



*Member of the FM Global Group*

# **Approval Standard for Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling**

**Class Number 3260**

**August 2000**

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# Foreword

The FM Approvals certification mark is intended to verify that the products and services described will meet FM Approvals' stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for certification by FM Approvals shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing shall ensure a consistently uniform and reliable product. Approval Standards strive to be performance-oriented. They are intended to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and listing depends on compliance with the Approval Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

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## I. INTRODUCTION

### 1.1 Purpose

- 1.1.1 This standard states Approval criteria for radiant energy-sensing fire detectors used for automatic fire alarm signaling.
- 1.1.2 FM Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program. Evaluation for environmental or hazardous location ratings will require additional examination per other standards such as FM Approval Standard 3600 – *Electrical Equipment For Use In Hazardous (Classified) Locations General Requirements*.

### 1.2 Scope

- 1.2.1 This standard sets performance requirements for radiant energy-sensing fire detectors for the protection of occupants, building space, structure, area, or object.
- 1.2.2 FM Approval Standards are intended to verify that the product described will meet stated conditions of performance, safety and quality that are useful to the ends of property conservation.

### 1.3 Basis for Requirements

- 1.3.1 The requirements of this Standard are based on experience, research and testing, and/or the standards of other national and international organizations. The advice of manufacturers, users, trade associations, jurisdictions, and loss control specialists has also been considered.
- 1.3.2 The requirements of this Standard reflect tests and practices used to examine characteristics of radiant energy-sensing fire detectors for the purpose of obtaining FM Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Detectors having characteristics not anticipated by this standard may be Approved if performance equal or superior to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, detectors which do meet all the requirements identified in this standard may not be Approved if other conditions which adversely affect performance, safety and quality exist or if the intent of this standard is not met.

### 1.4 Basis for FM Approval

FM Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:
- the suitability of the product;
  - the performance of the product as specified by the manufacturer and required by FM Approvals; and, as far as practical,
  - the durability and reliability of the product.

1.4.2 An examination of the manufacturing facility(ies) and an audit of quality control procedures shall be conducted. The examination shall evaluate the manufacturer's ability to produce the product which was examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of the FM Approvals' product follow-up program.

## 1.5 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval Agreement;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Facilities and Procedures Audits (F&PA's) conducted as part of the FM Approvals' product follow-up program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

## 1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products Approved under a previous edition shall comply with the new version by the effective date or forfeit Approval.

The effective date of this Standard is January 1, 2003 for compliance with all requirements.

## 1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-97, "*Standard for Use of the International System of Units (SI): The Modern Metric System.*"

## 1.8 Applicable Documents

The following standards, test methods, and practices are referenced in this standard:

ANSI/UL 50 – Enclosures for Electrical Equipment

FM Approval Standard 3600 – *Electrical Equipment For Use In Hazardous (Classified) Locations General Requirements*

IEC 60529 – Degree of Protection Provided by Enclosures (IP Code)

National Fire Protection Association (NFPA) 70 – National Electrical Code.

National Fire Protection Association (NFPA) 72 – National Fire Alarm Code

FM Approval Standard 3615 – *Explosionproof Electrical Equipment*

## 2. GENERAL INFORMATION

### 2.1 Product Information

2.1.1 Radiant energy sensing detectors fall into two (2) general categories: flame detectors and spark/ember detectors, depending upon the source of radiant energy they are intended to detect and the ambient in which they are to be used. Flame detectors are intended to respond to the radiant emissions from a flame and are expected to operate in normally illuminated environments. Spark/ember detectors are intended to respond to embers in a fuel stream flowing past them within a sheet metal pneumatic conveyance duct, chute, conveyor, or other location of limited illumination.

2.1.2 All radiant energy sensing detectors have a limited field of view and rely on a line-of-sight transmission of radiant energy from the source to the detector. Radiant energy sensing detectors employ infrared, visible, and/or ultraviolet sensors or combinations of sensors, selected to match the radiant emissions expected from the source to be detected. Since each fuel emits a unique spectra, not all detectors are capable of detecting all fuels.

