

NFPA®

1801

Standard on
Thermal Imagers for
the Fire Service

2021



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NFPA® 1801

Standard on

Thermal Imagers for the Fire Service

2021 Edition

This edition of NFPA 1801, *Standard on Thermal Imagers for the Fire Service*, was prepared by the Technical Committee on Electronic Safety Equipment and released by the Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment. It was issued by the Standards Council on March 15, 2020, with an effective date of April 4, 2020, and supersedes all previous editions.

This edition of NFPA 1801 was approved as an American National Standard on April 4, 2020.

Origin and Development of NFPA 1801

In December 2004, Dr. Francine Amon, Nelson Bryner, and Anthony Hamins of the National Institute of Standards and Technology (NIST) hosted the workshop, “Thermal Imaging Research Needs for First Responders.” The workshop provided a forum to discuss thermal imaging camera strategies, technologies, procedures, best practices, research, and development. Participants included representatives from the U.S. Fire Administration, International Association of Fire Chiefs, NIOSH NPPTL, Naval Research Lab, and thermal imaging camera and core manufacturers, as well as first responder users and trainers. The need for standards was clearly identified as a priority. In May 2005, as a direct result of that workshop, a group of manufacturers and fire service end users met to further identify the need for standardization. The Fire Service Thermal Imaging Camera Operational Standard (FSTICOS) Working Group was formed with Larry Konsin of the American Council for Thermal Imaging and MSA selected to be the group’s chairman.

The FSTICOS Working Group was well populated with representatives from all the manufacturers of fire service thermal imagers and imager core manufacturers along with fire fighter/end users and trainers. The Working Group focused principally on the needs of the fire service for thermal imagers and set about drafting a needs, functionality, usability, and ruggedness statement to begin defining the levels of performance that were deemed necessary. Through surveys conducted at fire service trade shows nationwide, fire fighters validated the findings of the group. As the FSTICOS Working Group was meeting bimonthly, Dr. Amon and her staff at NIST, with the assistance of the U.S. Army Night Vision Lab, began developing the criteria for image quality for fire service thermal imagers. The two groups met and collaborated on a proposed document for thermal imaging cameras. In September 2006, the FSTICOS Working Group requested that the NFPA Technical Committee on Electronic Safety Equipment (TC on ESE) work with them on the project. The TC on ESE agreed to create a Task Group on Fire Service Thermal Imagers, and many of the participants of the FSTICOS Working Group requested to be appointed as members of the TC’s task group. TC on ESE Chairman Bruce Varner appointed committee member Robert Athanas as the task group chairman and the following persons as task group members: Dr. F. Amon, N. Bryner, G. Francisco, C. Gestler, J. Hays, J. Henebury, P. House, R. Klug, L. Konsin, D. Little, S. Lumry, T. McDonald, M. McKenna, S. Nixdorff, T. Tedesco, D. Wiles, and T. Wolf.

During the development process, it became clear that the fire services operational environments were very different from most other emergency services organizations, which led the committee to change the focus of NFPA 1801 to thermal imagers for the fire service. The proposed standard was entered into the fall 2009 standards cycle and underwent several development changes as the committee worked with the very technical design criteria and test methods developed for this standard. As with all PPE product standards in the Project on Fire and Emergency Services Protective Clothing and Equipment, NFPA 1801 included requirements for independent third-party certification of thermal imagers to ensure compliance with the labeling, design, performance, testing, and certification requirements for the certification organizations and the thermal imager manufacturers to claim “certified as compliant” to NFPA 1801.

The Report on Proposals (ROP) for NFPA 1801 was released for public review and comment on December 29, 2008. Following the public review period, which closed on March 6, 2009, the Report on Comments (ROC) was processed in the spring of 2009. The Technical Correlating Committee (TCC) on Fire and Emergency Services Protective Clothing and Equipment processed the proposed NFPA 1801 at their meeting in late May 2009 and approved the document to go forward.

The 2010 edition of NFPA 1801 was recognized as one of the most technical documents assembled and released under the NFPA Fire and Emergency Services Protective Clothing and Equipment Project to date. The image quality tests that were developed specifically for the standard were complicated due to their highly technical nature, and the degree to which they were reproducible from testing laboratory to testing laboratory was in question.

