



The European Organisation for Civil Aviation Equipment
L'Organisation Européenne pour l'Équipement de l'Aviation Civile

**MINIMUM OPERATIONAL PERFORMANCE SPECIFICATION
FOR SURFACE MOVEMENT RADAR SENSOR SYSTEMS
FOR USE IN ADVANCED SURFACE MOVEMENT GUIDANCE
AND CONTROL SYSTEMS (A-SMGCS)**

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FOREWORD

1. This document, prepared by EUROCAE Working Group 41, was accepted by the Council of EUROCAE on January 2004.
2. EUROCAE is an international non-profit making organisation. Membership is open to European manufacturers of equipment for aeronautics, trade associations, national civil aviation administrations, users, and non-European organisations. Its work programme is principally directed to the preparation of performance specifications and guidance documents for civil aviation equipment, for adoption and use at European and worldwide levels.
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5. This document is compliant with the requirements of the surveillance function within EUROCAE ED-87A "MASPS for Advanced Surface Movement Guidance and Control Systems", January 2001.
6. Copies of this document may be obtained from:

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CHAPTER 1

GENERAL

1.1 PURPOSE AND SCOPE

This EUROCAE Minimum Operational Performance Specification (MOPS) specifies the minimum performance requirements of Surface Movement Radar Sensor Systems for use in Advanced Surface Movement Guidance and Control Systems (A-SMGCS).

Throughout this document, the term “SMR” will be used to mean a Surface Movement Radar Sensor System, as described in paragraph 1.4.

Chapter 1 provides information required to understand the need for the SMR characteristics and tests defined in the remaining chapters. It describes typical SMR applications and operational objectives and, along with EUROCAE ED-87A, *Minimum Aviation System Performance Specifications for A-SMGCS*, forms the basis for the performance criteria stated in Chapters 2 and 3. Definitions and abbreviations essential to the proper understanding of this document are also provided in Chapter 1.

Chapter 2 contains general design requirements for an SMR for use during surface movement operations at an airport, including health and safety and environmental aspects.

Chapter 3 contains the Minimum Operational Performance Requirements for the SMR, defining performance under weather conditions likely to be encountered during surface movement operations.

Chapter 4 identifies laboratory means of testing performance characteristics of the SMR under environmental conditions representative of those that may be encountered in actual operations.

Chapter 5 describes recommended test procedures for demonstrating compliance with the requirements of Chapters 2 and 3 in the factory or laboratory.

Chapter 6 describes recommended test procedures for demonstrating compliance with the requirements of Chapters 2 and 3 for the installed SMR.

1.2 MOPS APPLICATIONS

The specifications contained in this document specify desired system characteristics that should prove useful to designers, manufacturers and users of SMR equipment.

It should be noted that this document provides *minimum* operational performance specifications for the SMR functions. These performance specifications are aimed toward the basic SMR application as a non-cooperative sensor in a multi-sensor A-SMGCS, as defined in EUROCAE ED-87A. Performance standards for functions or components that apply to capabilities that exceed the stated minimum requirements are identified as optional features.

Compliance with this MOPS ensures that the SMR will satisfactorily perform its intended functions, as given by section 1.3, during surface movement operations.

Compliance with the MOPS does not necessarily constitute compliance with regulatory requirements. Any regulatory application of this document wholly or in part is the sole responsibility of the appropriate air traffic control authority.

As the measured values of the equipment performance characteristics may be a function of the method of measurement, standard test conditions and methods of testing are recommended in this document.

The word “equipment” as used in this document includes all components and units necessary for the SMR to correctly perform its functions.

1.2.1 Mandating and Recommendation Phrases

1.2.1.1 “Shall”

The use of the word “Shall” indicates a mandated criterion; i.e. compliance with the particular procedure or specification is mandatory and no alternative may be applied.

1.2.1.2 “Should”

The use of the word “Should” (and phrases such as “It is recommended that...”) indicates that although the procedure or criterion is regarded as the preferred option, alternative procedures, specifications or criteria may be applied, provided that the manufacturer, installer or tester can provide information or data to adequately support and justify the alternative.

1.3 SYSTEM DESCRIPTION

1.3.1 SMR Applications and Operational Objectives

SMRs in an A-SMGCS are intended for use during aerodrome ground operations to inform air traffic controllers about the presence and location of aircraft, vehicles and obstacles on those parts of the aerodrome surface where aircraft movements take place.

The SMR function is the non-cooperative detection of moving and stationary objects on the surface of an aerodrome. Non-cooperative detection is necessary in order to detect all objects of operational interest, including those that are not equipped with suitable transponders or other co-operative surveillance means.

