



AEROSPACE STANDARD	AS5681™	REV. C
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Superseding AS5681B		
Minimum Operational Performance Specification for Remote On-Ground Ice Detection Systems		

RATIONALE

This document has been revised to meet the document harmonization and quality criteria issued by the SAE G-12 Steering Committee in October 2023. Specifically, the spellings of various technical terms have been revised to conform to the preferred spellings put forth by the committee.

FOREWORD

Exposure to weather conditions on the ground that are conducive to clear ice formation can cause aircraft surfaces and components to adversely affect aircraft performance, stability, and control.

Regulations governing aircraft operations in icing conditions shall be followed. Specific rules for aircraft are set forth in the United States Code of Federal Regulations (14 CFR), EASA Operation Regulations (EU-OPS), Canadian Aviation Regulations (CAR), and others. Paraphrased, these rules specify that no one may dispatch or takeoff an aircraft with frozen deposits on components of the aircraft that are critical to safe flight. A critical surface or component is one which could adversely affect the mechanical or aerodynamic function of an aircraft. In the event of differences or discrepancies in the requirements set out in this standard and any requirements set out in the domestic regulations applicable to the end user, the domestic regulation requirements shall supersede those set out in this standard.

The human factors tests reported in FAA reports DOT/FAA/TC-06/20 and DOT/FAA/TC-06/21 have shown that, based on the particular conditions of the tests, remote on-ground sensors that meet the requirements of this standard perform more consistently and are more reliable than human visual and/or tactile detection of clear ice on an aircraft critical surface in winter conditions.

Human factors tests have demonstrated that in certain circumstances, respect for the regulations may be most reliably achieved by use of remote on-ground sensors. These circumstances do not include the specific case of frost. Frost is generally readily detected visually and may affect the takeoff performance of an aircraft at roughness levels below the reliable detection threshold of sensors available at the time of publication of this document.

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1. SCOPE

This SAE Aerospace Standard (AS)/Minimum Operational Performance Specification (MOPS) specifies the minimum performance requirements of remote on-ground ice detection systems (ROGIDS). These systems are ground based. They provide information that indicates whether frozen contamination is present on aircraft surfaces.

Section 1 provides information required to understand the need for the ROGIDS, ROGIDS characteristics, and tests that are defined in subsequent sections. It describes typical ROGIDS applications and operational objectives and is the basis for the performance criteria stated in Sections 3 through 5.

Section 2 provides reference information, including related documents, definitions, and abbreviations.

Section 3 contains general design requirements for the ROGIDS.

Section 4 contains the Minimum Operational Performance Requirements for the ROGIDS, which define performance in icing conditions likely to be encountered during ground operations.

Section 5 describes environmental test conditions that provide laboratory means of testing the overall performance characteristics of the ROGIDS in conditions that may be encountered in actual operations.

Section 6 describes recommended test procedures for demonstrating compliance with Sections 3 and 4.

Section 7 contains the operational evaluation requirements for verifying the performance of the ROGIDS when installed for in-service use.

1.1 Applications of This Document

Compliance with this AS/MOPS ensures that the ROGIDS will satisfactorily perform its intended functions.

Compliance with this AS/MOPS does not necessarily constitute compliance with regulatory requirements. Any application of this document in whole or in part is the sole responsibility of the appropriate regulatory agencies. It is recommended to seek guidance from the regulatory agencies before developing any test plans or test procedures. The manufacturer should confer with the regulatory agencies to determine those tests that need to be witnessed or performed by the regulatory agencies or other acceptable entity(s) and any associated reporting requirements.

The measured values of the ROGIDS performance characteristics may be a function of the method of measurement. Therefore, controlled test conditions and methods of testing are recommended in this document.

Mandating and Recommendation Phrases:

a. "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.

b. "Should"

The use of the word "should" (and phrases such as, "it is recommended that," etc.) 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.