The committee sought the assistance and resources of the Fire Protection Research Foundation to coordinate a series of round-robin tests to determine the lab-to-lab repeatability of the image quality tests. The project was conducted by Dr. Francine Amon, Ph.D., who began this project while employed by the National Institute of Standards and Technology (NIST). The remainder of the testing was conducted by Chad Morey of Intertek Testing Services of Cortland, New York. Additional sponsorship of the project came from Draeger Safety, Honeywell First Responder Products, ISG Infrasy, MSA, and Scott Safety.

A number of changes that needed to be made were identified in the document. A Tentative Interim Amendment (TIA) and Errata were issued to address these changes. Ultimately, the committee decided that the best course of action was to immediately enter the revision cycle for Annual 2012 and review the document for any additional changes.

In April 2011, several thermal imager manufacturers began work to revise the testing issues. In June 2011, at the direction of TC on ELS Chairman Bruce Varner, a task group was formed chaired by committee member Robert Athanas of FDNY and SAFE-IR, Inc. In an effort to identify and resolve these issues in an expeditious manner, the task group was comprised of thermal imager manufacturer technical personnel (engineers from the thermal imager camera and core manufacturers) and testing lab technicians. Task group members included Daniel Akins and John Morris (ISG INFRASYS), Landon Borders and Kyle Hawes (Bullard), Craig Gestler (MSA), Jason Patterson (Scott Safety), Jon Turner and Bill Wilson (e2v Technologies), and Dr. Bernd Spellenberg and Travis Tedesco (Draeger Safety). The thermal imager core manufactures were represented by Humphrey Ha (L-3 Communications), and Bob Nishi and Julie Hoy Moreira (FLIR Systems). Certification and testing organizations were represented by Steve Sanders and Jim Rose (SEI) and Jason Allen and Chad Morey (Intertek). Fire service representation included Bob Athanas of FDNY/SAFE-IR and Steve Townsend of the Carrollton, Texas Fire Department.

The first task group meeting was held on June 29, 2011, in Newark, New Jersey, where testing issues were further clarified and a course of action was developed and agreed upon by all the participants. This meeting was followed by several lengthy conference calls and many hours of research and testing over the summer months to meet a September 2011 NFPA 1801 ROC deadline.

The last task group meeting was held in Austin, Texas, on September 19, 2011, prior to a full meeting of the TC on ELS to finalize the proposed work. The final comments included revised language and test procedures, which improved the content of the first edition of the standard as initially written. The committee was balloted according to the NFPA Regulations Governing Committee projects. The ballot subsequently passed, enabling the committee's changes to be included in the 2013 edition of NFPA 1801. It should be noted that participation and cooperation of all task group members and the support afforded them by their employers during this project was unprecedented and should serve as a model for future projects.

The 2018 edition of NFPA 1801 also applied to the design, performance, testing, and certification of thermal imagers originally certified to the previous edition of this standard, that incorporate replacement parts, components, and/or software, to be certified to the 2018 edition of the standard. New UL standard references were added, as were specifications for labeling upgraded thermal imagers. The TI BASIC operational format was permitted to include audio, video, and data transmission.

The 2018 edition of NFPA 1801 also added a design requirement for an audio/video recording indicator, as well as several editorial and referenced document updates.

A summary of the 2018 edition technical requirements follows:

- Battery locking mechanism testing was added so that where the use of a tool-secured feature is relied upon to meet ANSI/ISA-12.12.01 and this feature is not automatically engaged, the camera will inform the user by a message that prevents normal use of the camera.
- All imagers are required to pass a 2-hour run time conducted with video and image capture functions active.
- The thermal imager must display a useful image within 30 seconds of power being applied (battery installed).
- The thermal imager must display an icon in the form of a red dot inside a green circle when recording audio/video.
- Camera resolution of 76,800 pixels (320 × 240) is a minimum requirement.
- A sensor/image refresh rate of at least 25 Hz is required.
- Only specified symbols can be displayed at power-up.
- A display resolution of 76,800 was added to match the sensor requirement.
- A display resolution of 76,800 was added to match the sensor requirement.

