system user and, if available, can be transmitted to external interfaces.

FOD Alert

Notification by the FOD Detection System to the user console and, if available, to the external interfaces that FOD was detected on the monitored surface.

FOD False Alarm

A FOD Alarm triggered by the FOD Detection System user resulting in action to remove a FOD that does not exist. An FOD False Alarm will typically be a consequence of a FOD False Alert.

Inclement weather conditions

For the purpose of operational performance in this standard, inclement weather condition is defined as wind speed exceeding 60 knots (mean average) and/or precipitation exceeding 16mm/h.

Manoeuvring Area (ICAO Annex 14 SARPs)

Part of an aerodrome used for take-off, landing and taxiing of aircraft, excluding Aprons.

Monitored surface

Part of an aerodrome that is monitored by a FOD Detection System.

Modularity

Characteristics of a system that describes its capability to be enhanced by the addition of one or more modules to improve its technical or functional performance.

Movement Area (ICAO Annex 14 SARPs)

Part of an aerodrome to be used for take-off, landing and taxiing of aircraft, consisting of the Manoeuvring Area and Aprons.

Requirement

An identifiable element of a function specification that can be validated and against which an implementation can be verified.

1.4**ABBREVIATIONS**

The following abbreviations are used in this document.

AGL	Airfield Ground Lighting
AI	Artificial Intelligence
A-SMGCS	Advanced Surface Movement Guidance and Control System
ASTERIX	All Purpose Structured EUROCONTROL Surveillance Information Exchange
ATC	Air Traffic Control
ATM	Air Traffic Management
EASA	European Union Aviation Safety Agency
EUROCAE	European Organisation for Civil Aviation Equipment
FOD	Foreign Object Debris
HMI	Human Machine Interface
ICAO	International Civil Aviation Organisation

LVP	Low Visibility Procedure
MASPS	Minimum Aviation System Performance Standard
PPE	Personal Protective Equipment
SARPs	Standards and Recommended Practices
WGS-84	World Geodetic Survey (1984)

1.5

REFERENCE DOCUMENTS

- [1] EUROCAE ED-274 – Operational Services and Environment Description for Aerodrome Foreign Object Debris Detection Systems, 08/2020
- [2] Advisory Circular FAA AC 150/5210-24A – Airport Foreign Object Debris (FOD) Management, 08/02/2024
- [3] Advisory Circular FAA AC 150/5220-24 Airport Foreign Object Debris (FOD) - Detection Equipment, 30/09/2009
- [4] EUROCAE ER-022 – Artificial Intelligence in Aeronautical Systems: Statement of Concerns, 02/2021
- [5] ICAO Annex 14 (Aerodrome Design and Operations)
- [6] ICAO DOC 9981 'PANS – Aerodromes' 3rd Edition
- [7] EUROCAE ER-003 - Definition and Taxonomy for Foreign Object Debris 05/2013
- [8] EUROCONTROL Specification for Surveillance Data Exchange Asterix Part 26 Category 239, ED 1.0, 2015

SUPPLEMENTARY DOCUMENTS

- [9] Commission Regulation (EU) NO 139/2014 ('The Aerodrome Regulation')
- [10] ED Decision 2014/012/R AMC/GM TO ANNEX IV-Part Operations Requirements (PART-ADR.OPS)
- [11] CS-ADR-DSN – Issue 6 Certification Specifications and Guidance Material for Aerodrome Design

1.6

OPERATIONAL CONTEXT OF FOD DETECTION SYSTEM

1.6.1

Operational Environment

FOD can appear at any location on the movement area; however, FOD on runways is the most serious safety hazard. For this reason, this document focuses mainly on FOD detection on runways; however, it does not preclude the potential for a system to be used for taxiway and apron monitoring.

The FOD Detection System should be compatible with the aerodrome environment and operations (e.g., snow removal operations, aircraft typology, amount of traffic, climate etc).

1.6.2

Operational objectives

The objectives of the FOD Detection System are to increase the detection of FOD on the area being monitored and to assist in deciding the necessary course of action.

