

Flame Retardant & Flame Resistant Test Standards White Paper

Some of the most important standards in the building industry are flame retardant or resistant (FR) test standards. A building's capability of meeting certain FR standards is paramount to limiting destruction of property and preventing injury or loss of life of the occupant. FR standards vary by geographic location of the building and by application of the building material. The intent of this article is to define what FR standards are applicable to window shade fabric and clarify the use of other common FR standards utilized in the building industry.

Important Terms

Flame Retardant:

Products that are chemically treated and designed to slow down ignition or combustion. The majority of window shade fabrics fit this category (e.g. 100% polyester shade fabrics with a surface FR treatment).

Flame Resistant:

Products made from materials that are inherently nonflammable and designed to self-extinguish (e.g. 100% fiberglass shade fabrics).

After Flame:

The time during which the material continues to burn after the ignition source is removed.

Char Length (Damaged Length):

The criteria used for tests in which a specimen is positioned vertically with a flame source applied to the bottom of the specimen. The length of the damage caused by the flame moving upward is measured. Criteria for passing varies by standard.

Residual Flame:

Fragments of material that fall to the bottom of a test chamber and continue to burn.

National Fire Protection Association (NFPA):

A global nonprofit organization that develops codes and standards designed to eliminate death, injury, property and economic loss due to fire related hazards. While NFPA codes and standards are widely recognized internationally, they are more commonly used in North America.

International Building Code (IBC):

Created by the International Code Council, this code provides the minimum requirements to safeguard public health, safety and general welfare of building occupants. This code has been widely accepted internationally and in the US, and it contains both prescriptive and performance related requirements.

Life Safety Code (NFPA 101):

A resource developed by the NFPA for strategies to protect people based on building construction, protection, and occupancy that minimize the effects of fire related hazards. This code outlines the NFPA test standards required for specific applications.

Building Codes

Building codes are intended to benefit public safety and support the industry's need for one set of codes without regional limitations. The International Building Code (IBC) provides a multitude of regulations, including fire standards, that are widely accepted internationally. The NFPA created the Life Safety Code (NFPA 101) as a competing standard to the IBC. However, NFPA 101 only covers flammability standards. Both codes are revised every three years.

The IBC has been adopted as a base building code by most jurisdictions in the US. The largest portion of this code covers fire prevention, including test standards for building materials and regulations regarding sprinkler systems and emergency exits. NFPA 101 has also been widely accepted in the US and, while it is not a legal code, it is crafted in such a way to facilitate adoption into law. The intent of NFPA 101 is to provide an environment for the occupants that is reasonably safe from fire. Despite having competing codes, both the IBC and NFPA 101 are generally accepted by the building industry and are very similar regarding fire safety regulations.

There is often confusion over both the IBC and NFPA 101, because they are frequently placed in the same category as FR test standards. Both NFPA 101 and IBC are building codes and not test standards. They both specify which flammability standard is applicable for commercial applications based on each specific building material. You may see "NFPA 101, Class A" listed as a fire classification. This is misleading, because a Class A rating is given based on the results of a test required by NFPA 101. For example, ASTM E84 is the FR test standard specified in NFPA 101 as a requirement for building material applications. The correct usage would be to assign that rating to the test standard that is in compliance with the Life Safety Code (e.g. ASTM E84 Class A rating in compliance with NFPA 101). Additionally, listing the FR test alone (e.g. ASTM E84 Class A) implies compliance with NFPA 101 for that type of application.

Fire Standards for Specific Applications

Materials can be classified as either flame retardant or flame resistant depending on the composition of the material. Since all FR standards are intended to test both types of material, these two terms are used interchangeably and may share the acronym "FR". Flame resistant materials will likely achieve a higher rating or classification than flame retardant materials when applying the same test standard.

There are a multitude of FR standards and fire classifications based on how each material functions as a part of the building. Because the majority of Mermet's market is roller shade application, the most common FR standards that Mermet adheres to are applicable to window shade and drapery material used in buildings. Mermet's products can also be used in a variety of applications and in other environments. Because of this, additional FR standards by specific application are also referenced.

NFPA 701: *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*

NFPA 701 is a fire retardancy standard required for textiles used in most public spaces such as schools, churches,

auditoriums, theaters, and commercial buildings. It is specifically designed for textiles that will be hanging freely (e.g. roller shades). This test standard requires ten individual samples of a specified size to be exposed to a flame for 45 seconds. The performance criteria for this test is based on the percentage weight loss after exposure and residual flame. In order to pass this test, total weight loss cannot exceed 40% and the residual flame cannot exceed an average of 2 seconds.

There are two test methods required by this FR standard (Test Method 1, small scale & Test Method 2 large scale). Both test methods require similar performance criteria. However, Test Method 2 is only required for textiles that weigh more than 21 oz/yd². Because Mermet does not currently have any product that is heavier than that specified weight, only Test Method 1 is required.

For window shade applications, the IBC specifies the flammability standard NFPA 701. This section is referred to as IBC 806.1 “Decorative Materials and Trim”. Additionally, NFPA 101 assigns FR standards based on application in Chapter 10 of its code. Section 10.3.1 “Draperies, Curtains, and other Loosely Hanging Furnishings and Decorations” assigns NFPA 701 as the required test standard. You may see specific references to these codes as a fire classification. However, meeting NFPA 701 automatically infers compliance with these building codes.