### 2.2 Approval Application Requirements

2.2.1 To apply for an Approval examination the manufacturer, or its authorized representative, shall submit a request to:

Electrical Group Manager  
FM Approvals  
1151 Boston-Providence Turnpike  
Norwood, MA 02062 U. S. A.

2.2.2 The manufacturer shall provide the following preliminary information with any request for Approval consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for Approval consideration;
- brochures, sales literature, specification sheets, installation, operation and maintenance procedures; and
- the number and location of manufacturing facilities making the products submitted for Approval.

- 2.2.3 All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. Documents in other than the English language shall be provided with English translation.

### 2.3 Requirements for Samples for Examination

- 2.3.1 Following set-up and authorization of an Approval examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by FM Approvals following review of the preliminary information. Sample requirements may vary depending on design features, results of prior testing, and results of the foregoing tests. It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated utilizing prototypes is at the discretion of FM Approvals. Testing may be performed at FM Approvals, at a manufacturer's qualified test facility, or at a qualified third-party location, as mutually agreed.
- 2.3.2 General: for functional tests outlined below, the manufacturer shall provide at least four detectors which are deemed to be representative of the manufacturer's normal production with regard to construction and calibration. All four detectors will be subjected to the baseline, flame response sensitivity, and false alarm tests; the remainder of the tests will be spread over the four samples as outlined in Table 1.

*Table 1: Test Assignments*

<i>Test</i>	<i>Paragraph</i>	<i>Sample 1</i>	<i>Sample 2</i>	<i>Sample 3</i>	<i>Sample 4</i>
Baseline Sensitivity	4.1.2	x	x	x	x
Flame Response	4.2.2	x	x	x	x
False stimuli	4.3.2	x	x	x	x
Field of view	4.4.2	x			
Switching	4.5.2	x			
Humidity cycling & conditioning	4.6.2		x		
Voltage variation	4.7.2			x	
Temperature extremes	4.8.2		x		
Vibration	4.9.2			x	
Dielectric strength	4.10.2		x		
Bonding	4.11.2		x		
Durability	4.12.2				x
Stability	4.13.2				x
Extraneous transients	4.14.2				x
Surge transient tests	4.15.2				x
Spark/Ember Detector	4.16.2	x	x	x	x

### 3. GENERAL REQUIREMENTS

#### 3.1 Review of Documentation

During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The product shall be capable of being used within the limits of the Approval investigation.

#### 3.2 Required Features

- 3.2.1 Means shall be provided to mount the detector securely and independently of the wiring.
- 3.2.2 The detector shall be capable of withstanding normal handling and installation.
- 3.2.3 Means shall be provided to identify a detector in alarm. If the detector is equipped with an integral alarm indicator LED, it shall be red in color.
- 3.2.4 Radiant energy-sensing fire detectors intended for use in hazardous locations shall comply with FM Approval requirements for hazardous location electrical equipment in addition to this standard.
- 3.2.5 The detector and enclosure shall be suitable for the intended environmental exposures as determined by testing in accordance with acceptable national, regional, or international electrical codes.
- 3.2.6 The unit shall accommodate secure wiring methods in accordance with NFPA 72.
- 3.2.7 The detector shall be compatible with an Approved fire alarm control unit that will produce an alarm response when the detector is in alarm and that produces a distinctive trouble signal when a power failure disables the detector.
- 3.2.8 Response may be in milliseconds; however, alarm initiation shall be no greater than 30 seconds from the initial flame exposure.
- 3.2.9 Detectors rated at or above 30 V ac and 60 V dc require a proper ground terminal to be provided.
- 3.2.10 Duplicate terminals or leads, or their equivalent, shall be provided on each radiant energy-sensing fire detector for the express purpose of connecting into the fire alarm system to provide supervision of the device and termination in accordance with NFPA 72 requirements.

