FM Approvals®

Member of the FM Global Group

Examination Standard for Electric Flashlights and Lanterns for Use in Class I, II, and III, Division 2, Hazardous (Classified) Locations

Class Number 3613

May 2021

.

Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose

1.1.1 This standard states testing and certification requirements for electric flashlights and lanterns for use in Class I, II and III, Division 2 hazardous (classified) locations as defined in the National Electrical Code®, ANSI/ NFPA-70 (NEC®).

1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

1.2.1 This standard applies to flashlights and lanterns that employ primary (non-rechargeable) and secondary (rechargeable) cells or batteries.

1.2.2 Electrical apparatus intended for use in Class I, Division 2 hazardous (classified) locations is apparatus in which any spark or thermal effect, produced under normal conditions, is incapable of causing ignition of a specified mixture of flammable or combustible material in air.

1.2.3 Electric flashlights and lanterns intended to be used in Class II (combustible dusts) or Class III (flyings and fibers) hazardous (classified) locations are those which contain a dust-tight enclosure and are incapable of causing ignition of a specified dust or fiber.

1.2.4 The requirements of this standard are based on consideration of ignition in locations made hazardous by the presence of flammable or combustible material under normal atmospheric conditions. For the purposes of this standard, normal atmospheric conditions are generally considered to be:

1) an ambient temperature of -20°C to +40°C;
2) an oxygen concentration of not greater than 21 percent by volume; and
3) a barometric pressure in the range 0.8 atmosphere to 1.1 atmosphere.

Note: Equipment specified for atmospheric conditions beyond the above limits is subject to special investigation.

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 organizations. The advice of manufacturers and users was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of electrical equipment for the purpose of obtaining certification. Electrical equipment having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification 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 for certification; and as far as practical,

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures is made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Where units of measurement are expressed in U.S. customary units, they are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. Conversions are in accordance with ANSI/IEEE/ASTM SI-10. Where units of measurement are expressed in SI units, US customary units may also be provided.

1.8 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 cited edition applies:

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*

FM Approvals Class No. 3600: Electrical Equipment for Use in Hazardous (Classified) Locations — General Requirements

FM Approvals Class No. 3611: Electrical Equipment for Use in Class I, Division 2, Class II, Division 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Normal Operating Conditions — Equipment is in normal operational conditions when it:

1) conforms electrically and mechanically with its design specifications;
2) is used within the limits specified by the manufacturer; and
3) is subject to outgassing due to gasses emitted from batteries or cells during charging, discharging, aging or improper connection of batteries.

Outgassing — Process of gasses being emitted from batteries or cells during charging, discharging, aging or improper connection of batteries.

Venting — A mechanism designed to relieve overpressure resulting from outgassing of cells.

2. GENERAL INFORMATION

2.1 Product Information

The electric flashlights and lanterns covered by this standard are powered by primary (non-rechargeable) or secondary (rechargeable) cells or batteries. The flashlight or lantern may be supplied with a variety of cells or batteries. If the flashlight or lantern is determined to be sealed, it shall employ a venting mechanism to relieve overpressure resulting from outgassing of cells.

2.2 Approval Application Requirements

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

- A complete list of all models, types, sizes, and options for the products or being submitted for certification consideration;
- A complete list of all cell or battery types to be submitted for certification consideration
- General assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, electrical schematics, nameplate format, brochures, sales literature, spec. sheets, and
- The number and location of manufacturing facilities.
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the product.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of use. The certification examination results may further define the limits of the final certification.

3.2 Markings

3.2.1 In addition to the marking requirements in FM Approvals Standard Class No. 3600, flashlight and lantern equipment shall be marked with the following information:

- The following statement (or equivalent): ''USE ONLY (Manufacturer) TYPE XXXX BATTERIES AND TYPE XXXX BULB''
- Where space prohibits a warning statement, the warning symbol shall be affixed to the outside of the enclosure referencing the Instruction Manual. An example of a warning statement that shall appear in the Instruction Manual in bold lettering is as follows. ''WARNING—WHEN REPLACING BATTERIES, REMOVE ALL EXISTING BATTERIES AND REPLACE WITH NEW BATTERY SET. REPLACE ONLY WITH (Manufacturer and Type) BATTERIES. DO NOT CHANGE BATTERIES IN HAZARDOUS LOCATIONS.''
- A label or marking appearing on the inside of the battery housing illustrating the proper connection of batteries. As an added option, this label or marking information may appear on the outside of the enclosure. The warning symbol shall also appear on the outside of the enclosure referencing the Instruction Manual. The statement, in bold lettering, appearing in the Instruction Manual should call attention to the user emphasizing that improper connection of batteries may present a serious safety hazard. The statement shall also include periodic inspections of the enclosure to ensure the mechanical integrity of the device resulting from any leakage of caustic materials from the battery cells.

