



Member of the FM Global Group

Examination Standard for Plastic Pipe and Fittings for Automatic Sprinkler Systems

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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.

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1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states certification requirements for plastic pipe and fittings in light hazard occupancies for use in automatic wet sprinkler fire protection systems.
- 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 encompasses the design and performance requirements for plastic pipe and fittings in light hazard occupancies for use in automatic wet sprinkler fire protection systems. The intent is to determine:
 - That specific pipe and fittings are capable of maintaining sprinkler system integrity and performance during a fire.
 - If one of the intended uses of the plastic pipe and fittings is in a hybrid sprinkler system using internally coated steel pipe (*i.e.* plastic pipe connected to internally coated steel pipe), evaluation of the plastic pipe and fittings under this standard shall include chemical compatibility testing with all certified manufacturer applied internally coated steel pipe (*i.e.* internally coated by the manufacturer).
- 1.2.2 Certification standards are intended to verify that the product described will meet stated conditions of performance, safety, and quality useful to the ends of property conservation.
- 1.2.3 Plastic pipe and fittings examined in accordance with this standard may be certified for unexposed (shielded) or exposed service in light hazard occupancies.
 - 1.2.3.1 Products certified for unexposed use require a permanently installed non-combustible barrier with a minimum 15 minute rating in accordance with ASTM E119. Alternatively, pipe and fittings discussed in this standard may be used with a certified fire resistant barrier evaluated in accordance with Standard 1636, “*Fire Resistant Barriers for use with CPVC Pipe and Fittings in Light Hazard Occupancies*”. Only plastic pipe and fittings tested with a specific fire resistant barrier in accordance with Standard 1636 may be used.
 - 1.2.3.2 Products certified for exposed use may be used exposed when installed in accordance with the manufacturer’s installation instructions and all of the following criteria are met:
 - *Occupancy must be covered by an HC-1 Hazard Category*
 - *Sprinklers must have quick response thermal sensing elements.*
 - *Sprinkler systems must be wet pipe type*
- 1.2.4 Plastic pipe and fittings certified to this standard have not been evaluated for use in seismically active areas.

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 plastic pipe and fittings for the purpose of obtaining certification. Plastic pipe and fittings 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:

- Suitability of the product;
- Performance of the product as specified by the manufacturer and required for certification; and, as far as practical,
- Durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of the 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 audits 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 on 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

Units of measurements 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.

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

ANSI/ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*.

ASTM D543, *Standard Specification for Evaluating the Resistance of Plastics to Chemical Reagents*

ASTM D638, *Standard Test Method for Tensile Properties of Plastics*

ASTM D1598, *Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure*

ASTM D2444, *Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)*

ASTM D2837, *Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products*

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*

ASTM E1354, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*

ASTM F442/F442M, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)*

ASTM F2389, *Standard Specification for Pressure-Rated Polypropylene (PP) Piping Systems*

ASTM G154, *Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials*

NFPA 13, *Standard for the Installation of Sprinkler Systems*

NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*

NSF/ANSI Standard 61, *Drinking Water System Components - Health Effects*

International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*

ISO 9080, *Plastics piping and ducting systems – Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation.*

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Accepted

This term refers to installations acceptable to the authority enforcing the applicable installation rules. Acceptance is based upon an overall evaluation of the installation. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere.

Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

Pipe and fittings made of chlorinated poly (vinyl chloride) plastic in which the chlorinated poly (vinyl chloride) is in the greatest amount by weight.

Hazard Category 1 (HC-1)

Areas with light overall combustible loading with limited combustibles used in processes, or operations of low hazard. This includes combustible furnishings that are typically noncontinuous in well-subdivided areas. This hazard category does not include any incidental storage of plastics, or plastics used in the construction of walls and/or ceilings. Examples include residential, offices, noncombustible manufacturing, and hospitals.

Hydrostatic Design Basis (HDB)

One of a series of established stress values for a plastic material. It is obtained by categorizing the Long Term Hydrostatic Strength of the material as described in ASTM D2837 or equivalent national/international standard.

Hydrostatic Design Stress (HDS)

The maximum allowable stress used in the design of plastic pipe of a given material. It is obtained by multiplying the Hydrostatic Design Basis (HDB) by a design factor.

$$HDS = HDB \times DF$$

Light Hazard Occupancy

NFPA 13, “Standard for Installation of Sprinkler Systems”, defines classes of occupancies. The light hazard occupancies wherein it is anticipated that plastic sprinkler piping will be used include hotels, hospitals, offices, schools, apartment buildings, and similar non-mercantile, non-manufacturing or non-warehousing occupancies. These occupancies are characterized by relatively low combustible loadings and completely finished interiors.