#### 3.3 Markings

- 3.3.1 The radiant energy-sensing fire detector shall be permanently and legibly marked with the manufacturer's name, city, and state; the model designation; serial number or equivalent means to identify the date of manufacture; operating voltage; electrical load ratings; and the FM Approval Mark (see Appendix A).
- 3.3.2 The trade name or model designation shall correspond with the manufacturer's catalog designation and shall uniquely identify the product.
- 3.3.3 The FM Approval Mark (see Appendix A) shall be displayed visibly and permanently on the product. The manufacturer shall not use this Mark on any other product unless such product is covered by separate agreement with FM Approvals.

### 3.4 Manufacturer's Installation and Operation Instructions

3.4.1 The product installation, operating, and maintenance instructions shall be reviewed for each type and model of detector submitted for Approval; the instructions shall be complete and appropriate for the detector. The installation instructions or manual must be marked with a document name, number, revision, and date. The following items are required:

- Operating temperature
- Humidity
- Voltage
- Enclosure ratings
- Fuel, size of fire, distance from detector
- False alarm sources as enumerated in paragraph 4.3
- Instructions for determining detector sensitivity, e. g. calibrated test method, calibrated sensitivity test instrument.

3.4.2 The installation, operating, and maintenance instructions shall be included with each detector or installation as required.

3.4.3 All wiring terminal designations and adjustment controls shall be clearly labeled. Instructions for connection and settings shall be included in the Installation and Operation Manual. All field adjustments shall be in accordance with this document.

### 3.5 Calibration

All examinations and tests performed in evaluation to this Standard shall use calibrated measuring instruments traceable and certified to national standards.

### 3.6 Installation and Maintenance

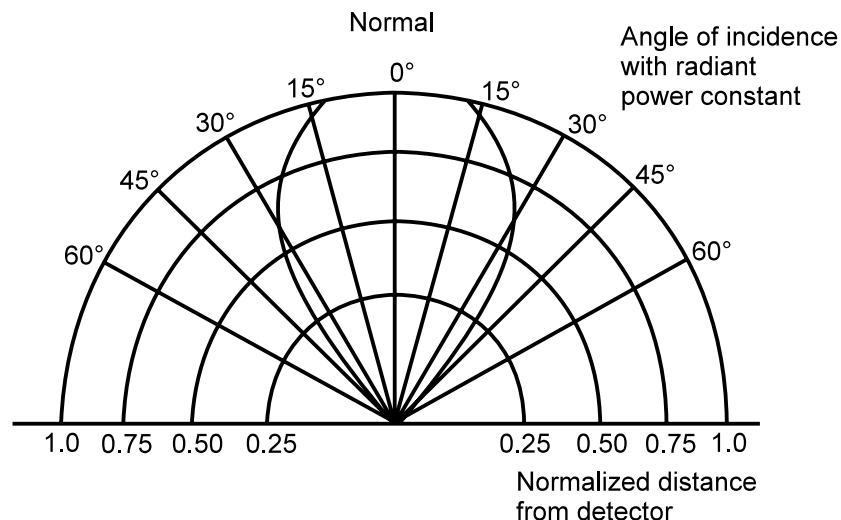
3.6.1 Detectors are adversely affected by accumulations of dust or other coatings on the lens or sensitive element. The product literature shall include cleaning and maintenance instructions, and stress the need for regular response tests.

3.6.2 The product literature shall specify a device or a readily reproducible technique for checking the response of an installed detector. The device or technique shall be evaluated during the examination of the detector for reliability, accuracy of calibration, and, if applicable, suitability for hazardous location use.

3.6.3 The response test shall be equivalent or proportional to the radiant emissions from the test sources (flames or embers) used to establish the sensitivity of the detector during the course of the examination. The response test shall not employ a radiator of either unknown emittance or uncontrolled distance.

