International Standard

ISO 7240-33

Fire detection and alarm systems —

Part 33: Thermal image fire detectors

Systèmes de détection d'incendie et d'alarme —
Partie 33: Détecteurs d'incendie utilisant l'imagerie thermique

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

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Introduction

A thermal image fire detection system differs from some point-type detectors (e.g. those specified in ISO 7240-6 or ISO 7240-7) in that the detection is performed remotely from the actual fire and therefore does not involve sensor contact with the products of combustion. The fire detection is based on mathematical algorithm analysis of a thermal image. The thermal image from a thermal camera can be processed by software to determine the presence of heat or flame, or both (depending on the capability of the system), which is visible in the image.

Thermal image fire detectors consist of three elements: a sensor, a controller, and a transmission path between the sensor and image processor. The elements can be in a single cabinet, or the sensor and processor can be in separate cabinets, interconnected by a transmission path.

The processor incorporates an alarm and fault signalling interface to connect to a compatible fire detection control and indicating equipment transmission path.

In this document, two enclosure protection ratings are specified for dust and water ingress protection.

Three environmental temperature ranges are specified in this document, for detectors suitable for installation indoors or outdoors.

A fire detection and alarm system is required to function satisfactorily not only in the event of fire, but also during and after exposure to conditions likely to be met in practice, including corrosion, vibration, direct impact, indirect shock and electromagnetic interference. Tests in this document are intended to assess the performance of the thermal image fire detectors under such conditions.

This document is not intended to place any other restrictions on the design and construction of thermal image fire detectors.

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Fire detection and alarm systems —

Part 33:
Thermal image fire detectors

1 Scope

This document specifies requirements, test methods and performance criteria for thermal image fire detectors (TIFD), which operate in the infrared spectrum, for use in fire detection and alarm systems installed in and around buildings.

Detectors developed for the protection of specific risks that incorporate special characteristics (including additional features or enhanced functionality for which this document does not define a test or assessment method) are beyond the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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IEC 60068-2-1, *Environmental testing — Part 2-1: Tests — Tests A: Cold*

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IEC 60068-2-2, *Environmental testing — Part 2-2: Tests — Tests B: Dry heat*

IEC 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60068-2-42, *Environmental testing — Part 2-42: Tests — Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-75, *Environmental testing — Part 2-75 Tests – Test Eh: Hammer tests*

IEC 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62599-2, *Alarm systems — Part 2: Electromagnetic compatibility — Immunity requirements for components of fire and security alarm systems*

3 Terms and definitions

3.1 Definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

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— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
controller
information technology equipment as part of thermal image fire detectors that record and/or perform analytics on images

Note 1 to entry: The controller may be remote from the sensor.

3.1.2
response threshold value
T
temperature at which a detector signals an alarm when tested as specified in 5.1.6

3.1.3
field of view
FOV
image captured by the thermal image fire detector

Note 1 to entry: The FOV can be expressed as an angle or as a width and height, at a specified distance.

3.1.4
thermal image fire detector
TIFD
self-contained device or distributed system in which the analysis of thermal images is performed to measure temperature in order to detect the likely presence of fire within the images being analysed

3.2 Abbreviated terms

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EM	electromagnetic compatibility
FDCIE	fire detection control and indicating equipment
FOV	field of view
MIC	measuring ionization chamber
IP	ingress protection
RTV	response threshold value
TIFD	thermal image fire detector

4 Requirements

4.1 Conformity

In order to conform to this document, the TIFD shall meet the following requirements:

a) conform to the requirements of Clause 4, which shall be verified by visual inspection or engineering assessment;

b) be tested as specified in Clause 5, meeting the requirements of the tests;

c) be marked in accordance with Clause 7 and be accompanied by the documentation specified in Clause 8, which shall be verified by visual inspection.

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4.2 Fire phenomena

The manufacturer shall declare, in the data presented in Clause 8, the stimulus to which the TIFD is designed to respond. The stimulus that the TIFD responds to shall consist of objects radiating in the infrared wavelength and optionally, flames.

4.3 Immunity to unwanted alarms

Detectors shall be immune from phenomena that can cause unwanted alarms.

Tests shall be performed where the manufacturer claims immunity to the phenomena.

4.4 Detection range

The manufacturer shall declare the ranges at which the TIFD shall detect a fire in the data supplied in Clause 8. The manufacturer shall define the size of the hot object which can be detected at the declared distance.

4.5 Camera lens monitoring

Complete obscuration of the camera lens that inhibits fire detection in the operating FOV shall cause a fault signal.

4.6 Individual alarm indication

Where the TIFD does not display an image of the FOV to the user, then each thermal image fire detector shall be provided with an integral red visual indicator by which the individual detector signalling an alarm can be identified, until the alarm condition is reset. Where other conditions of the detector can be visually indicated, these shall be clearly distinguishable from the alarm indication.