The 2021 edition features editorial changes as well as:

- In Chapter 4, updated test matrices include both stand-alone and integrated thermal imagers.
- In Chapter 6, the spot temperature measurement feature has moved from the TI BASIC operational format to the TI BASIC PLUS operational format. Despite all thermal imager manufacturer user manual warnings not to use temperature measurement to make tactical decisions, it became apparent in three recent NIOSH Firefighter Fatality Investigation Reports that there is a lack of understanding on behalf of the fire service of the feature's capabilities. Although the use of the temperature measurement feature was not considered the sole factor in these fatalities, its use and potential misuse certainly could be considered a factor in a cascading series of events that may have been attributed to these fire fighter injuries and fatalities. The move is further substantiated in all previous editions of NFPA 1801 in Subsection 6.5.2, which requires additional training for TI BASIC PLUS operational format functions, enhancements, and innovations beyond TI BASIC.
- In Chapter 8, an updated spatial resolution source target has been added, as well as an updated region of interest selection figure to simplify testing and testing procedures without compromising image quality.

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NFPA 1801

Standard on

Thermal Imagers for the Fire Service

2021 Edition

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex B.

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall specify the design, performance, testing, and certification requirements for thermal imagers used by fire service personnel during emergency incident operations.

1.1.2 This standard shall specify requirements for new thermal imagers for the fire service.

1.1.2.1* This standard shall also specify the minimum requirements for the design, performance, testing, and certification of thermal imagers certified to an earlier edition of this standard that incorporate parts, components, and/or software to meet this edition of the standard.

1.1.3 This standard shall not specify requirements for thermal imagers manufactured prior to the effective date of this standard.

1.1.4 This standard shall not specify requirements for thermal imagers manufactured to any other standards or other requirements.

1.1.5* Any accessories or enhancements built into, attached to, or sold with the thermal imager by the thermal imager manufacturer for later attachment shall be tested with the thermal imager with those accessories and enhancements installed or attached, as specified in 4.3.9.4, to ensure the performance and functions of the thermal imager.

1.1.6 This standard shall not be construed as addressing all of the safety concerns, if any, associated with the use of this standard by testing facilities. It shall be the responsibility of the persons and organizations that use this standard to establish safety and health practices and to determine the applicability of regulatory limitations prior to use of this standard for designing, manufacturing, and testing.

1.1.7 Nothing herein shall restrict any jurisdiction or manufacturer from exceeding these minimum requirements.

1.2 Purpose.

1.2.1 The purpose of this standard shall be to establish minimum requirements for thermal imagers manufactured for fire service use.

1.2.2 Controlled laboratory tests used to determine compliance with the performance requirements of this standard shall not be deemed as establishing performance levels for all situations, environments, and conditions to which thermal imagers could be exposed.

1.2.3 This standard shall not be interpreted or used as a detailed manufacturing or purchase specification, but it shall be permitted to be referenced in purchase specifications as minimum requirements.

1.3 Application.

1.3.1 This standard shall apply to all thermal imagers used by fire service personnel during an emergency incident.

1.3.2 This standard shall apply to the design, performance, manufacturing, testing, and certification of new thermal imagers used by fire service personnel.

1.3.2.1 This standard shall also apply to the design, performance, testing, and certification of thermal imagers originally certified to the previous edition of this standard that incorporate replacement parts, components, and/or software to be certified to this edition of the standard.

1.3.3 This standard shall not apply to any thermal imager manufactured in accordance with other standards. However, manufacturers shall be permitted to have noncompliant thermal imagers modified to meet the requirements of this standard and become certified as compliant with this standard.

1.3.4* This standard shall not apply to accessories and enhancements that could be built into or attached to a certified thermal imager before or after purchase but that are not necessary for the thermal imager to meet the requirements of this standard. Any accessories or enhancements built into, attached to, or sold with the thermal imager by the thermal imager manufacturer for later attachment shall be tested with the thermal imager with those accessories and enhancements installed or attached, as specified in 4.3.9.4, to ensure the performance and functions of the thermal imager.

1.3.5 This standard shall not apply to criteria for use of thermal imagers by the fire service.

1.4 Units.

1.4.1 In this standard, values for measurement are followed by an equivalent in parentheses, but only the first stated value shall be regarded as the requirement.