### 3.7 Specifications

- 3.7.1 All manufacturer-specified sensitivities, i. e. fuel, size, distance, and response time shall be tested during the examination. The sensitivity shall be expressed as the maximum distance from the fire center at which the flame detector will give consistent alarm responses in a specified time not to exceed thirty seconds. The manufacturer shall identify the sensitivity of a flame detector to one or more of the fires defined below.
- 12 x 12 in. (0.3 x 0.3 m) N-heptane pan fire;
  - 12 x 12 in. (0.3 x 0.3 m) alcohol (type specific) pan fire;
  - 5 in. (127 mm) propane flame from a 0.021 inch (0.53 mm) orifice;
  - 4 in. (102 mm) and/or 8 in. (203 mm) diameter pan of polypropylene pellets for wet bench applications.
- 3.7.2 For a spark/ember detector, the manufacturer shall specify the minimum size and velocity of the spark or ember of the given fuel that the detection system is to detect.
- 3.7.3 An algebraic, graphical or statistical description of the sensitivity of the detector shall illustrate the relationship between the distance from the fire center and time -- the average response time at a given distance throughout the specified field of view for the detector. (See example below)



- 3.7.4 The product literature shall specify the field of view of the radiant energy detector within which sensitivity is at least 50% of the on-axis sensitivity.

### 3.8 Software Requirements

- 3.8.1 For radiant energy detectors dependent on software/firmware programs for normal operation:
- All software and firmware shall be identified by release level which is clearly marked on, or capable of being displayed by, the product for ease of identification;
  - All changes to software/firmware shall result in a revision to the release level;
  - The operating software/firmware shall not be accessible for any changes or modifications beyond what it has been Approved for; and
  - Any software failure that renders the detector inoperable shall result in a trouble condition at the detector and be appropriately transmitted to the fire alarm control (e.g. watchdog timer).

## 4. PERFORMANCE REQUIREMENTS

### 4.1 Baseline Sensitivity Test

#### 4.1.1 Requirement

Certain detector samples will be subjected to a baseline sensitivity test to establish sensitivity by which the results of other tests in the program will be measured.

#### 4.1.2 Test/Verification

Each detector sample shall be subjected to a small-scale sensitivity test, specified by the manufacturer, with specified fuel, size, and distance. This will establish baseline sensitivity equivalent to the full-scale testing in the Flame Response Sensitivity testing. The results of that test will be documented and used to evaluate any deviation following those tests outlined below. A shift in measured sensitivity in response to the test conditions shall not exceed 10%. This shift is defined as a reduction in the distance to the fire center with respect to that used in the baseline sensitivity test. The sample detector must respond at a distance equal to 90% of that used for the baseline sensitivity test.

### 4.2 Flame Response Sensitivity Test

#### 4.2.1 Requirement

The flame detector shall respond to all of the manufacturer specified fires as described previously in Section 3.7.1.

#### 4.2.2 Test/Verification

The test shall be set up in an area which will minimize the effects of outside stimuli such as reflection of flame, wind conditions, and artificial lighting. At least three tests of each fuel at each specified distance shall be conducted in order to get a consistent response. Distance from the detector will be measured to the center of the pan when a pan fire is involved. Response times to each type of fire will be documented, along with the size of fire and distance from the detector to the fire.

### 4.3 False Stimuli Response Test

4.3.1 The flame detector shall respond to radiation of the intended wavelength (infrared, visible and/or ultraviolet) without false alarm due to modulated and non-modulated direct and reflected sunlight, or to various modulated and non-modulated sources of artificial light when installed in accordance with the manufacturer's instructions. The chop rate is defined in the test procedure.