1.2 Safety

While the materials, methods, applications, and processes described or referenced in this procedure may involve the use of hazardous materials, this procedure does not address the hazards that may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and processes, and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

1.3 Functional Description of System

The function of ROGIDS is to detect clear ice on aircraft surfaces.

ROGIDS are intended to be used during aircraft ground operations to inform the ground crew and/or the flight crew and/or a relevant system about the condition of monitored aircraft surfaces.

ROGIDS make a remote measurement of a monitored surface, and may be handheld, pedestal, or vehicle mounted.

The ROGIDS may provide an alternative to the visual and tactile post-deicing checks required by aviation regulatory agencies, including the European Union Aviation Safety Agency (EASA), the United States Federal Aviation Administration (FAA), and Transport Canada Civil Aviation (TCCA), to determine the condition of aircraft critical surfaces in operating conditions involving freezing contamination. Approval for the use of ROGIDS as a means of performing post-deicing checks rests with the appropriate regulatory agency.

In addition, the ROGIDS may also supplement visual and tactile pre-deicing checks for clear ice. Approval for the use of ROGIDS as a means of performing pre-deicing checks rests with the appropriate regulatory agency.

1.4 The ROGIDS should typically include:

- a. At least one sensor that is directly or indirectly sensitive to the physical phenomena of aircraft icing during weather conditions consistent with ground icing operations.
- b. A processing unit to perform signal processing. The unit may either be integrated with or separate from the sensor(s).
- c. A device to provide information to the flight and/or ground crew.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS1424	Fluid, Aircraft Deicing/Anti-Icing, SAE Type I
AMS1428	Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV
ARP5485	Endurance Time Test Procedures for SAE Type II/III/IV Aircraft Deicing/Anti-Icing Fluids
ARP5945	Endurance Time Test Procedures for SAE Type I Aircraft Deicing/Anti-Icing Fluids
SAE J1211	Handbook for Robustness Validation of Automotive Electrical/Electronic Modules
SAE J1455	Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications

2.1.2 Code of Federal Regulations (CFR) Publications

Available from United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

47 CFR Part 15 Federal Communications Commission Part 15 – Radio Frequency Devices
Section 15.109 Radiated Emission Limits

2.1.3 RTCA/EUROCAE Publications

RTCA documents (DO) available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

EUROCAE Documents (ED) available from EUROCAE Secretariat, 9-23 Rue Paul Lafargue, 93200 Saint-Denis, France, Tel: +33 1 40 92 79 30, <https://www.eurocae.net/>.

RTCA DO-160/ED-14 Environmental Conditions and Test Procedures for Airborne Equipment

RTCA DO-178/ED-12 Software Considerations in Airborne Systems and Equipment Certification

RTCA DO-254/ED-80 Design Assurance Guidance for Airborne Electric Hardware

2.1.4 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

AC 120-107 Use of Remote On-Ground Ice Detection System -
http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document/information/documentID/813451

DOT/FAA/TC-06/20 Comparison of Human Ice Detection Capabilities and Ground Ice Detection System Performance Under Post-deicing Conditions
http://www.tc.faa.gov/acb300/Techreports/TC06_20_GIDS.pdf

DOT/FAA/TC-06/21 Human Visual and Tactile Ice Detection Capabilities under Aircraft Post Deicing Conditions
http://www.tc.faa.gov/acb300/Techreports/TC06_21_GIDS_new.pdf

HF-STD-001 FAA Human Factors Design Standard
<https://hf.tc.faa.gov/hfds/>

2.1.5 Transport Canada Publications

Available from Transport Canada, Tower C, Place de Ville, 330 Sparks Street Ottawa, Ontario K1A 0N5, Tel: 1-800-305-2059, www.tc.gc.ca.

