FM Approvals®

*Member of the FM Global Group*

# Examination Standard for Cable Fire Propagation

**Class Number 3972**

**April 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**
1.1 Purpose ..... 1
1.2 Scope ..... 1
1.3 Basis for Requirements ..... 1
1.4 Basis for Certification ..... 1
1.5 Basis for Continued Certification ..... 2
1.6 Effective Date ..... 2
1.7 System of Units ..... 2
1.8 Normative References ..... 2
1.9 Terms and Definitions ..... 2
**2 GENERAL INFORMATION ..... 4**
2.1 Product Information ..... 4
2.2 Certification Application Requirements ..... 4
2.3 Requirements for Samples for Examination ..... 4
**3 GENERAL REQUIREMENTS ..... 5**
3.1 Review of Documentation ..... 5
3.2 Physical or Structural Features ..... 5
3.3 Markings ..... 5
3.4 Manufacturer's Installation and Operation Instructions ..... 6
3.5 Manufacturers Responsibilities ..... 6
3.6 Test Representation ..... 6
3.7 Calibration ..... 6
**4 PERFORMANCE REQUIREMENTS ..... 7**
4.1 Fire Propagation Index ..... 7
4.2 Smoke Damage Index (GP-1-4910 requirement only) ..... 7
**5 OPERATIONS REQUIREMENTS ..... 8**
5.1 Demonstrated Quality Control Program ..... 8
5.2 Surveillance Audit ..... 9
5.3 Manufacturer's Responsibilities ..... 9
**6 BIBLIOGRAPHY ..... 9**

# 1 INTRODUCTION

## 1.1 Purpose

1.1.1 This standard states testing and certification requirements for establishing the classification for cable fire propagation.

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 is applicable, but not limited, to various types of electrical cables having outer insulating coverings or metallic sheath, which may be used for commercial and industrial purposes including electrical (power and control), data, communication, robotic usage and optical cables, herein called cables This standard is applicable, but not limited to, any type of round cable or ribbon (flat) cable.

1.2.2 This standard does not assess the cable's ability to provide circuit integrity when the cable is subjected to a fire source.

1.2.3 This standard is not applicable to cable coatings applied after the cable has been installed.

1.2.4 This standard does not evaluate the corrosivity of the products of combustion of these materials.

## 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, users, trade associations, jurisdictions and/or loss control specialists was also considered.

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

1.3.3 The classification described in Section 3 is based on the fire propagation characteristics of a cableListing requirements prohibit substitution of components in the cable construction without prior authorization. The classification described in Section 4.1.2 is based on the fire propagation and smoke yield characteristics of the cable assembly.

## 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,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be 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 agencies 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

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. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

### 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*

ASTM E2058 Standard Test Methods for Measurement of Material Flammability Using a Fire Propagation Apparatus (FPA), *American Society of Testing Materials*

### 1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

*Cable* – a conductor (electrical or optical) with or without insulation and other coverings (single conductor cable) or a combination of conductors insulated from one another (multi-conductor cable)

*Class Of Cable* - cables constructed using the same materials (insulation, wrapping, jacketing, etc.) but may have a range of the number of conductors available within that specific cable construction

*Critical Heat Flux* – the maximum heat flux at or below which there is no ignition

*Chemical Heat Release* – the heat release during the fire propagation process and determined from the generation rates of carbon monoxide and carbon dioxide

*Heat Flux* – the rate of heat flow measured across a given surface

*Insulated Wire* – a slender rod or filament of drawn metal with an insulating cover

*Fire Propagation Index (FPI)* – a measure of the fire propagation tendency of the cable and is the ratio of the radiant heat flux provided by the flame and the thermal response parameter of the cable

*Self-Sustained Flame Propagation* – a cable flame propagation assisted by the flame heat flux from the burning cable only and not by other heat sources

*Smoke Damage Index (SDI)* – smoke yield multiplied by FPI. It is an indicator of the extent of smoke contamination of the environment during fire propagation

*Thermal Response Parameter (TRP)* – a property of material describing its reaction to heat in terms of ignition temperature, thermal conductivity, density and specific heat

# 2 GENERAL INFORMATION

## 2.1 Product Information

The cables covered by this standard may be supplied as insulated single- or multiple-conductor having a metallic or non-metallic sheath. The conductor is usually manufactured of electrically conductive materials such as copper or aluminum, or may be a fiber optic material. Various combinations of polymeric materials, modified by additives, are used for insulations and jackets.