The overall objective is to enhance safety performance and reduce the costs to operators by reducing risks of incidents and accidents on the movement area because of FOD. The aim is for FOD Detection Systems to be integrated into an aerodrome safety management system.

As far as technically feasible, weather conditions should not adversely impact the system performance.

The FOD Detection System should be monitoring the surface continuously (24/7).

1.6.3

FOD Detection System relationship with other subsystems

As the existence of FOD on the movement area has the potential to affect aerodrome operations, a FOD Detection System should provide interfaces to any relevant systems

and be supplementary to existing airside safety operations concerning movement area inspections.

This document does not describe in detail how this integration can be achieved because aerodrome operations may be organised differently at different aerodromes. Local considerations, policies and procedures will ultimately determine the extent of integration.

When not integrated with another system, the FOD Detection system shall be able to be operated as standalone system.

1.6.4 Training

It is essential that a training program is delivered for the system user and maintenance provider detailing the following aspects:

- Standard operating procedures
- Maintenance procedures (1st, 2nd level support according to needs)

1.6.5 Maintenance

To ensure maximum availability of a FOD Detection System, a maintenance schedule should be agreed between the customer and the supplier.

1.7 FUNDAMENTAL SYSTEM DESIGN CONCEPTS

1.7.1 Modularity

The FOD Detection System may consist of sub-systems which, when integrated, are designed to meet the specific operational requirements of the customer. The system should be modular so that a wide range of requirements can be met. A modular system consists of sub-systems that can be added or removed to tailor the system performance to the operational and functional requirements. Adding or removing a sub-system should not affect the performance and function of other sub-systems.

A modular system is also a possible way to achieve a system or implementation that is scalable to the operational environment.

1.7.2 Evolution

FOD Detection Systems should allow for technological and operational changes and enhancements, which will allow service providers to update, change or add to the FOD Detection System capability.

1.7.3 Use of Artificial Intelligence

Use of Artificial Intelligence may optimize FOD Detection System performances in order to assist user in decision making.

The first obvious use of such technology applies to video and picture analysis. At the time of publication of this standard, AI applications are able to recognize objects in many different situations and therefore to provide user with a pre-identification of FOD and an estimate of the size of the FOD. Providing FOD categorisation allows the user to better assess the risk taken by not removing it from the area it is located.

Nevertheless, the use of such technology is subject to irregular performances that will depend on the quality of the images (resolution and/or clarity) that the sensors are able to output.

When implemented, this technology should incorporate a Machine Learning algorithm, enabling the system to continuously adapt to the operational situation. The training of the AI may also take into account detection performance during adverse weather conditions, to improve overall effectiveness.

The system should offer users a mechanism to indicate what kind of object has been detected or for the user to correct the system in order for it to learn and achieve improved performances. This capability is needed because of the uncertainty of objects that can be detected on the ground and should lead to a reduction of false alerts over time.

The second use of AI technology involves assisting in decision making. As far as the system (or the user) has been able to identify any object and its position on the monitored area, the system should enable the user to monitor the detected FOD and take a decision.

Given the state of AI maturity at the time of publication of this standard, AI should not be used for autonomous decision making but may only assist the decision maker to assess the FOD.

1.7.4 External Interoperability

FOD Detection System may support external systems.

A data exchange standard has been defined using the ASTERIX Category 239 [8] to facilitate the integration of the FOD Detection System information into other aerodrome systems. The use of the messages distributed via this data exchange standard depends on the operational concept of the aerodrome for the handling of FOD. Possible applications are the display of the FOD location to the FOD removal team, the integration of FOD alerts or alarms into an A-SMGCS or the simple provision of the FOD information to the Air Traffic Controller.

In addition, an external interface for the transmission of the video and/or image used for FOD validation may be made available.

1.7.5 Compliance with Applicable Aerodrome Requirements

The installation of the FOD Detection System should be compliant with all requirements applicable at the site of installation.