#### 4.3.2 Test/Verification

The flame detector will be tested in the presence of modulated and non-modulated direct and reflected sunlight, arc welding, heated bodies such as electrical heaters, and various sources of artificial light such as incandescent, fluorescent, and halogen. The arc welding will use a 1/8 in. (0.3 cm) or 3/16 in. (0.5 cm) type 7014, 7013 or 6012 rod, 1/4 in. (0.6 cm) to 1/2 in. (1.3 cm) steel plate, and a 180-200 Ampere setting. Distances from these sources will vary according to manufacturer's claims or the type of detector. The detector will produce no trouble or false alarm signal in the presence of these false stimuli, and it will continue to respond satisfactorily to a test fire in the presence of these sources.

#### 4.4 Field of View

##### 4.4.1 Requirement

For all fuels claimed in the specifications, the flame detector will be tested to confirm the manufacturer's claims for field of view.

##### 4.4.2 Test/Verification

Tests will be conducted using at least one of the fires described in Section 3.7.1 above. Within the specified field of view, the detector response shall be at least 50% of the on-axis sensitivity (measured in units of distance) in at least four directions (left, right, up, and down).

#### 4.5 Switching

##### 4.5.1 Requirement

The detector's alarm signal to the control shall occur within the manufacturer's specified response time not to exceed 30 seconds.

##### 4.5.2 Test/Verification

A test sample shall be exposed to flame radiation, and its response shall be monitored to ensure actuation according to the manufacturer's specifications (the manufacturer's specified source may be used for the radiation source).

#### 4.6 Humidity Cycling and Conditioning

##### 4.6.1 Requirement

- a) The detector shall remain functional and produce no false indication of fire when subjected to a change from 50% relative humidity at 70°F (21°C), to 90% relative humidity at 100°F (38°C) in 15 minutes.
- b) The detector shall remain functional, with no trouble signal or change in operating characteristics, shall have less than 10% shift in measured sensitivity, and shall produce no false indication of fire when subjected to a humidity test as follows:
  - 1) For detectors intended solely for indoor dry environments, a relative humidity of 93%±2% and temperature of 90°F±3°F (32°C±2°C) for a period of 24 hours.
  - 2) For detectors intended for indoor/outdoor damp or wet environments, a relative humidity of 95%±3% and temperature of 140°F±3°F (60°C±2°C) for a period of 24 hours.

##### 4.6.2 Test/Verification

- a) After conditioning at 50% relative humidity and 70°F (21°C), the test sample shall remain functional and produce no false indication of fire when subjected to a change in environmental conditions to a relative humidity of 90% and temperature of 100°F (38°C) within 15 minutes.
- b) The test sample will be conditioned in a relative humidity and temperature as noted in paragraph 4.6.1b (above) for a period of 24 hours. There shall be no trouble signal and no false indication of fire during this exposure. At the end of the conditioning period, while still exposed to the test conditions, the sample shall be exposed to the baseline sensitivity radiation source and shall produce less than 10% shift in measured sensitivity.

## 4.7 Voltage Range

### 4.7.1 Requirement

The device shall produce no trouble signal or false indication of fire and less than 10% shift in measured sensitivity when operated between 85% and 110% of rated input voltage. If an absolute voltage range, beyond the 85% and 110% of nominal, is specified by the manufacturer, the unit will be tested at the extremes of the range.

### 4.7.2 Test/Verification

The unit, with nominal rated voltage applied, shall be exposed to a flame radiation source. The input voltage shall then be varied from 85 to 110% of nominal, or the manufacturer's range (whichever is wider), and the unit again exposed to the radiation source at both of these voltage extremes. The unit shall produce less than 10% shift in measured sensitivity, no trouble signal, and no false indication of fire during these tests.

## 4.8 Temperature Extremes

### 4.8.1 Requirement

The device shall produce less than 10% shift in measured sensitivity, no trouble signal, and no false indication of fire following exposure to temperature extremes described below.