As a sensor in an A-SMGCS, an SMR, combined with some cooperative surveillance means, can provide sufficient information to unambiguously identify aircraft and continuously track their positions. It is anticipated that, to gain full advantage of the improved surveillance capability offered by A-SMGCS, some changes to ATC procedures would be necessary.

The SMR application requires high resolution in order to discriminate between closely spaced targets, and provision of accurate and timely position information at an adequate update rate to determine target speed and direction. For a simple sensor system, the expected range for operational use under all specified weather conditions will not normally exceed 4 km.

Figure 1-1 below, reproduced from ED 87A, shows how the SMR fits in to the overall A-SMGCS.

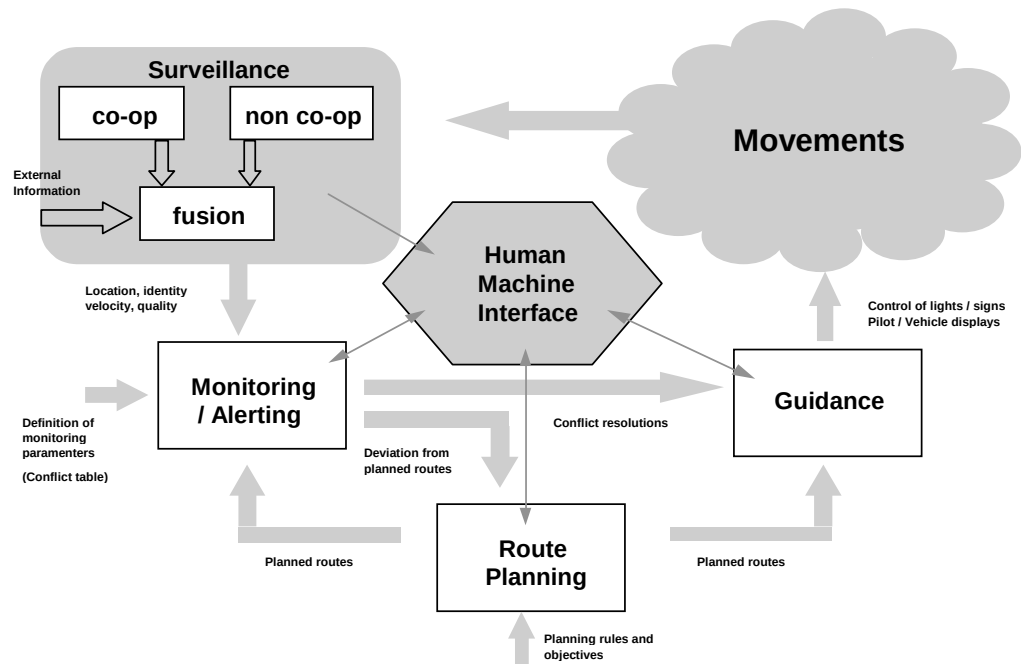


FIGURE 1-1 : CONCEPTUAL BLOCK DIAGRAM FOR A-SMGCS

1.3.2

SMR Types

SMR types fall into the following two main sub-categories:

1. **Conventional (rotating antenna) SMR** that scan mechanically in a continuous 360-degree arc, and
2. **Fixed Antenna SMR** that scan electronically in a sector.

Although the majority of the performance requirements specified in this MOPS will apply to both types, the document is primarily concerned with **conventional SMR**.

For the A-SMGCS application, an SMR will include some form of target extraction to enable it to output information about the location, size, and shape of detected objects.

In addition, SMRs should be capable of providing a “raw” primary radar image for presentation on a suitable display.

1.4

COMPOSITION OF AN SMR

The SMR should be modular in its construction and will normally include at least the following basic functional units:

- Antenna Unit
- Transmitter Unit
- Receiver Unit
- Local Control and Monitoring Unit
- Target Extractor Unit