1.4.2 Equivalent values in parentheses shall not be considered as the requirement because those values are approximate.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1408, *Standard for Training Fire Service Personnel in the Operation, Care, Use, and Maintenance of Thermal Imagers*, 2020 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2018 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, 2019 edition.

2.3 Other Publications.

2.3.1 ASME Publications. American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ANSI/ASME Y14.5M, *Dimensioning and Tolerancing*, 1982.

ANSI/ASME B46.1, *Surface Texture (Surface Roughness, Waviness, and Lay)*, 1978.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 2016.

ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*, 2013.

2.3.3 ISO/IEC Publications. International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland.

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*, Ed. 2.2, 2013/Cor 1:2013.

IEC 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*, 2016.

IEC 61000-6-3, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial, and light-industrial environments*, 2011.

IEC 62133, *Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*, 2017.

ISO 9001, *Quality management systems — Requirements*, 2008.

ISO 9001, *Quality management systems — Requirements*, 2015.

ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*, 2017.

ISO 17025, *General requirements for the competence of testing and calibration laboratories*, 2005/Cor 1: 2006.

ISO 17493, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*, 2016.

ISO Guide 27, *Guidelines for corrective action to be taken by a certification body in the event of misuse of its mark of conformity*, 1983.

ISO/IEC 17021-1, *Conformity assessment — Requirements for bodies providing audit and certification of management systems*, 2015.

ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes, and services*, 2015.

2.3.4 NIST Publications. National Institute of Standards and Technology, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070.

NIST Technical Note 1630, *Evaluation of Image Quality of Thermal Imagers Used by the Fire Service*, February 2009.

2.3.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 1642, *Lithium Batteries*, 2012, revised 2015.

UL 2054, *Household and Commercial Batteries*, 2004, revised 2011.

ANSI/UL 121201, *Standard for Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*, 2017.

2.3.6 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3* General Definitions.

3.3.1 Assembly. Processes including, but not limited to, sewing, gluing, laminating, tacking, or other means of attaching whereby materials or component parts are put together to form a portion of the compliant product or the complete compliant product.

3.3.2 Blackbody. An object that absorbs all electromagnetic radiation that falls onto it; no radiation passes through the object, and none is reflected.

3.3.3 Certification Organization. An independent third-party organization that determines product compliance with the requirements of this standard using product testing and evaluation and that administers a labeling, listing, and follow-up program.

3.3.4 Certification/Certified. A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods the manufacturer uses to determine continued compliance of labeled and listed products with the requirements of this standard.

3.3.5 Compliance/Compliant. Meeting or exceeding all applicable requirements of this standard.

3.3.6 Compliant Product. Equipment that is certified to the applicable NFPA standard.

3.3.7 Component. Any material, part, or subassembly used in the construction of the compliant product.

3.3.8 Drip. To run or fall in drops or blobs.

3.3.9 Emissivity. The ratio of the radiation emitted by a surface to the radiation emitted by a blackbody at the same temperature.

3.3.10 Failure Mode and Effects Analysis (FMEA). A risk assessment technique for systematically identifying potential failures in a system or a process.

Δ 3.3.11 Follow-Up Program. The sampling, inspections, tests, or other measures conducted by the certification organization on a periodic basis to determine the continued compliance of labeled and listed products that are produced by the manufacturer to the requirements of this standard.

3.3.12 Haze. Light that is scattered as a result of passing through a transparent object.

3.3.13 Icon. A symbol that represents an option, program, or system status.

3.3.14 Luminance. A photometric measure of the amount of light that passes through or is emitted from a particular area.

3.3.15 Manufacturer. The entity that directs and controls any of the following: compliant product design, compliant product manufacturing, or compliant product quality assurance; also, the entity that assumes liability for the compliant product or provides the warranty for the compliant product.

3.3.16 Melt. A response to heat by a material resulting in evidence of flowing or dripping.

3.3.17 Model. The collective term used to identify a group of elements or items of the same basic design and components from a single manufacturer produced by the same manufacturing and quality assurance procedures that are covered by the same certification.

3.3.18 Pixel Saturation. Incident energy that causes a sensor to respond at its maximum value.

3.3.19 Power Source Indicator. A visual signal displayed on a thermal imager that indicates the status of the power supply.