Long Term Hydrostatic Strength (LTHS)

Plastic materials exhibit a time-dependant response to stress. This occurs in a predictable fashion. If samples of plastic pipe are pressurized to various levels, they will fail after periods of time proportional to those pressures. The specific relationship is that the logarithm of the time to failure is negatively proportional to the logarithm of the stress.

$$\log T = a - b \log S$$

Where a and b are constants.

This stress, S , is the hoop stress in the material due to internal pressure at a constant temperature. ASTM D2837 details test procedures for obtaining this relationship for thermoplastic piping products. The relationship is then used to determine a particular maximum S that should not cause failure until at least after a minimum desired life. That S is termed the Long Term Hydrostatic Stress (*LTHS*) for the material in question. For purposes of certification of plastic piping, the $T = 50$ years shall be used to determine *LTHS*.

Permanently Installed, Non-Combustible Barriers

A permanently installed barrier is one that cannot be removed without substantial cosmetic damage (e.g., a plastered ceiling). The intent of the requirement is to inhibit casual removal of the barrier for various purposes of convenience, such as re-routing of wiring, as this leads to protracted periods of exposure of the piping. Drop-in ceiling tiles, as used in suspended ceilings are specifically considered not to be “permanently installed” for the purposes of this definition. Non-combustible is defined as having a minimum finish fire rating of 15 minutes when tested per ASTM E119.

Pressure Rating (PR)

The maximum constant internal pressure plus surge pressure allowance, at a given temperature, that can be successfully withstood by pipe of a given Hydrostatic Design Stress and Standard Dimension Ratio (*SDR*).

$$PR = (2 \times HDS) \div (SDR - 1)$$

Design Factor (DF)

A number, less than or equal to 0.5, by which the Hydrostatic Design Basis (*HDB*) is multiplied to obtain the Hydrostatic Design Stress (*HDS*). This *DF* is used to account for variations in conditions from those contemplated in the design of an installation, rough handling of piping, and manufacturing variations.

Standard Dimension Ratio (SDR)

The ratio of average outside diameter of a pipe to its minimum wall thickness. This number is constant for all sizes of pipe of a given material and pressure rating.

Wet System

A system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that the water discharges immediately from sprinklers opened by a fire.

2. GENERAL INFORMATION

2.1 Product Information

- 2.1.1 Plastic piping for sprinkler systems can be identical in materials, sizes, wall thicknesses, and other design and manufacturing aspects to plastic piping for domestic or process water systems. Some specialized fittings designed to facilitate sprinkler installation are available, and many products have been specifically designed for fire protection service.
- 2.1.2 Piping is usually either extruded (pipes) or injection molded (fittings) of specific thermoplastic formulations, in conformance to nationally or internationally recognized standards.
- 2.1.3 Pipe and fittings usually must be of the same material to provide for secure jointing. Chlorinated polyvinyl chloride (CPVC) based products typically are joined by solvent cementing, while polyolefin (PO) based products are usually joined by thermal fusion methods. Composite, reinforced (thermosetting) products are usually joined by epoxy cements or mechanical connections.

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 and one complete set of manufacturing drawings;
- Materials list(s) and material specifications;
- Anticipated marking format;
- Brochures, sales literature, specification sheets;
- Installation, operation and maintenance procedures; and
- The number and location of manufacturing facilities.

All documents shall be part of a controlled system and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

- 2.3.1 Following set-up and authorization of a certification examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by the certification agency following review of the preliminary information. Sample requirements may vary depending on formulation features and results of prior testing. Testing shall use regular production pipe and fittings assembled per the manufacturer's published instructions. All joining techniques submitted shall be tested in all sizes submitted. However, all configurations need not be tested for qualification of a given line. The certification agency will designate those items to be tested which, in its judgment, adequately sample the designs. Any decision to use data generated utilizing prototypes is at the discretion of the certification agency. The manufacturer's test facilities may be used for testing. If testing is performed at the certification agencies facilities, it is the manufacturer's responsibility to provide any necessary test fixtures. Any manufacturer supplied test fixtures shall be returned to the manufacturer at their request.
- 2.3.2 In order to qualify for automatic sprinkler system service, plastic piping shall be examined on a design-by-design, manufacturer-by-manufacturer, and plant-by-plant basis. This is because the manufacture of plastic piping requires sufficient art in its execution that identical designs, executed in identical materials by different manufacturers or, even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample piping, selected in conformance to this criterion shall satisfy all of the following performance requirements and be installed in a manner identifiable as being within the scope of

conditions defined by the testing.

- 2.3.3 The certification examination consists of determination of hydrostatic design basis (*HDB*) of the specific material used, verification of an appropriate design factor of safety, tests of mechanical durability and practicality, and other tests, as noted. A complete review of installation specifications shall be conducted to assure, as far as possible, a practical and reliable installation. Inspection of the product manufacturing facility shall be conducted to assure conformance with the requisite tests and specifications.