3.2.2 When the temperature of the outer surface enclosure or lens of the flashlight or lantern exceeds 80°C (176°F), when measured in accordance with clause 4.6 and referenced to 40°C (104°F), or higher marked ambient, the flashlight or lantern shall be marked with the international warning symbol. ⚠

Note: The international symbol ⚠ is used to refer the operator to an explanation in the equipment instructions.

3.2.3 Marking Permanency

The degree of performance of labels and marking information on equipment for classified locations is a practical consideration. Equipment labels containing the data required by this standard and its applicable subparts, including adhesion to the equipment enclosure material, shall not degrade due to exposure to chemicals of the Group for which the equipment is rated. Metal labels secured to the product by permanent mechanical means (e.g., drive screws) are considered satisfactory without further tests.

Compliance shall be determined by the chemical compatibility test according to clause 4.8.

3.2.4 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.2.5 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification

agency and the certification scheme.

3.2.6 Marking shall have lettering in which:

- the precautionary signal word for any warning marking shall be at least 2.75 mm (0.11 in.) high;
- the text shall be at least 1.5 mm (0.06 in.) high and contrasting in color to the background; or
- if molded or stamped in a material, the text shall be at least 2.0mm (0.08 in.) high and, if not contrasting in color, a depth or raised height of at least 0.5mm (0.02 in.).

3.3 Manufacturer's Installation and Operation Instructions

3.3.1 The manufacturer shall

- prepare instructions for the installation, maintenance, and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.4 Calibration

3.4.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.4.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

4. CONSTRUCTION REQUIREMENTS AND TESTS

4.1 Enclosure Construction

4.1.1 Exposed surfaces and parts shall be made of a non-sparking material, such as plastic or brass, unless the part is protected by a recess or a guard.

Exception: Such a surface may be of a sparking material if subjected to a special investigation.

4.1.2 All metallic parts of an electric flashlight or lantern shall be made of corrosion-resistant material or protected against corrosion.

4.1.3 The electric flashlight or lantern enclosure, if applicable, shall have means for venting to limit an increase in pressure inside the enclosure due to outgassing of the batteries. The manufacturer shall specify the maximum venting pressure, which shall not exceed 6 psi (41 kPa), on a controlled document.

Protection of the venting scheme shall be required to prevent blockage from ingress of foreign material.

4.2 Cells and Batteries

4.2.1 For equipment employing primary cells or batteries, fresh cells shall be used for each series of tests.

4.2.2 For equipment employing secondary cells or batteries, the cells or batteries shall be charged and discharged a minimum of three times prior to any testing. Testing shall be conducted using fully charged cells or batteries.

4.3 Drop Tests

Flashlight and lantern equipment shall be subjected to the impact resulting from accidental drop. This condition shall be simulated by dropping the device vertically six times, through a distance of 3 ft (0.9 m) onto a concrete floor. Where a threaded cover or assembly parts are used to actuate the lamp, testing shall be conducted with the batteries in place and the threaded cover or assembly parts shall be unscrewed two turns past the extinguishing or lighting point of the lamp, whichever is more severe. The attitude of the apparatus' impact shall be varied on every drop to impact on all sides or axes, as applicable. There shall be no separation or ejection of the batteries from the apparatus, nor other damage which could affect the apparatus for Division 2 hazardous (classified) locations.

4.4 Enclosure Pressure Tests

4.4.1 Testing shall be conducted on at least six samples of the enclosure to:

1) verify the manufacturer's maximum specified venting pressure of the enclosure according to clause 4.4.2; and
2) verify the mechanical integrity of the enclosure according to clause 4.4.3.

4.4.2 A series of pressure tests on the sample enclosures void of batteries shall be conducted and the maximum internal pressure recorded prior to venting. Venting pressures exceeding the manufacturer's maximum pressure constitutes a failure.