TP 14449 Development of Ice Samples for Visual and Tactile Ice Detection Capability Tests

TP 14450 Development of Ice Samples for Comparison Study of Human and Sensor Capability to Detect Ice on Aircraft

TP 14452 Feasibility of ROGIDS Test Conditions Stipulated in SAE Draft Standard AS5681

CASS 622.11 Commercial Air Service Standard - Ground Icing Operations Standard

CAR 602.11 Canadian Aviation Regulations - Aircraft Icing

AC No. 602-001 Operational Use of Remote On-Ground Ice Detection Systems (ROGIDS) for Post De-icing Applications
<http://www.tc.gc.ca/eng/civilaviation/opssvs/managementservices-referencecentre-ac-600-602-001-492.htm#s5-0>

2.1.6 CEN/IEC/ISO Publications

CEN/EN documents available from CEN, 23, rue de la Science B-1040 Brussels, Tel: +32 2 550 0811, info@cencenelec.eu.

EN 50082-2 Electromagnetic compatibility - Generic immunity standard - Part 2: Industrial environment

2.1.7 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 7637 Road vehicles - Electrical disturbances from conduction and coupling

2.1.8 ARINC Publications

Available from ARINC, 2551 Riva Road, Annapolis, MD 21401-7435, Tel: 410-266-4000, www.arinc.com.

ARINC-415 Operational and Technical Guidelines on Failure Warning and Functional Test

ARINC-604 Guidance for Design and Use of Built-in Test Equipment (BITE)

2.1.9 Weather-Related Publications

WMO documents are available from World Meteorological Organization, P.O. Box 2300, CH-1211, Geneva 2, Switzerland, Tel: 617 227 2425, wmopubs@ametsoc.org.

World Meteorological Organization Aerodrome Reports and Forecasts – Doc No. 782, revised 1 Jan 1996

2.2 Definitions

ANTI-ICING: A precautionary procedure that provides protection of an aircraft against the formation of frost or ice and accumulation of snow or slush on treated surfaces of the aircraft for a limited period of time.

CLEAR ICE: Clear ice forms at temperatures at or below 0 °C, often associated with a high concentration of large supercooled water droplets. It can also be a residual product of an incomplete deicing process. Clear ice is hard and appears as a smooth and glassy coating that can be very difficult to detect without a tactile inspection. Clear ice might not be seen during a walk around, particularly if the wing is wet or during nighttime operations. Clear ice can occur in flight or on the ground. Clear ice adheres firmly to surfaces, is difficult to remove, and requires special care during deicing/anti-icing.

DEICING: A procedure by which frost, ice, snow, or slush is removed from the aircraft in order to provide aerodynamically clean surfaces. This is typically performed using heated (at least 60 °C) deicing fluid.

DEICING EVENT: A deicing event is the series of actions required to deice and inspect one aircraft, culminating with the release of that aircraft in what is considered to be a state compliant with the ground icing regulatory requirements.

DEICING (and ANTI-ICING) FLUIDS: The fluids used for conduct of the deicing (and anti-icing) procedures. These are typically ethylene or propylene glycol based.

FALSE NEGATIVE: An indication of the absence of frozen contamination when frozen contamination is present on the reference surface.

FALSE POSITIVE: An indication of the presence of frozen contamination when no frozen contamination is present on the reference surface.

DEICING/ANTI-ICING FLUID FAILURE: When the deicing/anti-icing fluid can no longer absorb incoming precipitation and provide protection from the adherence of frozen contamination on treated surfaces. Characteristics of fluid failure can be surface freezing or snow accumulation, random snow accumulation, and/or dulling of surface reflectivity caused by the gradual deterioration of the deicing/anti-icing fluid, possibly indicated by the presence of frozen contamination in or on the deicing/anti-icing fluid.

FROZEN CONTAMINATION/CONTAMINANTS: For the purpose of this AS/MOPS: frost, ice, snow, slush.

ILLUMINANCE: The amount of visible light power incident per unit area of a surface; measured in lux (lumens per square meter) or foot-candles (lumens per square foot).

LATENT FAILURE: A latent failure is one that is inherently undetected when it occurs.

MAXIMUM DETECTION ANGLE: The maximum angle with respect to the surface being monitored that the ROGIDS sensor can be aimed and still be expected to achieve the performance specified in this MOPS.