Where the indicator is mounted on the camera, the visual indicator shall be visible from a distance of 6 m in an ambient light intensity up to 500 lx at an angle of up to:

a) 5° from the axis of the detector in any direction, and

b) 45° from the axis of the detector in at least one direction.

4.7 Connection of ancillary devices

The detector may provide for connections to ancillary devices (remote indicators, control relays, etc.), but open- or short-circuit failures of these connections shall not prevent the correct operation of the detector.

4.8 Monitoring of detachable cameras

For detachable cameras, a means shall be provided to detect the disconnection of the camera, in order to give a fault signal.

4.9 Connection of more than one TIFD to the FDCIE transmission path

Where a TIFD is designed to share the transmission path to the FDCIE with other devices; connections shall be such that a single transmission fault does not prevent an alarm signal from more than one TIFD.

Where more than one TIFD share the transmission path to the FDCIE, connections shall be such that one TIFD fault signal does not prevent the alarm signal from any other TIFD.

A TIFD fault shall raise a fault at the FDCIE where the TIFD forms part of a distributed system and transmission path to the FDCIE connecting other devices.

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4.10 Manufacturer's adjustments

It shall not be possible to change the manufacturer's settings, including the response behaviour of the TIFD, except by special means (e.g. the use of a special code or tool) or by breaking or removing a seal.

4.11 On-site adjustment of response behaviour

If there is provision for on-site adjustment of the response behaviour of the detector, then:

a) for all of the settings at which the manufacturer claims conformance, the detector shall conform to the requirements of this document and access to the adjustment means shall be possible only by the use of a code or special tool or by removing the detector from its base or mounting;

b) any setting or settings at which the manufacturer does not claim conformance to this document shall be accessible only by the use of a special code or tool, and it shall be clearly marked on the detector or in the associated data that if these setting or settings are used, the detector does not conform to this document.

Adjustments may be carried out at the TIFD or at the fire detection control and indicating equipment.

4.12 Protection against the ingress of foreign bodies

The manufacturer shall declare, in the data presented in Clause 8, an enclosure protection rating (i.e. IP rating in accordance with IEC 60529) from Table 1 to which the TIFD is designed to be protected against.

Table 1 — Thermal image fire detector enclosure protection

Application	IP rating (minimum) (see IEC 60529)
Indoor	30
Outdoor	54
Other	A rating nominated by the manufacturer exceeding the minimum for the application.

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Where the TIFD includes more than one subassembly (e.g. a separate sensor and controller), some parts of the detector not designed to be installed in the environment to which the rating applies need not be assessed. In this case, the manufacturer's data shall declare the IP rating of each subassembly.

4.13 Operating temperature

The manufacturer shall declare the operating temperature specified in Table 2 to which the TIFD is designed to operate.

Table 2 — Thermal image fire detector operating environment

Application	Temperature °C
Indoor controlled	0 to 40
Indoor	−10 to 55
Outdoor 1	−25 to 70
Outdoor 2	−40 to 55

Where the TIFD includes more than one subassembly (e.g. a separate sensor and controller i.e. a distributed system), some parts of the TIFD not designed to be installed in the temperature to which the rating applies

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shall be assessed separately for their intended installation location. In this case, the manufacturer's data shall declare the environment suitable for each subassembly.

NOTE It is acceptable for a manufacturer to declare more than one temperature range. In this case, the testing would be at the extremes of either range.

4.14 Software

4.14.1 General

The requirements of 4.14.2 and 4.14.3 shall be met for detectors which rely on software control in order to fulfil the requirements of this document. See 8.2 for information on software data documentation.

4.14.2 Software design

In order to ensure the reliability of the detector, the following requirements for software design apply:

a) the software shall have a modular structure;

b) the design of the interfaces for manually and automatically generated data shall not permit invalid data to cause error in the program operation;

c) the software shall be designed to avoid the occurrence of deadlock of the program flow.

4.14.3 Storage of programs and data

4.14.3.1 The program necessary to conform to this document and any preset data, such as manufacturer's settings, shall be held in non-volatile memory. Writing to areas of memory containing this program and data shall be possible only by the use of a special tool or code and shall not be possible during normal operation of the detector.

4.14.3.2 Site-specific data shall be held in memory which will retain data for at least two weeks without external power to the detector, unless provision is made for the automatic renewal of such data, following loss of power, within 1 h of power being restored.

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

Carry out the testing after the test specimen has been allowed to stabilize in the standard atmospheric conditions for testing as follows.

Temperature:	(15 to 35) °C
Relative humidity:	(25 to 75) %
Air pressure:	(86 to 106) kPa

The temperature and humidity shall be substantially constant for each environmental test where the standard atmospheric conditions are applied.

In addition to the requirements above, there shall be no external elements that have the potential to impact the TIFD, including, but not limited to rain or snow.

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5.1.2 Mounting arrangements

Mount the specimen by its normal means of attachment in accordance with the manufacturer's instructions. If these instructions describe more than one method of mounting, then choose the method considered to be most unfavourable for each test.