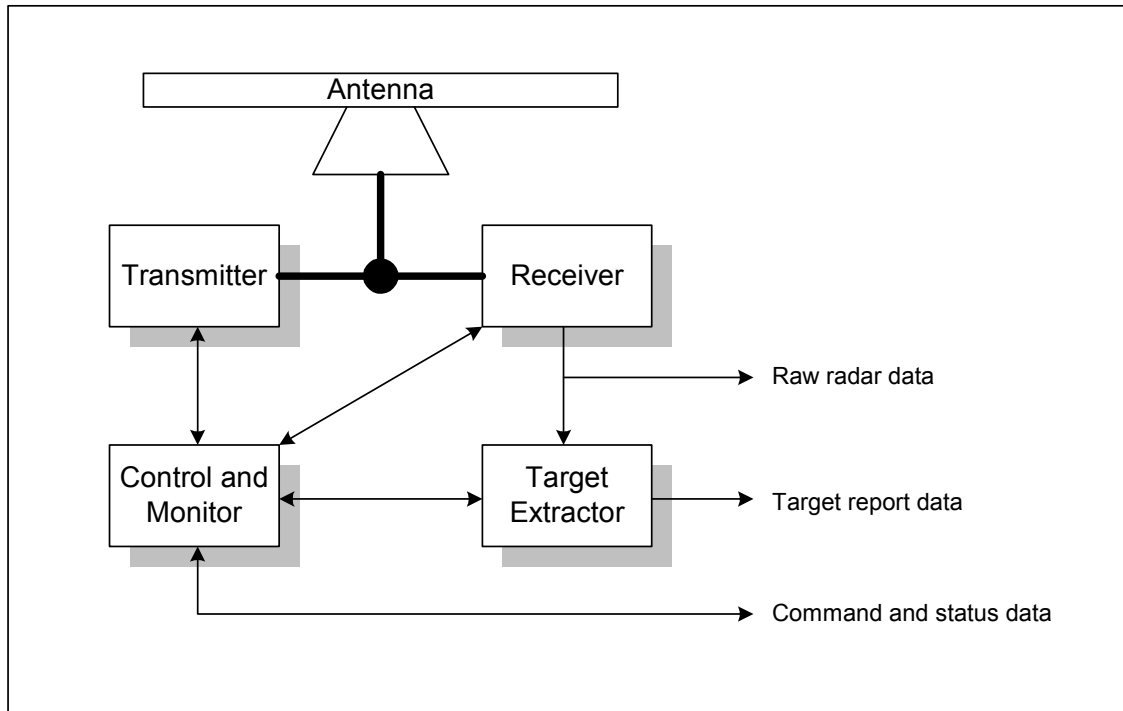


FIGURE 1-2 : COMPOSITION OF AN SMR

Other items, which may be considered in defining a complete SMR, are:

- Remote Control and Monitoring Unit
- Lightning Protection Devices
- Obstruction Lights
- Uninterruptible Power Supply (UPS)
- Radome
- Waveguide Dehydration Unit
- Air Conditioning Unit

1.4.1

Siting of SMR Equipment

The SMR antenna requires clear line of sight to the targets throughout the area to be covered. It can be mounted on a building or on a suitable mast or tower. In choosing a site for an SMR antenna, consideration must also be given to fixed reflecting surfaces and the resulting location of false returns.

Transmitter and receiver are often combined into one (transceiver) unit, and will normally be mounted close to the antenna unit in order to minimise signal attenuation caused by long waveguides.

A local control and monitoring unit co-located with the SMR transmitter/receiver will provide, as a minimum, a means to start and stop the SMR and a means to monitor its performance.

A remote control and monitoring unit (RCMU) provides a means for maintenance personnel to control and monitor the SMR from another location. For some applications, it may be desirable to control and monitor multiple SMRs from a single RCMU.

Target extractor units may be co-located with the SMR transmitter/receiver or installed at a different location connected to the receiver by a suitable analogue and/or digital communication link.

1.5 DEFINITIONS AND ABBREVIATIONS

1.5.1 Definitions

The following defined terms are used within the context of this document:

Advanced Surface Movement Guidance and Control System

Systems providing routing, guidance, surveillance and control to aircraft and affected vehicles in order to maintain movement rate under all local weather conditions within the aerodrome Visibility Operational Level (AVOL) whilst maintaining the required level of safety.

Aerodrome

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

Apron

A defined area on an aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

Availability

The probability that a system or an item is in a functioning state at a given point in time.

Classification

A function which groups targets into various types (e.g. large, medium, small).

Continuity of Service

The ability of a system or an item to perform its required function without unscheduled interruption throughout the duration of the intended operation.

Data Fusion

A generic term used to describe the process of combining surveillance information from two or more sensor systems or sources.

Integrity

An attribute of a system or an item indicating that it can be relied upon to perform correctly on demand. (It includes the ability of the system to inform the user in a timely manner of any performance degradation.)

Manoeuvring Area

That part of an aerodrome to be used for take-off, landing and taxiing of aircraft, excluding aprons.

Movement Area

That part of an aerodrome to be used for take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and aprons.

Obstacle

All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

Raw Video

A signal at the output of an SMR receiver that can be processed to present the primary radar image on a screen.