## 2.2 Certification 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 services being submitted for certification consideration;
- General assembly drawings, materials list, anticipated marking format, brochures, sales literature, and/or product specification sheets.
- 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 following review of the preliminary information.

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.

# 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 installation and use. The investigation shall define the limits of the Certification.

3.1.2 Drawing(s), formulation(s) and specifications identifying materials, formulations and construction details shall be provided to the certification agency for each configuration tested (i.e., itemized percentage of combustible material types per unit length.)

3.1.3 A drawing(s) shall be provided to the certification agency indicating the size and location of the markings as they will be shown on the product.

3.1.4 The manufacturer shall also provide to the certification agency copies of all brochures, sales literature and specification sheets relating to the cable(s) submitted for testing.

3.1.5 This standard does not test cables for their electrical or mechanical properties.

## 3.2 Physical or Structural Features

3.2.1 The cable submitted for testing can be any shape, most common being round cable or ribbon (flat) cable.

## 3.3 Markings

3.3.1 The marking, to be placed along the length of the cable, shall be repeated at intervals not exceeding 24 inches (610 mm) and shall bear the certification agency's mark of conformity and the rating(s) as applicable as shown below:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- product tradename
- GP-1 or GP-1-4910
- Agency certification mark

3.3.2 All markings shall be of a contrasting color with respect to the background (e.g., white marking on black background).

3.3.3 The certification markings shall be used only in conjunction with the products which have been tested and certified by the certification agency.

3.3.4 All markings shall be legible and durable.

### 3.4 Manufacturer's Installation and Operation Instructions

3.4.1 The manufacturer shall

- prepare instructions for the installation, maintenance, and operation of the product;
- 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.

### 3.5 Manufacturers Responsibilities

3.5.1 The manufacturer shall furnish cable samples as outlined in the proposal. The samples shall be labeled so as to properly identify each sample so that they correspond to the documentation provided.

3.5.2 Cable construction of the samples tested shall be representative of production samples and shall conform to the specifications and drawings provided by the manufacturer.

### 3.6 Test Representation

3.6.1 The smallest diameter class of cable will be tested and if successfully tested, then certification can be granted to larger diameter cables of the same class (materials and construction).

### 3.7 Calibration

3.7.1 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.

3.7.2 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 PERFORMANCE REQUIREMENTS

## 4.1 Fire Propagation Index

4.1.1 For GP-1 rated cables, the Fire Propagation Index (FPI) shall be less than 10 $(m/s^{1/2})/(k/W/m)^{2/3}$ and have non-self sustained flame propagation.

4.1.2 For GP-1 4910 rated cables, the Fire Propagation Index (FPI) shall be less than or equal to 6 $(m/s^{1/2})/(k/W/m)^{2/3}$ and have non-self sustained flame propagation.

4.1.3 Fire Propagation Index (FPI) evaluation shall be in accordance with ASTM E2058.

## 4.2 Smoke Damage Index (GP-1-4910 requirement only)

4.2.1 Smoke Damage Index (SDI) of $\leq 0.4$ $[(m/s^{1/2})/(k/W/m)^{2/3}]$ [g/g]

4.2.2 Smoke Damage Index (SDI) evaluation of cables shall be conducted in accordance with ASTM E2058.

# 5 OPERATIONS REQUIREMENTS

## 5.1 Demonstrated Quality Control Program

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

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifiers surveillance program.
- Quality of performance is determined by field performance and 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 may be part of the certification agencies 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*.