

ED-297

MINIMUM OPERATIONAL PERFORMANCE STANDARD (MOPS) FOR AIRBORNE THERMAL CAMERA SYSTEMS

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

This document contains Minimum Operational Performance Standards (MOPS) for Thermal Camera Systems. The standards specify the minimum performance expected from thermal camera equipment and related functions.

Compliance with this standard is recommended as a means of assuring that the equipment will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operation.

1.2 BACKGROUND

In early 2020, the world airline market was suddenly brought to a halt by the Covid-19 pandemic. Starting in China, this virus was rapidly transmitted worldwide by the prevalence of air travel, resulting in outbreaks in ~220 countries with more than 3.3m deaths at the time this document was first published.

The virus is spread by the transmission of droplets, and is particularly transmitted in enclosed areas like aircraft cabins. As a result, the airline business dropped by more than 90% and with “social distancing”, and it was feared no aircraft would be able to fly more than 50% full for the foreseeable future. This put many passenger carrying airlines into a precarious financial position.

If a technical solution could be found to identify individuals carrying the virus before they enter the aircraft, this may help regulators worldwide allow higher passenger loads with reduced social distancing.

One of the main characteristics of patients having the virus is a fever above 38°C; this temperature can be detected by a thermal camera – the technology is widely used within airports, particularly in the Asia Pacific region.

1.3 PURPOSE AND SCOPE

The purpose of this document is to define the specification and parameters for Thermal Camera Systems which could be used on-board commercial aircraft to sense and / or monitor the temperature of passengers to a sufficiently high degree of accuracy, to help recovery of the airline industry in the post-Covid-19 world. The systems defined would highlight to the cabin crew when a passenger presents with an elevated temperature which might indicate a fever, ideally at the aircraft door, so that, depending on operational procedures, they may be isolated and potentially refused permission to board.

This MOPS is aimed at ensuring any equipment that is compliant with it will be able to attain the necessary regulatory approval; approval is generally facilitated by the recognition of such standard by the relevant authorities as being an Acceptable Means of Compliance (AMC) with the applicable regulations.

The document is structured as follows:

- CHAPTER 1 (this chapter) provides general information required to understand the need for the equipment characteristics and tests defined in the remaining chapters. It describes typical equipment applications and operational objectives and is the basis for the performance criteria stated in later chapters. Definitions essential to the proper understanding of this document are also provided.
- CHAPTER 2 contains the General Design Requirements.
- CHAPTER 3 contains the Design Specifications for the Thermal Camera and associated parts.
- CHAPTER 4 prescribes the Requirements for Supplier Acceptance Testing, detailing minimum performance specifications under standard operating conditions.

- CHAPTER 5 defines the environmental test conditions which provide a laboratory means of determining the overall performance characteristics of the equipment under conditions representative of those which may be encountered in actual operations.
- CHAPTER 6 specifies the performance required of the installed equipment. Ground and flight tests for the installed equipment are included when performance cannot be adequately determined through testing under standard test conditions.

The word “equipment” as used in this document includes all components necessary for the system to properly perform its intended function(s). For example, the “equipment” may be comprised of a set of separate components and/or units that are integrated in such a way as to make up a complete system. In this case, all of the foregoing components and units constitute the “equipment.” It should not be inferred from this example that the equipment design will necessarily include multiple separate components and/or units. This will depend on the specific design solution chosen by the manufacturer.

This MOPS applies to a specific defined function. The equipment may have additional features related to that function for which there are no specified minimum performance requirements. For example, many Very High Frequency (VHF) radios have an active-standby frequency “flip-flop” feature for which there are no specified requirements or tests. Equipment may also have additional functions for which other MOPS or European Technical Standards Orders (ETSOs) may be applicable or, it may contain additional functions not defined by any MOPS or ETSO and so separate guidance may therefore be applicable.

It is important to note that the tests contained in this MOPS are intended to verify compliance with its defined specifications only – **ensuring the safety of any installation or use of Thermal Camera Systems on-board any aircraft is outside its scope.** Approval for installation and use shall remain the responsibility of the relevant aircraft design organisation and/or regulatory body.

1.4 APPLICATIONS

Compliance with this MOPS by manufacturers, installers and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended function(s) under all conditions normally encountered in routine aircraft operations.