MAXIMUM DETECTION DISTANCE: The furthest the ROGIDS sensor can be from the surface being monitored that the ROGIDS sensor can be aimed and still be expected to achieve the performance specified in this MOPS.

MINIMUM DETECTION ANGLE: The minimum angle with respect to the surface being monitored that the ROGIDS sensor can be aimed and still be expected to achieve the performance specified in this MOPS.

MINIMUM DETECTION DISTANCE: The closest the ROGIDS sensor can be to the surface being monitored that the ROGIDS sensor can be aimed and still be expected to achieve the performance specified in this MOPS.

MONITORED SURFACE: The surface of concern regarding ice hazard.

PRE-DEICING CHECK: An examination of an aircraft's wings and/or other critical surfaces to check for the presence of frozen contamination, usually performed to determine the need for deicing.

POST-DEICING CHECK: An examination of an aircraft's wings and/or other critical surfaces after a deicing has been performed to determine the presence of any remaining frozen contamination.

Ra: Average surface roughness.

ROGIDS: A system or device that makes a remote measurement of a monitored surface to determine whether frozen contamination is present. For the purpose of this AS, the intended function of the ROGIDS is the detection of clear ice.

SYSTEM: A combination of components which are interconnected to perform one or more functions.

2.3 Abbreviations

AC	Advisory Circular (FAA)
AMJ	Advisory Material Joint (JAA)
ARINC	Aeronautical Radio, Inc.
ARP	aerospace recommended practice
AS	aerospace standard
BIT	built in test
BITE	built in test equipment
CAR	Canadian Aviation Regulations

CFR	United States Code of Federal Regulations
CEN	Comité Européen de Normalisation. European Committee for Standardisation. Europäisches Komitee für Normung.
EASA	European Union Aviation Safety Agency
EN	Norme Européenne. European Standard. Europäische Norm.
EU-OPS	EASA Operation Regulations
EUROCAE	The European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration (USA)
FOD	foreign object damage
FPD	freezing point depressant; used to qualify the nature of deicing/anti-icing fluids
FTA	fault tree analysis
GIDS	ground ice detection system
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
JAA	Joint Aviation Authorities (Europe)
JAR	Joint Aviation Requirements (Europe)
Lx	lux
MOPS	minimum operational performance specification
MTBF	mean time between failure
OAT	outside air temperature
ROGIDS	remote on-ground ice detection system(s)
RTCA	Radio Technical Commission for Aeronautics
TC	Transport Canada

3. GENERAL DESIGN REQUIREMENTS

3.1 Introduction

This section identifies general design considerations for ROGIDS.

3.2 Complex Hardware and Software Design

3.2.1 Hardware Design

The design of complex hardware such as large scale integrated circuits shall follow the guidelines specified in document RTCA DO-254/EUROCAE ED-80. The hardware criticality level will depend on the particular ROGIDS architecture.

3.2.2 Software Design

Software design shall follow the guidelines specified in document RTCA DO-178/EUROCAE ED-12. The software criticality level will depend on the particular ROGIDS architecture.

3.3 Technical Requirements

3.3.1 Materials

Materials should be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in the ROGIDS.

3.3.2 Workmanship

All components shall be fitted properly and firmly in their appropriate positions. All electrical connections shall be mechanically secured and electrically sound. Care shall be given to neatness and thoroughness of soldering, wiring, welding, brazing, surface treatments, painting, screwed and bolted assemblies, marking of parts and assemblies, and elimination of burrs and sharp edges.

3.3.3 Mean Time Between Failure (MTBF)

The manufacturer shall report the MTBF.

3.3.4 Electrical Bonding and Grounding

The ROGIDS grounding system should provide for separation of AC power, DC power, chassis ground, and signal ground(s). Optionally, signal ground(s) may be "referenced" to chassis ground. Wire shields shall not be used as a signal return.