### 4.8.2 Test/Verification

For indoor applications, the device shall be exposed to minimum limits of 32° and 120°F (0° and 49°C) for a period of at least 24 hours at each limit. For outdoor applications, the device shall be exposed to minimum limits of -40° to 140°F (-40° to 60°C) for at least 24 hours at each limit. The device shall then be exposed to a flame radiation source at the end of each conditioning period while still exposed to the test conditions. The unit shall produce less than 10% shift in measured sensitivity based upon flame radiation distance and shall produce no trouble signal or false indication of fire during and at the conclusion of these tests.

**Note:** DETECTORS INTENDED FOR USE AT HIGHER OR LOWER TEMPERATURES THAN THOSE SHOWN ABOVE SHALL BE TESTED AT THE SPECIFIED TEMPERATURE EXTREMES AND SPECIALLY MARKED FOR USE AT THE SPECIFIED TEMPERATURES.

## 4.9 Vibration

### 4.9.1 Requirement

The detector assembly, including base and mounting hardware, shall withstand the effects of vibration.

### 4.9.2 Test/Verification

With rated input voltage applied and mounted in its intended orientation the detector shall be subjected to a 4-hour vertical vibration test of 0.02 in. (0.5 mm) total displacement at a linear frequency sweep of 10 to 30 Hz, at a sweep rate of approximately two cycles per minute. The unit shall produce no false indication of fire, no trouble signal, and less than 10% shift in measured sensitivity at the conclusion of this test. There shall be no loosening of parts or permanent deformation as a result of this test.

#### 4.10 Dielectric Strength

##### 4.10.1 Requirement

The device shall provide the required degree of protection from electrical shock.

##### 4.10.2 Test/Verification

A sample detector shall successfully withstand for one minute a 60 Hz dielectric strength test of 1000 V ac plus twice the maximum rated voltage. Detectors whose voltage ratings are less than 30 V ac or 60 V dc shall successfully withstand 500 V ac or 710 V dc for one minute. The dielectric strength test shall be conducted between all applicable combinations of the following: power supply conductors, signaling circuit conductors, ground connection, other output conductors, and detector body.

#### 4.11 Bonding

##### 4.11.1 Requirement

Any accessible conductive surface which is likely to become energized in the event of a fault shall be bonded to a ground terminal with a circuit resistance of less than or equal to 1.0 ohm. This requirement applies to those radiant energy-sensing fire detectors in which the maximum voltage is greater than 30 V rms or 60 V dc. The bonding conductor(s) shall be green or green with one or more yellow stripes. The size of the bonding conductor(s) shall be at least equivalent in size to the primary circuit conductors.

##### 4.11.2 Test/Verification

The detector sample shall be evaluated according to Section 4.11.1 requirements. Measurements of bonding resistance shall be made with a calibrated multimeter.

#### 4.12 Durability

##### 4.12.1 Requirement

The unit shall be tested for durability.

##### 4.12.2 Test/Verification

One or more sample detectors shall be cycled through 500 power on/off cycles. Any detector susceptible to the wearing of parts (i.e., a mechanical relay) shall be cycled through 500 operate-reset functions under maximum rated load. The detector shall continue to operate and there shall be less than 10% shift in measured sensitivity based upon flame radiation distance at the conclusion of this test.

#### 4.13 Stability

##### 4.13.1 Requirement

The detector shall be able to withstand an extended period in standby operation.

##### 4.13.2 Test/Verification

One or more detector samples, adjusted to maximum sensitivity, will be energized for normal standby operation in a clean-air (working-office type) atmosphere for a period of at least 30 days. There shall be no false signal nor any evidence of instability.

#### 4.14 Extraneous Transients

##### 4.14.1 Requirement

No false signal will be generated when the radiant energy detector is subjected to extraneous transients from sources which are described below.

##### 4.14.2 Test/Verification

One powered sample of the detector will be subjected to extraneous transients described below.