Any regulatory application of this document in whole or in part is the sole responsibility of appropriate government agencies.

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

1.4.1 Mandating and Recommendation Phrases

- **“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.
- **“Should”** - The use of the word “Should” (and phrases such as “*It is recommended that...*”, etc.) indicate that though 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 equivalence information or data to adequately support and justify the alternative.

1.5 DESCRIPTION OF SYSTEM(S)

The systems mentioned in this document cover thermal cameras and Thermal Camera System configurations for mobile (hand-held) solutions, wired and wireless stand-alone (autonomous) Thermal Camera Systems, and thermal cameras that are integrated into existing on-board Video Surveillance Systems (VSS). All these solutions could be used to detect boarding passengers having an elevated temperature.

1.6 DEFINITIONS AND ABBREVIATIONS

1.6.1 Definitions

Accuracy	Measures how repeatable a given measurement of a known source is in an extended measurement testing. This is the standard deviation and Route Mean Square (RMS) error of repeated measurements of a reference source at a fixed temperature for an extended time period.
Artefacts	Unintended picture elements, distortions or aberrations introduced during image transmission, processing or display.
Depth of focus	The range of distances over which no loss in sharpness can be detected by the eye viewing the system display.
Drift	The range of values of a set of repeated measurements. This is the range of mean temperatures recorded from multiple extended measurements.
Field of view	The area that can be seen from a given location by the visual device.
Image	A visual representation of an object.
Imaging systems	The means by which images are captured and displayed.
Normal aircraft operations	As used in this document, means when the external aircraft doors are open with passengers boarding, and also when the doors are closed and locked.
Normal operational lighting conditions	Lighting that the particular aircraft configuration would experience during normal aircraft operations.
External ambient lighting	From bright/full sunlight, as it enters the aircraft, to the dark of night.
Interior lighting	Lights in, or that can affect, the coverage area from fully bright to near darkness with cabin lighting set to night levels. As used in this document, it is assumed that emergency lighting falls within this range.
Pop-up	A function that changes the current display from one image to another, or displays an image on a previously blank screen, without action by the flight crew.
Primary & Secondary screening devices	The term 'primary screening' is used to indicate the first temperature measurement point passengers pass through at an airport; measurements points after this are referred to as providing a 'secondary screening'. The thermal camera systems described in this MOPS may act as either primary or secondary screening devices, depending on the specific processes in place at any particular airport and / or airline operation.
Reference source	An adjustable calibrated stable temperature source to be used during testing.
Stability	Measures how repeatable the result is day-to-day. This is the standard deviation of the mean temperature from an extended measurement over a number of days.
Test	A means of demonstrating compliance, whether it is on a bench or in a laboratory, or using a test aircraft in a configuration representative of the configuration to be certified, in a ground and/or flight environment.
Screening distance	The distance between the camera and the target passenger at the location where temperature measurements are taken.
Thermal target	An object used to facilitate testing in place of a human subject.

Threshold temperature	The temperature above which the system will generate an Alert.
Thermal Camera System	The word “system” as used in this document includes all components necessary for the sensing equipment system to properly perform its intended functions. Note this may also include a Calibration Source (CS).
Visual device	Equipment that captures an image which can be displayed.

1.6.2

Abbreviations

API	Application Programming Interface
BIT	Built in Test
C	Celsius
CIU	Camera Interface Unit
CS	Calibration Source (eg Black Body Radiator)
DAL	Design Assurance Level (also Development Assurance Level)
DDP	Declaration of Design and Performance
EASA	European Union Aviation Safety Agency
ETSO	European Technical Standards Orders
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
FAR	"Federal Aviation Regulation", that is, requirements developed and maintained by the FAA
FCC	Federal Communications Commission
FoV	Field of View
GUI	Graphical User Interface
ICAO	International Civil Aviation Organisation
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
m	meters
MOPS	Minimum Operational Performance Standard
MPEG	Motion Picture Experts Group
mm	millimetre
ms	milliseconds
NTSC	National Television Standards Committee
ONVIF	Open Network Video Interface Forum
PII	Personally identifiable information
PAL	Phase Alternating Line (European Version baseband video)
RMS	Root Mean Square
RTCA	Radio Technical Commission for Aeronautics
SECAM	Système Electronique Couleur Avec Mémoire
TSA	Transportation Safety Agency
UL	Underwriter Laboratories