3.3.20 Product. See 3.3.6, Compliant Product.

3.3.21* Product Label. A marking provided by the manufacturer for each compliant product containing compliance statements, certification statements, manufacturer, model information, or similar data.

3.3.22 Resolution. Separation or division into constituent or elementary parts as expressed by the number of pixels in the displayed image.

3.3.23 Sample. Equipment or equipment components that are randomly selected from the manufacturer's production line, from the manufacturer's inventory, or from the open market.

3.3.24 Sensitivity. The degree of response of a receiver or instrument to an incoming signal or to a change in the incoming signal.

3.3.24.1 Low Sensitivity. The least thermally sensitive operational mode, used to increase the thermal imager's temperature range.

3.3.25 Sensitivity Mode. An operational function that relates to the degree to which temperature differences are resolved.

3.3.26 Service Life. The period that a compliant product can be useful before retirement.

3.3.27 Specimen. The item that undergoes testing; the conditioned equipment or equipment component that is tested. Specimens are taken from samples. (See also 3.3.23, *Sample*.)

3.3.28 Temperature Measurement Zone. A transparent green square that aids in aiming a thermal imager for temperature measurements.

N 3.3.29 Thermal Imager (TI). Special electronic equipment that creates a picture based on the heat produced by a person or object.

N 3.3.29.1 Integrated TI. A removable or nonremovable TI that is an integral part of another item or items of protective clothing, protective equipment, or both.

N 3.3.29.1.1 Nonremovable. An integrated TI that is not removable and cannot be used independently of the item or items with which it is integrated.

N 3.3.29.1.2 Removable. An integrated TI that is removable so that it can be used independently of the item or items with which it is integrated.

N 3.3.29.2 Stand-Alone TI. A TI that is not an integral part of any other item of protective clothing or protective equipment.

3.3.30 White-Hot Polarity. A display methodology whereby a grayscale image is created based on the fact that the warmest object in the field of view is the whitest object.

Chapter 4 Certification

4.1 General.

4.1.1 For the process of certification of thermal imagers as being compliant with NFPA 1801, all such thermal imagers shall meet the requirements of Section 4.1, General; Section 4.2, Certification Program; Section 4.3, Inspection and Testing; Section 4.4, Annual Verification of Product Compliance; Section 4.5, Manufacturers' Quality Assurance Program; Section 4.6, Hazards Involving Compliant Product; Section 4.7, Manufacturers' Investigation of Complaints and Returns; and Section 4.8, Manufacturers' Safety Alert and Product Recall Systems.

4.1.2 All certification shall be performed by a certification organization that meets at least the requirements specified in Section 4.2, Certification Program, and that is accredited for personal protective equipment in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes, and services*. The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.1.3 Manufacturers shall not claim compliance with portions or segments of the requirements of this standard and shall not use the NFPA name or the name or identification of this standard, NFPA 1801, in any statements about their respective product(s) unless the product(s) is certified as compliant to this standard.

4.1.4 Where thermal imagers are compliant, the product shall be labeled and listed.

4.1.5 Where thermal imagers are compliant, the product shall also have a product label that meets the requirements specified in Section 5.1, Product Label Requirements.

4.1.6 The certification organization's label, symbol, or identifying mark shall be attached to the product label, shall be part of the product label, or shall be immediately adjacent to the product label.

4.1.7 The certification organization shall not certify any thermal imager to the 2018 edition of this standard on or after the NFPA effective date for the 2021 edition.

4.1.8 The certification organization shall not permit any manufacturer to label any thermal imager as compliant with the 2018 edition of this standard that is certified as compliant with the 2021 edition of NFPA 1801 after the effective date plus 14 months.

4.1.9 The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2018 edition of NFPA 1801 from all thermal imagers that are under the ownership and control of the manufacturer on the effective date plus 14 months, and the certification organization shall verify that this action is taken.

4.2 Certification Program.

4.2.1 The certification organization shall not be owned or controlled by manufacturers or vendors of the product being certified.

4.2.2 The certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability.

4.2.3 The certification organization shall be accredited for personal protective equipment in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes, and services*. The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.2.4 The certification organization shall refuse to certify products to this standard that do not comply with all applicable requirements of this standard.

4.2.5 The contractual provisions between the certification organization and the manufacturer shall specify that certification is contingent on compliance with all applicable requirements of this standard.

