IEC TS 63144-1

Edition 1.0 2020-04

TECHNICAL SPECIFICATION

Industrial process control devices – Thermographic cameras – Part 1: Metrological characterization

IEC TS 63144-1:2020-04(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.200, 25.040.40

ISBN 978-2-8322-7969-4

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Part 1: Metrological characterization

FOREWORD

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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 63144-1, which is a Technical Specification, has been prepared by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this Technical Specification is based on the following documents:

Draft TS	Report on voting
65B/1129/DTS	65B/1159/RVDTS

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 63144 series, published under the general title *Industrial process control devices – Thermographic cameras*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Thermographic cameras (also called "thermographic imagers" or "infrared cameras") are being increasingly used for spatially and temporally resolved, non-contact radiation temperature measurement. Tracing the temperature values indicated by these instruments to the International Temperature Scale (ITS-90) is gaining in importance for the comparability of measurements. The precondition for their calibration and metrological application with low uncertainties is to accurately describe and determine the essential metrological data of thermographic cameras. Whereas there are international regulations to determine the technical specifications for radiation thermometers – namely IEC TS 62492-1 and IEC TS 62492-2 – there is a lack of such regulations for thermographic cameras in such a detailed form.

This document is Part 1 of a series of technical specifications for thermographic cameras. It is intended to improve comparability and testability of the essential metrological technical data of thermographic cameras. To this end, unambiguous procedures are laid down for the indication and the determination of this technical data. Future IEC TS 63144-2 is intended to specifically address the absolute calibration procedures and the corresponding uncertainties for thermographic cameras in more depth and detail.

INDUSTRIAL PROCESS CONTROL DEVICES – THERMOGRAPHIC CAMERAS –

Part 1: Metrological characterization

1 Scope

This part of IEC 63144 applies, in the field of metrology, to the statement and testing of technical data in datasheets and instruction manuals for thermographic cameras that are used to measure the temperature of surfaces. This includes, unless otherwise stated, both two-dimensional and one-dimensional (line cameras or line scanners) temperature measuring instruments, independently of the scanning principle (fixed multi-element detector or scanning camera system).

This document describes standard test methods to determine relevant metrological data of thermographic cameras. Manufacturers and sellers can choose relevant data and can state that the data shall be compliant with this Technical Specification.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE The term “uncertainty” used in this document is precisely derived from the above databases and more specifically from ISO/IEC Guide 98-3:2008 [3].

3.1
blackbody radiator
radiator that emits radiation in a very good approximation of Planck's radiation law

Note 1 to entry: A blackbody radiator is a source of thermal radiation with an effective emissivity close to 1.

3.2
coverage factor
numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

Note 1 to entry: Coverage factor, k, is a number larger than one and, typically, in the range from 2 to 3.

3.3
detector format used
number of detector elements (detector pixels) that have actually been used to record the image

Note 1 to entry: The term "pixel", which is frequently used, will not be used in this document since it can refer both to the detector (detector element) and to the image (image element).

3.4
exposure time
minimum period of time during which the input quantity (measurement temperature or measurement radiation) is applied in the event of abrupt changes in order for the output signal of the thermographic camera to reach a pre-defined value

3.5
emissivity setting range
range within which the emissivity of the target can be set at the thermographic camera

3.6
field of view
FOV
horizontal and vertical angle of the maximum realizable image section of the thermographic camera, with specified optics

Note 1 to entry: The field of view is the angular extent of the observable world that is seen at any given moment.

3.7
influence of air humidity
parameter which gives the additional uncertainty of the measured temperature value of a target depending on the deviation of the actual humidity from the humidity at calibration referring to a defined measuring range

[SOURCE: IEC TS 62492-1:2008, 3.1.11, modified – "depending on the relative air humidity at a defined ambient temperature" replaced with "of a target depending...measuring range".]

3.8
influence of the internal instrument temperature
parameter which gives the additional uncertainty of the measured temperature value of a target depending on the deviation of the actual internal temperature of the thermographic camera from the internal temperature at calibration referring to a defined measuring range

[SOURCE: IEC TS 62492-1:2008, 3.1.10, modified – "depending on the deviation of the temperature...ambient conditions" replaced with "of a target depending...measuring range".]

3.9
inhomogeneity equivalent temperature difference
IETD
smallest resolvable temperature difference that corresponds to the noise distributed over the surface of the image elements in an image

Note 1 to entry: "Noise distributed over the surface" means the position-dependent deviation of the indicated value of an image element from the mean value of all elements without the influence of time-dependent noise at a homogeneous radiance of the source.

3.10
instantaneous field of view
IFOV
horizontal and vertical angle resulting from the computation of the section of the field of view detected by a single detector element of the thermographic camera with aberration-free optics with a specified focal length

3.11
integration time
time span in which a quantum detector converts the incident radiation into an output signal

Note 1 to entry: The measurement signal is also integrated when using thermal detectors, but in this case, the integration time is not representative for the description of the time-dependent behaviour.

3.12
integration time setting range
range in which the time span for the conversion of the radiation signal into an output signal can be set (for thermographic cameras with a quantum detector)

3.13
interchangeability
half the maximum deviation between the measurement results of two thermographic cameras of the same type that are operated under identical conditions

[SOURCE: IEC TS 62492-1:2008, 3.1.15, modified – Definition revised.]

3.14
internal instrument temperature
internal temperature which is determined by the manufacturer at one or several representative points and is provided to the user in order to monitor the admissible operating temperatures and to indicate additional components in the measurement uncertainty

3.15
long-term stability
reproducibility of measurements repeated over a period of at least three months

[SOURCE: IEC TS 62492-1:2008, 3.1.12, modified – "over a long time" replaced with "a period of at least three months".]

3.16
measurement accuracy
closeness of agreement between a measured quantity value and a true quantity value of a measurand

Note 1 to entry: The concept “measurement accuracy” is not a quantity and is not given a numerical quantity value. A measurement is said to be more accurate when it offers a smaller measurement error.

3.17
measurement uncertainty
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

EXAMPLE The half-width of an interval having a stated coverage probability.

Note 1 to entry: "Measurement uncertainty" and "measurement accuracy" are not synonyms.

[SOURCE: ISO/IEC Guide 98-3:2008, 2.2.3, modified – Notes replaced with the example and note to entry.]

3.18
measuring distance
distance or distance range between the thermographic camera and the target for which the thermographic camera is designed and in which a focussed imaging of the target is possible

[SOURCE: IEC TS 62492-1:2008, 3.1.4, modified – "radiation thermometer" replaced with "thermographic camera" and "and in which a focussed imaging of the target is possible" added.]

3.19
measuring temperature range
temperature range, with respect to the blackbody, for measurements in which the thermographic camera is designed

Note 1 to entry: For this temperature range, the measurement uncertainty remains within defined limits.