Reliability

The ability of a system or an item to perform a required function under specified conditions, without failure, for a specified period of time.

Reported Position Accuracy (RPA)

The difference, at a specified confidence level, between the reported position of the target and the actual position of the target at the time of the report.

Requirement

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

Target

Any aircraft, vehicle or obstacle, whether stationary or moving, which is located within the coverage area of the SMR and which is of sufficient size to be operationally significant.

Target Report

A data record containing all relevant information pertaining to a target detected by the SMR.

Track

A progressive series of estimates of a target position.

Update

A renewal of target reports relating to all targets under surveillance

1.5.2**Abbreviations**

A-SMGCS	Advanced Surface Movement Guidance and Control System
ASTERIX	All Purpose Structured Eurocontrol Radar Information Exchange
ATC	Air Traffic Control
BITE	Built-in Test Equipment
EUROCAE	European Organisation for Civil Aviation Equipment
HMI	Human Machine Interface
ICAO	International Civil Aviation Organisation
MASPS	Minimum Aviation System Performance Specification
MOPS	Minimum Operational Performance Specification
RCS	Radar Cross Section
RCMU	Remote Control and Monitoring Unit
RF	Radio Frequency
RPA	Reported Position Accuracy
SNMP	Simple Network Management Protocol
SMR	Surface Movement Radar (Sensor System)
UPS	Uninterruptible Power Supply
WGS-84	World Geodetic Survey (1984)

1.6**REFERENCES**

The following documents are incorporated by reference. The latest issue in effect shall be the one that will apply.

- 1) EUROCAE ED-87A: Minimum Aviation System Performance Specification for Advanced Surface Movement Guidance and Control Systems (January 2001)
- 2) EUROCAE ED-79/SAE ARP 4754: Certification Considerations for Highly-integrated or Complex Aircraft Systems (April 1997)
- 3) ICAO AOPG: Manual of Advanced Surface Movement Guidance and Control Systems (A-SMGCS)
- 4) ICAO: SARPS Annex 14 Aerodromes
- 5) ICAO: Aerodrome Design Manual (Doc. 9157, 1993)
- 6) ICAO: Annex 10 Volume IV (Radar of surveillance systems and anti-collision systems)
- 7) Eurocontrol Standard Document for Surveillance Data Exchange - Part 7 Transmission of Monosensor Surface Movement Data, SUR.ET1.ST05.2000-STD-07-01
- 8) The Internet Engineering Task Force, RFC 1155 Structure of Management Information

CHAPTER 2

GENERAL DESIGN REQUIREMENTS

2.1 INTRODUCTION

This chapter establishes the design criteria and general operational requirements for SMR equipment.

Other aspects of the SMR design are purely dependent on the manufacturer's philosophy as long as the minimum operational performance requirements specified in Chapter 3 are met.

2.2 AIRWORTHINESS AND CERTIFICATION

SMR is a ground based equipment and as such has no airworthiness requirements. The equipment will be required to meet European EMC standards as well as maintaining emissions within ITU regulations.

SMR equipment shall in no way, under normal or fault conditions, impair the airworthiness of aircraft in the vicinity.

2.3 OPERATION OF CONTROLS

The SMR equipment shall be designed so that controls intended for use during normal operations cannot be operated in any position, combination or sequence that would result in a condition detrimental to the reliability of the SMR equipment.

Controls, or access to parameters which affect the performance of the SMR, shall be protected in some way and shall not be readily accessible to maintenance personnel.

2.4 INSTALLATION

The SMR shall be compatible with the physical and environmental conditions expected to be present in installed locations. Installation of the equipment should permit ease of access for maintenance and testing. It should be physically impossible to install replaceable modules of the SMR improperly.

2.5 TEST METHODOLOGY

Tests should be performed using a combination of modelling and simulation, direct performance measurement on site, and analysis and extrapolation of results. Normally, testing of individual items of equipment would be performed both at the factory, or laboratory, and on site, whereas complete SMR testing can only reasonably be conducted on site, using a combination of targets of opportunity, controlled airport vehicles, and calibrated test targets.

2.6 EFFECTS OF TESTS

Unless otherwise stated, the design of the SMR shall be such that, during and after the application of the specified tests, no condition exists which would be detrimental to the subsequent performance of the system.

2.7 SOFTWARE MANAGEMENT DESIGN

Software design shall follow the guidelines specified in EUROCAE document ED-109 "Guidelines for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) System Software Integrity Assurance". The software criticality level will depend on the particular equipment function, however a minimum assurance of level 4 is required.