4.2.5.1 The certification organization shall not offer or confer any conditional, temporary, or partial certifications.

4.2.5.2 Manufacturers shall not be authorized to use any label or reference to the certification organization on products that are not compliant with all applicable requirements of this standard.

4.2.6 The certification organization shall have laboratory facilities and equipment available for conducting proper tests to determine product compliance.

4.2.6.1 The certification organization laboratory facilities shall have a program in place and functioning for calibration of all instruments, and procedures shall be in use to ensure proper control of all testing.

4.2.6.2 The certification organization laboratory facilities shall follow good practice regarding the use of laboratory manuals, form data sheets, documented calibration and calibration routines, performance verification, proficiency testing, and staff qualification and training programs.

4.2.7 The certification organization shall require the manufacturer to establish and maintain a quality assurance program that meets the requirements of Section 4.5, Manufacturers' Quality Assurance Program.

4.2.7.1 The certification organization shall require the manufacturer to have a product recall system specified in Section 4.8, Manufacturers' Safety Alert and Product Recall Systems, as part of the manufacturers' quality assurance program.

4.2.7.2 The certification organization shall audit the manufacturer's quality assurance program to ensure that the quality assurance program provides continued product compliance with this standard.

4.2.8 The certification organization and the manufacturer shall evaluate any changes affecting the form, fit, or function of the compliant product to determine its continued certification to this standard.

4.2.8.1 The certification organization and the manufacturer shall evaluate replacement parts, components, software, and upgrade procedures to determine any changes affecting the form, fit, or function of thermal imagers certified to earlier editions of this standard to permit incorporation of replacement parts, components, or software, leading to certification of devices to this edition of the standard.

4.2.8.2 Where a manufacturer has more than one model of thermal imager, all certified to this standard, the certifying organization and the manufacturer shall evaluate replacement parts, components, software, and upgrade procedures to determine the continued certification when modifying a fielded thermal imager with replacement parts, components, or software in one previously certified model to become another previously certified model.

4.2.9 The certification organization shall have a follow-up inspection program of the manufacturer's facilities of the compliant product with at least two random and unannounced visits per 12-month period to verify the product's continued compliance.

4.2.9.1 As part of the follow-up inspection program, the certification organization shall select sample compliant product at random from the manufacturer's production line, from the manufacturer's in-house stock, or from the open market.

4.2.9.2 Sample product shall be evaluated by the certification organization to verify the product's continued compliance in order to ensure that the materials, components, and manufacturing quality assurance systems are consistent with the materials, components, and manufacturing quality assurance that were inspected and tested by the certification organization during initial certification and recertification.

4.2.9.3 The certification organization shall be permitted to conduct specific testing to verify the product's continued compliance.

4.2.9.4 For products, components, and materials where prior testing, judgment, and experience of the certification organization have shown results to be in jeopardy of not complying with

this standard, the certification organization shall conduct more frequent testing of sample product, components, and materials acquired in accordance with 4.2.9.1 against the applicable requirements of this standard.

4.2.10 The certification organization shall have in place a series of procedures, as specified in Section 4.6, Hazards Involving Compliant Product, that address reports of situations in which a compliant product is subsequently found to be hazardous.

4.2.11 The certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions. The procedures shall include the presentation of information from both sides of a controversy to a designated appeals panel.

4.2.12 The certification organization shall be in a position to use legal means to protect the integrity of its name and label. The name and label shall be registered and legally defended.

4.3 Inspection and Testing.

4.3.1 For both initial certification and recertification of compliant products, the certification organization shall conduct both inspection and testing as specified in this section.

4.3.2 All inspections, evaluations, conditioning, and testing for certification or for recertification shall be conducted by a certification organization's testing laboratory that is accredited in accordance with the requirements of ISO 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.2.1 The certification organization's testing laboratory's scope of accreditation to ISO 17025, *General requirements for the competence of testing and calibration laboratories*, shall encompass testing of personal protective equipment.

4.3.2.2 The accreditation of a certification organization's testing laboratory shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.3.3 A certification organization shall be permitted to utilize conditioning and testing results conducted by a product or component manufacturer for certification or recertification, provided the manufacturer's testing laboratory meets the requirements specified in 4.3.3.1 through 4.3.3.5.