- a) radio frequency transmissions with radiation power levels equivalent to 5 Watts at 24 inches (0.6 m) in the 27 MHz, 150-174 MHz, 450-467 MHz, 850-870 MHz, and 900-920 MHz bands.
- b) A sequential arc (Jacob's ladder) generated between two 15 in. (0.4 m) long, No. 14 AWG (2.1 mm) solid copper conductors attached rigidly in a vertical position to the output terminals of an oil burner ignition transformer or gas tube transformer rated 120 volts, 60 hertz primary; 10,000 volts, 60 hertz, 23 mA secondary. The two wires are to be formed in a taper, starting with a  $\frac{1}{8}$  in. (3.2 mm) separation at the bottom (adjacent to terminals) and extending to 1.25 in (32 mm) at the top.
- c) operation of an electric drill rated 120 V, 60 Hz, 2.5 A.
- d) operation of a soldering gun rated 120 V, 60 Hz, 2.5 A.
- e) Operation of a 6 in (150 mm) diameter solenoid-type vibrating bell with no arc suppression and rated 24 V dc.

The detector will produce no false alarm or trouble signal in the presence of these extraneous transients, and it will respond satisfactorily to a test fire source in the presence of the extraneous transients.

#### 4.15 Surge Transient Tests

##### 4.15.1 Requirement

Protection against line surge transients will be a requirement for each submitted radiant energy detector.

##### 4.15.2 Test/Verification

One powered sample of the detector will be subjected to transient waveforms having peak levels of 100, 500, 1000, 1500, and 2400 V dc, as delivered into a 200 ohm load. This test applies to all field wiring terminals that have a possibility of being subjected to line-induced voltage (i.e., initiating device circuits, power circuits, and remote/auxiliary connections). *Exception:* Circuits specified to be 20 ft (6 m) or less in length and in conduit. The device is required to perform satisfactorily at the conclusion of the test, and it must not exhibit any instability such as alarm signals and non-self-restoring trouble signals during testing.

#### 4.16 Spark/Ember Detectors

##### 4.16.1 Requirement

The spark/ember detector must meet the minimum sensitivity requirements specified by the manufacturer using a source specified by the manufacturer.

#### 4.16.2 Test/Verification

The test must be performed in accordance with the manufacturer's instructions in a suitable environment. Testing will include response to the minimum size and velocity of the spark or ember as specified by the manufacturer. Using the manufacturer's recommended source, determine the maximum on-axis distance at which the spark detector under test can reliably respond to the test source. Tests will be conducted to confirm the manufacturer's field of view claim. Within this field of view, the detector response shall be at least 50% of the on-axis sensitivity (measured in units of distance) in at least four directions (left, right, up, and down).

### 4.17 Enclosure Requirements (including Plastic housings)

#### 4.17.1 Requirement

The detector enclosure must meet Type 1 enclosure ratings as a minimum for indoor applications. It is not necessary to mark the product for Type 1 enclosures. Additional claims made by the manufacturer will be verified according to appropriate enclosure classifications.

#### 4.17.2 Test/Verification

The detector enclosure will be evaluated according to acceptable national, regional or international electrical codes.

## 5. OPERATIONS REQUIREMENTS

A quality control program is required to assure that subsequent detectors produced by the manufacturer at an authorized location, shall present the same quality and reliability as the specific detectors examined. Design quality, conformance to design, and performance are the areas of primary concern. Design quality is determined during the Approval examination and tests, and is covered in the Approval Report. Conformance to design is verified by control of quality and is covered in the Facilities and Procedures Audit (F&PA). Quality of performance is determined by field performance and by periodic re-examination and testing.

### 5.1 Demonstrated Quality Control Program

5.1.1 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines
- incoming quality assurance, including testing
- in-process quality assurance, including testing
- final inspection and tests
- equipment calibration
- drawing and change control
- packaging and shipping
- handling and disposition of non-conformance materials.

In order to assure adequate traceability of materials and products, the manufacturer shall maintain records of all quality control tests performed, for a minimum period of two years from the date of manufacture.