On nonconductive enclosures, controls or metal parts which may be touched shall be bonded to ground. Case ground shall not be used for electrical power returns. Materials, surface preparation, and finishes for electric bonding surfaces shall be compatible with preservation of adequate electrical conductivity over the life of the ROGIDS. The maximum resistance across any bonding or grounding junction shall be 0.25 Ω , as manufactured.

3.3.5 Interchangeability

All major components having the same part number shall be interchangeable with each other physically and functionally.

3.3.6 Marking

Permanently and legibly mark each major component with the following information:

- a. Name and address of the manufacturer.
- b. The name, type, part number, or model designation of the component.
- c. The serial number and the date of manufacture of the component.

If the component includes software, the part number shall either include hardware and software identification, or use separate part numbers for hardware and software identification. The part number shall uniquely identify the hardware and software design, including modification status.

3.4 Exposure During Normal Operations

ROGIDS parts exposed to the external environment should be designed to withstand the temperature, pressure, chemical, and/or radiation environment associated with deicing/anti-icing conditions. ROGIDS parts exposed to the external environment should be designed to withstand impact from ice particles shed from the aircraft and remain functional.

3.5 Foreign Object Damage (FOD)

The ROGIDS should be constructed so that in the normal operating environment parts do not become loose in service and create a FOD hazard.

3.6 Human Factors

Design of any ROGIDS should include consideration of the applicable human factors enumerated in FAA Human Factors Design Standard HF-STD-001. As a minimum, each design shall consider the following factors:

3.6.1 Installation

Mounting location is dependent on local factors. For vehicle mounted units, this includes vehicle type, cab type, and optional equipment installed.

Mounting of the ROGIDS shall not interfere with the primary deicing/anti-icing functions of the deicing equipment. The mounting location of the sensor shall be such that it can obtain a clear scan of aircraft surfaces to be monitored. The ROGIDS display shall be mounted in a location easily visible to the operator responsible for checking the monitored surface during or after deicing/anti-icing operations.

The ROGIDS shall be compatible with the physical and environmental conditions of installation. SAE J1211 describes an excellent methodology to ensure that the final product will perform its intended function within the foreseeable operating environment. Installation of the equipment should permit ease of access for maintenance and testing. Each element of the ROGIDS shall be designed, or distinctly and permanently marked, to minimize the probability of incorrect assembly that could result in the malfunctioning of the system.

3.6.2 Hazards

The ROGIDS shall not present a hazard to personnel or property when in normal use. ROGIDS using laser-based or other potentially hazardous imaging technologies shall use an eye-safe design.

3.6.3 Interface Design

The display design shall:

- a. Utilize natural and meaningful symbology that is readily understood.
- b. Provide information that is immediately discernible. Results provided by the system shall be readily interpretable by a trained operator.
- c. Provide a clear indication when the ROGIDS is inoperative.
- d. Provide adequate display readability during normal operating conditions.
- e. In the event that the display does not encompass the entire surface to be checked, the interface shall be designed in a way that allows the operator to clearly identify the location of the area displayed in relation to the overall wing (or other entire surface to be checked). This is to ensure that no part of the surface to be checked has been omitted or erroneously duplicated.

3.7 Safety Requirements

3.7.1 Safety Assessment

A structured safety assessment shall be conducted to evaluate the failure modes and their effects on system operation.

The intent is to ensure that ground and flight crew are not presented with misleading information (false negatives) generated by system malfunctions which would allow dispatch and takeoff of an aircraft with contamination on the critical surfaces within the performance defined in Sections 4 and 5 of this AS/MOPS. System malfunctions may include:

- a. Malfunctions that are readily detected by the trained operator.
- b. Malfunctions not detectable by the trained operator.

Acceptable structured assessment procedures include but are not limited to:

- a. System Safety Assessment.
- b. Functional Hazard Assessment.
- c. Failure Modes and Effects Analysis.
- d. Fault Tree Analysis.

Appropriate software and hardware design assurance levels shall be selected based on a structured safety assessment process.

Overall equipment failure rate, including active failures, shall be provided by the ROGIDS manufacturer.