5.1.3 Operating conditions for tests

If a test method requires a specimen to be operational, then connect the specimen to suitable supply and monitoring equipment having the characteristics required by the manufacturer's data. Allow the specimen to stabilize prior to commencing the test.

Unless otherwise specified in the test method, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value, or the mean of the specified range.

If a test procedure requires a specimen to be monitored to detect any alarm or fault signals, then connections shall be made to any necessary ancillary equipment (e.g. through wiring to an end-of-line device for point detectors) to allow a fault signal to be recognized.

The details of the supply and monitoring equipment and the alarm criteria used shall be given in the test report (see Clause 6).

The tests shall be conducted without any masking of the image or field of view.

5.1.4 Tolerances

Unless otherwise stated, the tolerances for the environmental test parameters shall be as given in the basic reference standards for the test (e.g. the relevant part of the IEC 60068 series).

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If a specific tolerance or deviation limit is not specified in a requirement or test procedure, then a tolerance of ±5 % shall be applied.

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5.1.5 Provision for tests

The following shall be provided for testing conformance to this document:

a) for a TIFD utilizing detachable cameras, a minimum of one controller and a minimum of five cameras;

b) for a TIFD that incorporates the camera and controller into a single unit, five samples of the TIFD;

c) for a TIFD where the camera employs interchangeable lenses, a minimum of one sample of each compatible lens declared by the manufacturer as part of equipment complying with this document;

d) the data specified by Clause 8;

e) multiple TIFD specimens, beyond those specified in a) to c), utilizing different distances, lenses and focal lengths may be simultaneously tested at the same test fire.

The specimens submitted shall be deemed representative of the manufacturer's normal production with regard to their construction and calibration. This implies that the mean response threshold value of the specimens found in the reproducibility test (5.3), should also represent the production mean, and that the limits specified in the reproducibility test should also be applicable to the manufacturer's production.

5.1.6 Measurement of response threshold value

5.1.6.1 General

Mount the specimen in accordance with 5.1.2 in the fire test room in the designated area (see Annex A) or other suitable test area in accordance with the manufacturer's instructions.

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Connect each specimen to its supply and monitoring equipment, as specified in 5.1.3, and allow it to stabilize in its quiescent condition before the start of each test.

Detectors which dynamically modify their sensitivity in response to varying ambient conditions can require special reset procedures and/or stabilization times. In such cases, the manufacturer shall provide data to ensure that the state of the detectors at the start of each test is representative of the normal quiescent state.

Place calibrated radiation emitter (black body source) within the depth of field of the camera, or at a distance as agreed between manufacturer and test house. Use the same distance for all the RTV-tests.

Each RTV test shall be carried out under the same environmental conditions. Objects in the test room that can potentially affect the measurement shall be limited or controlled. Environmental conditions to control include room temperature, atmospheric pressure, and relative humidity.

Set the TIFD to trigger an alarm when $T \geq T_a$, where T_a is the alarm temperature setpoint. T_a shall be chosen by the manufacturer, but shall be greater than 60 °C. The manufacturer is permitted to disable any configurable time delays in the detection algorithm for testing of response threshold.

Place a calibrated radiation emitter in the centre of the field of view, at the agreed distance, such that the emitter occupies no greater than 1/9 of the number of pixels in the thermal image array

Raise the radiation temperature from the emitter from T_a – 20 °C up to T_a + 20 °C at a speed of 3 K/min. The RTV value (T_{RTV}) is the radiation temperature of the emitter at which the TIFD generates an alarm signal.

5.1.7 Test schedule

Test the specimens in accordance with the test schedule in Table 3. After the reproducibility test, number the specimens in the order of their response threshold temperature (i.e. those with the lowest response threshold temperature are numbered 1). For cameras with a separate controller, choose one controller arbitrarily to conduct the indicated tests.

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Table 3 — Test schedule

Test	Subclause	Specimen no. (s)		
		Camera with and without separate controller	Controller installed in the same location as camera	Controller installed in an indoor controlled location
Repeatability	5.2	One chosen arbitrarily	N/A	N/A
Reproducibility	5.3	All specimens	N/A	N/A
Pixel array uniformity	5.4	All specimens	N/A	N/A
Detector lens blocking	5.5	1	N/A	N/A
Fire sensitivity	5.6	All specimens	N/A	N/A
Moving object immunity	5.7	1	N/A	N/A
Response at minimum and maximum distance	5.8	2		
Variation in supply parameters	5.9	2	N/A	N/A
Dry heat (operational)	5.10	3	1	N/A
Dry heat (operational)[a]	5.11	3	1	N/A
Cold (operational)	5.12	4	1	N/A
Cold (operational)[b]	5.13	4	1	N/A
Cold controllers (operational)	5.14	4	N/A	1

[a] This test may be conducted in lieu of the dry heat test specified in 5.10.

[b] This test may be conducted in lieu of the cold test specified in 5.12.

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