4.3.3.1 The manufacturer's testing laboratory shall be accredited in accordance with the requirements of ISO 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.3.2 The manufacturer's testing laboratory's scope of accreditation to ISO 17025, *General requirements for the competence of testing and calibration laboratories*, shall encompass testing of personal protective equipment.

4.3.3.3 The accreditation of a manufacturer's testing laboratory shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.3.3.4 The certification organization shall approve the manufacturer's testing laboratory.

4.3.3.5 The certification organization shall determine the level of supervision and witnessing of the conditioning and test-

ing for certification or recertification conducted at the manufacturer's testing laboratory.

4.3.4 Sampling levels for testing and inspection shall be established by the certification organization and the manufacturer to ensure a reasonable and acceptable reliability at a reasonable and acceptable confidence level that products certified to this standard are compliant, unless such sampling levels are specified herein.

4.3.5 Inspection and evaluation by the certification organization shall include a review of all product labels to ensure that all required label attachments, compliance statements, certification statements, and other product information are at least as specified for thermal imagers in Section 5.1, Product Label Requirements.

4.3.6 Inspection and evaluation by the certification organization shall include an evaluation of any symbols and pictorial graphic representations used on product labels or in user information, as permitted in 5.1.5, to ensure that the symbols are clearly explained in the product's user information package.

4.3.7 Inspection and evaluation by the certification organization shall include a review of the user information required by Section 5.2, User Information, to ensure that the information has been developed and is available.

4.3.8 Inspection and evaluation by the certification organization for determining compliance with the design requirements specified in Chapter 6 shall be performed on whole or complete products.

4.3.9 Testing to determine compliance of the thermal imager and the components that are necessary for the proper operation of the thermal imager with the performance requirements specified in Chapter 7 shall be conducted by the certification organization in accordance with the specified testing requirements of Chapter 8. The order of testing shall be conducted as specified in Table 4.3.9(a) for stand-alone thermal imagers and Table 4.3.9(b) for thermal imagers integrated into other NFPA-compliant devices.

4.3.9.1 Testing shall be performed on new thermal imager products.

4.3.9.2 Testing shall be performed on specimens representative of materials and components used in the actual construction of the compliant product.

4.3.9.3 The certification organization also shall be permitted to use sample materials cut from a representative product.

4.3.9.4 Where any accessories, enhancements, or both are built into, attached to, or detachable from the thermal imager, including, but not limited to, methods of attachment to the operator, the certification organization shall inspect and evaluate the thermal imager as specified in Chapter 6 and shall test the thermal imager as specified in Chapter 8. The thermal imager shall meet all the performance requirements specified in Chapter 7 with those accessories and enhancements installed or attached, including, but not limited to, methods of attachment to the operator, to ensure that the performance and

Table 4.3.9(a) Test Matrix for Stand-Alone Thermal Imagers

Test Order	Specimens 1-3	Specimens 4-6	Specimens 7-9	Specimens 10-12	Specimens 13-15	Specimens 16-18
1	Image Recognition Test Section 8.1 Specimens 1-3	Image Recognition Test Section 8.1 Specimens 4-6	Corrosion Test Section 8.4 Specimens 7-9	Heat Resistance Test Section 8.6 Specimens 10-12	Image Recognition Test Section 8.1 Specimens 13-15	Image Recognition Test Section 8.1 Specimens 16-18
2	Field of View Measurement Section 8.11 Specimens 1-3	Cable Pullout Test Section 8.9 Specimens 4-6	Product Label Durability Test Section 8.8 Specimens 7-9	Product Label Durability Test Section 8.8 Specimens 10-12	Vibration Test Section 8.2 Specimens 13-15	Durability Test Section 8.13 Specimens 16-18
3	Effective Temperature Range Test Section 8.10 Specimens 1-3	Impact Acceleration Resistance Test — Ambient Section 8.3 Specimen 4			Image Recognition Test Section 8.1 Specimens 13-15	Image Recognition Test Section 8.1 Specimens 16-18
4	Thermal Sensitivity Test Section 8.12 Specimens 1-3	Impact Acceleration Resistance Test — Cold Section 8.3 Specimen 5				Product Label Durability Test Section 8.8 Specimens 16-18
5	Heat and Flame Test Section 8.7 Specimens 1-3	Impact Acceleration Resistance Test — Elevated Section 8.3 Specimen 6				
6		Image Recognition Test Section 8.1 Specimens 4-6				