3.7.2 Latent Failure Rate

Appendix D contains background material and rationale for the determination of the acceptable latent failure rate.

The acceptable rate for latent failures that lead to false negatives shall be on the order of 1 in 10000 deicing events (10^{-4} per deicing events).

Fault Tree Analysis and Failure Modes and Effects Analysis shall be conducted and documented to establish that the equipment false negative rate due to malfunction is less than the acceptable rate as defined above.

3.8 ROGIDS Operation

3.8.1 ROGIDS Controls

The operation of ROGIDS controls in all possible positions, combinations, and sequences shall not be detrimental to the continued normal operation of the ROGIDS.

ROGIDS controls that are not intended to be adjusted in normal operation shall not be readily accessible to the ground crew.

3.8.2 Data Processing

Following acquisition, the processing and interpretation of data by the ROGIDS shall be automatic.

The system shall be designed in such a manner as to preclude the display of invalid output data.

3.8.3 Built In Test Equipment (BITE)

The ROGIDS shall include a confidence (BITE) test. The test function shall be automatic during operation.

The BITE shall support the safety objectives and the reliability requirements of this document. BITE shall provide a clear indication of detected ROGIDS failures to the operator.

3.8.4 Nuisance Alarms

Nuisance alarms should be minimized.

3.8.5 Operating Weather Conditions

The ROGIDS shall perform its intended function during weather conditions consistent with ground icing operations.

3.8.6 Radio Frequency Emission

The ROGIDS shall demonstrate compliance to FCC 15.109(B) (refer to 47 CFR § 15.109).

3.9 Qualification Tests

3.9.1 Responsibility for Testing

The manufacturer of the product shall be responsible for the performance and documentation of all required tests specified in Sections 5, 6, and 7 to demonstrate compliance with this AS/MOPS.

3.9.2 Test Article

The tests shall be conducted with one or more ROGIDS that are in full conformity with production build.

3.10 Test Plan(s)

The manufacturer shall prepare a test plan or test plans detailing at a minimum the following:

- a. Purpose of test.
- b. Scope.
- c. Test article configuration (the test shall be conducted with one or more ROGIDS that are in full conformity with the production build).
- d. Applicable and reference documents.
- e. Test administration:
 1. Test activities and responsibilities.
 2. Quality assurance.
- f. Test documentation and data recording/capture.
- g. Pass/fail criteria.
- h. Pass/fail reporting.
- i. Actions to be taken in event of failure.

- j. Test equipment:
 - 1. Calibration.
 - 2. Safety and hazards.
 - 3. Material and handling.
- k. Test procedures to be prepared.
- l. Test reports to be prepared.

3.11 Test Procedures

The manufacturer shall prepare test procedures detailing at a minimum the following:

- a. Purpose.
- b. Scope.
- c. Test article configuration (the test shall be conducted with one or more ROGIDS that are in full conformity with the production build).
- d. Applicable and reference documents.
- e. General instructions:
 - 1. Test activities and responsibilities.
 - 2. Quality assurance and inspection.
 - 3. Standard test conditions.
 - 4. Test equipment calibration.
 - 5. Test documentation.
- f. Test equipment hardware and software.
- g. Test configuration.
- h. Test sequence.
- i. Test procedures.
- j. Pass/fail criteria.
- k. Pass/fail reporting.
- l. Actions to be taken in event of failure.

3.12 Test Report

The ROGIDS manufacturer shall prepare a test report detailing the following:

- a. The part number and serial number, which identifies the ROGIDS as tested, and hardware/software revision numbers as applicable.
- b. A description of the test facility and test procedures used.
- c. Results of all tests and technical data that substantiate the manufacturer's performance specifications.

The foregoing information shall be cross-referenced to the appropriate sections of this AS/MOPS.

3.13 Compliance Checklist

The manufacturer shall provide a declaration that design, verification, validation, testing, and analysis confirms that the equipment complies with all the requirements of this document. A compliance checklist shall be provided to facilitate this task. It is acceptable for the compliance check to provide a cross-reference between requirements in this document and manufacturer documents demonstrating compliance.