µm	micrometre
VSS	Video Surveillance System (any video camera system integrated into the aircraft interior)
WG	Working Group
Wifi	informally, Wireless Fidelity

1.7

NORMATIVE REFERENCES

- ED-14G/DO-160G “Environmental Conditions and Test Procedures for Airborne Equipment”
- ED-12B/DO-178B “Software Considerations in Airborne Systems and Equipment Certification”
- ED-80/DO-254 “Design Assurance Guidance for Airborne Electronic Hardware”
- Aircraft FAR Part 25 “Airworthiness Standards: Transport Category Aircrafts”
- MIL-HDBK-759C Handbook for Human Engineering Design Guidelines
- ICAO International Standards and Recommended Practices – Operation of Aircraft, ANNEX 6, Parts I, II and III
- CS 25 “European Aviation Safety Agency Certification Specifications for Large Aircrafts”
- FAA AC 43.13-1b – Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair
- FAA AC 25-10 Guidance for installation of miscellaneous non-required electrical equipment
- FAA AC 25-16 Electrical Fault and Fire Prevention and Protection
- Joint EASA-ECDC Aviation Health Safety Protocol Issue 3
- IEC 80601-2-59 “Medical electrical equipment – Part 2-59: Particular requirements for the basic safety and essential performance of screening thermographs for human febrile temperature screening”
- COVID-19 Aviation Health Safety Protocol – Operational Guidelines for the management of air passengers and aviation personnel in relation to the COVID-19 pandemic, EASA Cologne / European Centre for disease prevention and Control (ECDC) Solna, Issue 3, 17th June 2021

1.8

TEST PROCEDURES

The test procedures specified in this document are intended to be used as one means of demonstrating compliance with the performance requirements defined in CHAPTER 2 and CHAPTER 3. Although specific test procedures are cited, it is recognized that other methods may be preferred. These alternate procedures may be used if they provide at least equivalent information. In such cases, the procedures cited herein should be used as one criterion in evaluating the acceptability of the alternate procedures. Users of this document should not infer performance requirements based on Test Procedures.

The order of tests specified suggests that the equipment be subjected to a succession of tests as it moves from design, and design qualification, into operational use. For example, compliance with the requirements of CHAPTER 2, CHAPTER 3 and CHAPTER 4 shall have been demonstrated as a precondition to satisfactory completion of the installed system tests of CHAPTER 6.

The following points are of note:

- Environmental test requirements are specified in CHAPTER 5. The procedures and their associated limits are intended to provide a laboratory means of determining the electrical and mechanical performance of the equipment under environmental conditions, as expected to be encountered in actual operations. Unless otherwise specified, the environmental conditions and test procedures contained in ED-14G / DO-160G (Environmental Conditions and Test Procedures for Airborne Equipment), will be used to demonstrate equipment compliance.
- Bench Tests – Bench test procedures are specified in CHAPTER 4. These tests provide a laboratory means of demonstrating compliance with the requirements of CHAPTER 3. Test results may be used by equipment manufacturers as design guidance, for monitoring manufacturing compliance and, in certain cases, for obtaining formal approval of equipment design.
- Installed Equipment Considerations – Tests for the installed equipment are included when performance cannot be adequately determined through bench testing. The installed equipment test procedures and their associated limits are specified in CHAPTER 6. Although bench and environmental test procedures are not included in the installed equipment test, their successful completion is a precondition to completion of the installed test. In certain instances, however, installed equipment testing may be used in lieu of bench test simulation of such factors as power supply characteristics, interference from or to other equipment installed on the aircraft, etc. Installed tests are normally performed under two conditions:
 - a. With the aircraft on the ground and using simulated or operational system inputs.
 - b. With the aircraft in flight using operational system inputs appropriate to the equipment under test.
- Test results may be used to demonstrate functional performance in the intended operational environment.
- Operational Tests – The operational tests are also specified in CHAPTER 6. These test procedures and their associated limits are intended to be conducted by operating personnel as one means of ensuring that the equipment can be reliably used for its intended function(s).