### 5.1.2 Documentation/Manual

There shall exist an authoritative collection of procedures and policies. Such documentation shall provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system shall require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

### 5.1.3 Drawing and Change Control

The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the Approval Report, must be reported to, and authorized by, FM Approvals prior to implementation for production. The manufacturer shall assign an appropriate person or group to be responsible for reporting proposed changes to Approved or Listed products to FM Approvals before implementation. The manufacturer shall notify FM Approvals of changes in the product or of persons responsible for keeping FM Approvals advised by means of FM Approvals Form 797, Approved Product Revision Report or Address/Contact Change Notice. Records of all revisions to all Approved products shall be maintained.

## 5.2 Facilities and Procedures Audit (F&PA)

5.2.1 An audit of the manufacturing facility is part of the Approval investigation to verify implementation of the quality control program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a consistently uniform and reliable product. Inspections of facilities already producing similar Approved products may be waived at the discretion of FM Approvals.

5.2.2 Follow-up inspections shall be conducted quarterly by FM Approvals, or its designate, to determine continued compliance.

5.2.3 The client shall manufacture the product or service only at the location(s) audited by FM Approvals and as specified in the Approval Report. Manufacture of products bearing the FM Approval Mark is not permitted at any other location without prior written authorization by FM Approvals.

## 5.3 Manufacturing and Production Tests

Detectors rated at 30 V rms or 60 V dc and above shall be dielectric tested on 100% of production. The power leads and/or relay terminal leads and associated circuitry shall withstand, for one minute with no insulation breakdown, the application of 1000 V ac, 60 Hz, or 1400 V dc with respect to the protective ground lead. Alternatively, test potentials 20% higher may be applied for at least one second.

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### WARNING

The dielectric test required may present a hazard of injury to personnel and/or property and should be performed only under controlled conditions, and by persons knowledgeable of the potential hazards of such testing to minimize the likelihood of shock and/or fire.

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## APPENDIX A

### UNITS OF MEASUREMENT

**LENGTH:** in. – “inches”; (mm – “millimeters”)  
mm = in.  $\times$  25.4

ft – “feet”; (m – “meters”)  
m = ft  $\times$  0.3048

**AREA:** ft<sup>2</sup> – “square feet”  
(m<sup>2</sup> – “square meters”)  
m<sup>2</sup> = ft<sup>2</sup>  $\times$  0.0929

**TEMPERATURE:** °F – “degrees Fahrenheit”  
(°C – “degrees Celsius”)  
°C = (°F-32)  $\times$  0.556

**FREQUENCY:** Hz – “hertz” (Also the SI unit)

**WAVELENGTH:** “micron” = 10<sup>6</sup> m  
Å angstrom = m 1  $\times$  10<sup>-10</sup>

**APPENDIX B:  
APPROVAL MARKS**

**REPRODUCTION ART: FM Approval Marks**

**For use on nameplates, in literature, advertisements,  
packaging and other graphics.**



- 1) The FM Approvals diamond mark is acceptable to FM Approvals as an Approval mark when used with the word "Approved."
- 2) The FM Approval logomark has no minimum size requirement, but should always be large enough to be readily identifiable.
- 3) Color should be black on a light background or a reverse may be used on a dark background.

**For Cast-On Marks**



- 4) Where reproduction of the mark described above is impossible because of production restrictions, a modified version of the diamond is suggested. Minimum size specifications are the same as for printed marks. Use of the word "Approved" with this mark is optional.

NOTE: These Approval marks are to be used only in conjunction with products or services that have been FM Approved. The FM Approval marks should never be used in any manner (including advertising, sales or promotional purposes) that could suggest or imply FM Approval or endorsement of a specific manufacturer or distributor. Nor should it be implied that Approval extends to a product or service not covered by written agreement with FM Approvals. The Approval marks signify that products or services have met certain requirements as reported by FM Approvals.

Additional reproduction art is available through

FM Approvals  
P.O. Box 9102,  
Norwood, Massachusetts 02062  
USA