4.4.3 Where a threaded cover or assembly parts are used to actuate the lamp, a series of tests shall be

conducted to verify that there will be no ejection of the cover or parts of the device. With the batteries in place, the threaded cover or assembly parts shall be unscrewed two turns past the extinguishing or lighting point of the lamp, whichever is more severe, and the maximum pressure, obtained in clause 4.4.2., shall be applied to each of the six samples.

4.5 Spark Ignition Tests

4.5.1 Spark ignition tests shall be conducted using a 21% hydrogen-in-air gas mixture at 1.1 times the maximum recorded venting pressure according to clause 4.4.2.

A series of six tests on a battery set shall be conducted in its intended configuration for each battery type and manufacturer.

4.5.2 Tests

See *Spark ignition testing of nonincendive circuits* clause of ANSI/UL 121201.

4.6 Surface Temperature Requirements

The maximum temperature of any surface that may come in contact with a flammable gas or vapor-in-air mixture shall be determined under normal operational conditions. Measurements shall be made at any convenient ambient temperature between 10°C (50°F) and 40°C (104°F), corrected linearly to 40°C (104°F) or higher marked ambient.

4.7 Overcharge Tests for Rechargeable Batteries

Rechargeable batteries and battery packs shall be subjected to an overcharge to determine that there is no degradation of the battery's insulation or deformation of the battery(ies) due to any significant temperature rise. Batteries shall be charged at a rate of twice the ampere-hour rating until temperature stabilizes. The use of a protective component internal to the enclosure to prevent overheating will be considered during this test.

4.8 Chemical Compatibility Tests

See applicable clause of FM Approvals Class Standard 3600.

4.9 Dust-Tight Enclosure Test

For the purpose of this standard, an enclosure is considered suitable for Class II and III locations if it meets the requirements of this clause and clause 4.10. In addition, the equipment shall be dust-tight after the drop test described in clause 4.3 and the resistance to impact test on the lens described in FM Approvals Class Standard 3600.

4.9.1 The test is a circulating dust method conducted by using equipment in which talcum powder is maintained in suspension in a suitable closed chamber. The talcum powder used shall pass through a square-meshed sieve whose nominal wire diameter is 50 micrometers and whose nominal width between wires is 75 micrometers. The amount of talcum powder used is 2 kg per cubic meter of the test chamber volume and is not to be used for more than 20 tests.

4.9.2 The equipment under test is to be supported inside the test chamber, and the pressure inside the equipment is to be maintained below atmospheric pressure by a vacuum pump. If the enclosure has a single drain hole, the suction connection is to be made to a hole specially provided for the purpose of

the test. If there is more than one drain hole, the other drain holes are to be left open for the test. The object of the test is to draw into the equipment, if possible, a minimum of 80 times the volume of air in the enclosure without exceeding an extraction rate of 60 volumes per hour with a suitable depression. In no event shall the depression exceed 200 mm of water. If an extraction rate of 40 to 60 volumes per hour is obtained, the test is to be stopped after two hours. If, with a maximum depression of 200 mm of water, the extraction rate is less than 40 volumes per hour, the test is to be continued until 80 volumes have been drawn through, or a period of eight hours has elapsed. Where a threaded cover or assembly parts are used to actuate the lamp, testing shall be conducted with the batteries in place and the threaded cover or assembly parts shall be unscrewed two turns past the extinguishing or lighting point of the lamp, whichever is more severe.

4.9.3 No visible dust shall be detected inside the enclosure at the end of the test.

4.10 Dust Blanketing Temperature Test

4.10.1 The apparatus shall be oriented with the lens in an upward vertical position and shall be covered with carbon black dust until no more will stay on the lens or to a depth of 12 mm whichever is less.

4.10.2 The apparatus shall be operated under fault conditions appropriate to the device until all temperatures become constant. Measurements shall be made at any convenient ambient temperature between 10°C and 40°C, corrected linearly to 40°C or higher marked ambient.

4.10.3 There shall be no evidence of charring or ignition of the dust.

4.11 Additional Tests

Additional tests may be required, at the discretion of the certification agency, depending on design features and results of any foregoing tests.

5. OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent unit(s) produced by the manufacturer shall present the same quality and reliability as the specific sample(s) examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests, and is documented in the certification report.
- Continued conformance to this Standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and as necessary by periodic re-examination and testing.

5.1.2 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; and
- handling and disposition of non-conforming materials.

5.1.3 Documentation/Manual

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

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 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 certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility is part of the certification agency's surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 Manufacturer's Responsibilities

5.3.1 The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

6. BIBLIOGRAPHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.