3.14 Manufacturer's Performance Specifications

The manufacturer shall provide performance specifications for the ROGIDS. These shall include the maximum and minimum detection distances and angles.

3.15 Operating Procedures

A set of operating procedures for each specific ROGIDS shall be developed.

The manufacturer shall clearly identify all operational limitations.

4. MINIMUM PERFORMANCE SPECIFICATION

This section defines the minimum performance criteria that shall be used for the design of ROGIDS.

4.1 Frozen Contamination Detection

ROGIDS shall be able to detect and communicate the presence of:

- a. Pre-deicing clear ice.
- b. Post-deicing residual clear ice.
- c. Post-deicing residual clear ice during precipitation.

ROGIDS performance standards for detection of frost, snow, and slush on a critical surface have not been defined.

ROGIDS performance related to the detection of frost, snow, and/or slush may be addressed in future versions of this document.

4.1.1 Detection Threshold

The ROGIDS detection threshold shall ensure the detection of clear ice of 0.5 mm thickness or less, continuously distributed over an area of 315 cm², or less.

4.1.2 Ice Above the Detection Threshold

The ROGIDS shall detect and indicate the presence of ice on the monitored surface in excess of the detection threshold.

4.2 Monitored Surface Finish, Illumination Conditions, and ROGIDS Performance

The material, the surface finish, and/or the surface treatment of the monitored surface shall not adversely affect the ROGIDS performance.

The ROGIDS shall not be adversely affected by the transition between two or more surface finishes and/or illumination conditions.

4.3 Fluid Foaming Effects

The ROGIDS performance shall not be affected by foaming in applied deicing/anti-icing fluids.

5. MINIMUM PERFORMANCE SPECIFICATION IN ENVIRONMENTAL TEST CONDITIONS

5.1 Introduction

- a. The environmental tests described in this section will determine the ROGIDS ability to operate in conditions representative of those that may be encountered in actual operation.
- b. Tests in Table 1 are mandatory. All tests shall be completed in full and passed.
- c. Unless otherwise specified, the tests shall be conducted using ALL components of the ROGIDS.
- d. Tests in Table 1 have been adapted from RTCA DO-160. Guidance for adapting the specified RTCA DO-160 tests to ROGIDS testing is provided in the comments section for each test.
- e. For Test 4 in Table 1 (Fluids Susceptibility - ROGIDS External Components), it is permissible to remove the internal components of the ROGIDS for the duration of the test. However, Test 5 in Table 1 (Fluids Susceptibility - ROGIDS System) shall be performed using a fully functioning ROGIDS.
- f. Table 2 provides a series of optional tests. SAE J1211 identifies a shift in recent years to reliability-by-design methodologies being applied during the development process. The end-user environmental requirements will dictate specific design requirements that are appropriate for the intended function. This will, in turn, lead the end user and the equipment manufacturer to define which, if any, of the optional tests are conducted.
- g. The list of optional tests is not intended to be limiting, nor is it all encompassing, in the sense that there may be more appropriate tests for a given functionality and environment than those currently listed. The end user may consider other tests from RTCA DO-160 (or other test documents) that are not listed in Tables 1 and 2 as appropriate for their intended operational environment.

5.1.1 Alternative References

In addition to the optional tests in Table 2, SAE J1211 is a good source of information on reliability-by-design methodologies (also known as Robust Design Philosophy) to be applied during the development process. The handbook is intended to provide guidance to engineers on how to apply a robustness validation process during the development and qualification of automotive electrical/electronic modules.

5.2 Test Plan, Procedures, and Reports

A test plan and test procedures shall be prepared in accordance with 3.10 and 3.11.

A report of test results shall be prepared in accordance with 3.12.

All test procedures shall be documented. Where physical facility limitations exist which influence the setup and conduct of the tests, these limitations shall be noted.