N Table 4.3.9(b) Test Matrix for Integrated Thermal Imagers

Test Order	Specimens 1–3	Specimens 4–6	Specimens 7–9	Specimens 10–12	Specimens 13–15
1	Image Recognition Test Section 8.1 Specimens 1–3	Cable Pullout Test Section 8.9 Specimens 4–6	Heat Resistance Test Section 8.6 Specimens 7–9	Image Recognition Test Section 8.1 Specimens 10–12	Image Recognition Test Section 8.1 Specimens 13–15
2	Field of View Measurement Section 8.11 Specimens 1–3	Corrosion Test Section 8.4 Specimens 4–6	Product Label Durability Test Section 8.8 Specimens 7–9	Vibration Test Section 8.2 Specimens 10–12	Durability Test Section 8.13 Specimens 13–15
3	Effective Temperature Range Test Section 8.10 Specimens 1–3	Product Label Durability Test Section 8.8 Specimens 4–6		Image Recognition Test Section 8.1 Specimens 10–12	Image Recognition Test Section 8.1 Specimens 13–15
4	Thermal Sensitivity Test Section 8.12 Specimens 1–3				Product Label Durability Test Section 8.8 Specimens 13–15
5	Heat and Flame Test Section 8.7 Specimens 1–3				

functions of the thermal imager are not reduced or otherwise negatively affected.

4.3.10 The certification organization shall accept from the manufacturer, for evaluation and testing for certification, only product or product components that are the same in every respect as the actual final product or product component.

4.3.11 The certification organization shall not allow any modifications, pretreatment, conditioning, or other such special processes of the product or any product component prior to the product's submission for evaluation and testing by the certification organization. Manufacturers shall be permitted to refocus camera samples prior to conducting testing.

4.3.12 The certification organization shall not allow the substitution, repair, or modification, other than as specifically permitted herein, of any product or any product component during testing.

4.3.13 The certification organization shall not allow test specimens that have been conditioned and tested for one method to be reconditioned and tested for another test method unless specifically permitted in the test method.

4.3.14 Material changes in the form, fit, or function of a compliant product shall necessitate new inspection and testing to verify compliance to all applicable requirements of this standard that the certification organization determines can be affected by such change. This recertification shall be conducted before labeling the modified product as being compliant with this standard.

4.3.15 The manufacturer shall maintain all design, performance, inspection, and test data from the certification organization used in the certification of the manufacturer's compliant product. The manufacturer shall provide such data, upon request, to the purchaser or authority having jurisdiction (AHJ).

N 4.3.16 Accessory Certification.

N 4.3.16.1 Where a thermal imager submitted for certification to this standard is also submitted with an accessory that is built into, attached to, or sold for later attachment to the thermal imager, and an NFPA Project on Fire and Emergency Services Protective Clothing and Equipment standard exists for the product performance associated with the accessory, the accessory shall be certified to that NFPA standard.

N 4.3.16.2 In all cases, such accessories shall not degrade the performance of the thermal imager.

N 4.3.16.3 Where a thermal imager is submitted as an accessory that is built into, attached to, or sold for later attachment to a product, and an NFPA Project on Fire and Emergency Services Protective Clothing and Equipment standard exists for the product and the product is certified to that NFPA standard, the thermal imager shall be certified to NFPA 1801.

N 4.3.16.4 In all cases, the thermal imager shall not degrade the performance of the product.

4.4 Annual Verification of Product Compliance.

4.4.1 All thermal imagers that are certified as compliant with this standard shall undergo recertification on an annual basis. This recertification shall include the following:

- (1) Inspection and evaluation to all design requirements as required by this standard on all manufacturer models and components
- (2) Testing to all performance requirements as required by this standard on all manufacturer models and components within the following protocol:
 - (a) Where a test method incorporates testing both before and after preconditioning and the test generates quantitative results, recertification testing shall be limited to the conditioning that yielded the worst case test result during the initial certification for the model or component.