NFPA 84: Standard Test Method for Surface Burning Characteristics of Building Materials

This FR standard is applicable to exposed surfaces such as walls and ceilings. Any material that is considered a decoration or furnishing that is not a permanent fixture is not required to meet this standard. Examples of textile applications that would apply to this test standard are wall coverings, ceiling panels, and fixed partitions. Because this type of application is less common for Mermet products, this FR standard is performed by request only. Any Mermet products that are to be used for fixed applications, such as wall coverings, must be tested for and adhere to this standard.

The performance criteria for this test are surface flame spread and the amount of smoke developed or emitted from the textile when exposed to a flame source. When requests are made for the flame spread of a particular product, that is typically in reference to this test standard. The rate and distance the flame spreads between two reference points is based on a flame spread index. The amount of smoke developed is also based on an arbitrary index or scale. Unlike NFPA 701, this is not a pass/fail test. Performance is based on a class rating of A, B or C (sometimes also referred to as class I, II, or III). The Class A rating indicates the best FR performance. Below are the criteria for classification under this standard.

Classification	Flame Spread Index	Smoke Development
Class A	0-25	0-450
Class B	26-75	0-450
Class C	76-200	0-450

Textiles that are treated with an FR chemical, or are inherently FR, will likely meet Class A requirements. The IBC references this FR standard for interior wall and ceiling finish materials in section IBC 803.1.1. NFPA 101 references the use of this standard under section 10.2.3. Similar to NFPA 701, these codes may be referenced under fire classifications for a product. This is often why NFPA 101 is listed as Class A, because it is in reference to the test standard required for the code. However, a class rating based on test standard ASTM E84 infers compliance with these codes.

ASTM E136: *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*

This FR standard is specifically designed to test non-combustibility of materials used in construction. ASTM E136 is a requirement in the IBC for construction materials used on the exterior of a building. It is not applicable for interior finishes or trim materials.

The IBC provides an exception for the testing of a composite material. To attain this exception, the substrate, or structural base, must pass ASTM E136. Any coating or surfacing must be less than 0.125" thick on the substrate and pass ASTM E84 with a flame spread index of less than 50. If these requirements are met the full composite material shall be acceptable as a non-combustible material.

IMO 2010 FTP: *Fire Test Procedures Code (FTP) of the International Maritime Organization (IMO)*

The IMO is a specialized United Nations agency responsible for the safety and security of international shipping. This organization specifies this FR standard for drapery products used in the construction of international shipping vessels. The performance criteria for the standard is based on a combination of factors. The after flame must not exceed five seconds, the average char length must not exceed 150 mm, and the flame source must not burn through to the edge of the material from the point of ignition. This standard is based on a pass/fail result.

FMVSS 302: *Fuel System Integrity Standard*

This FR standard is required to test the flammability of interior materials of cars, trucks, buses, and recreational vehicles. Two reference points, beginning at the point of ignition, are set on the specimen to measure the time it takes for the material to burn between the two points. To meet the minimum requirements for this standard, the fabric cannot burn at a rate of more than four inches per minute.

CAN/CGSB-4.162-M80: *Hospital Textiles—Flammability Performance Requirements*

This Canadian standard is intended to test the flammability of textiles used in hospitals and healthcare related buildings. Performance criteria for this standard is based on an average after flame that does not exceed two seconds and char length. Maximum average char length is determined based on the specific weight of the fabric. Heavier fabrics have a lower maximum char length while lighter weight fabrics are allowed a larger maximum char

length.

Additional Fire Standards by Region

California Title 19: *California Code of Regulations, Title 19, Division 1, Chapter 13*

The state of California requires a stricter flammability requirement than NFPA 701. The California State Fire Marshal has mandated compliance with this standard, which relates to fire and life safety regarding occupied spaces. The performance criteria for this standard is char length that does not exceed six inches for any individual specimen and no after flame for more than four seconds.

CAN/ULC-S109-03: *Flame Tests of Flame-Resistant Fabrics and Films*

Similar to NFPA 701, this vertical flame test is required for textiles used in occupied buildings in Canada. This standard combines performance criteria for NFPA 701 and California Title 19. The residual flame cannot exceed two seconds on any specimen, and the char length cannot exceed 250 mm on any individual sample. Similar to NFPA 701, this standard specifies both a small scale and large scale test method. However, unlike NFPA 701 both test methods are required in order to meet the entire standard regardless of weight of the product.

CAN/ULC-S102-10: *Standard Method of Test for Surface Burning Characteristics of Building Materials*

This standard is required for building material applications aside from roller shades. This Canadian standard meets similar performance criteria to ASTM E84.

CMVSS 302: *Flammability of Interior Materials—Canadian Transportation Standard*

Equivalent performance criteria to FMVSS 302, this FR standard applies to motor vehicles in Canada.

NFP 92-503 (often referred to as M1): *Electrical Burner Test Fire Classification Standard*

This FR standard provides criteria for classifying the flammability of textiles for use in France. This is one of the strictest FR standards in the world. Specimens are positioned vertically, and the flame is held against the fabric surface. Any flaming of the material that continues after the flame source is removed is measured. The performance criteria also include the production of burning droplets (similar to residual flame) and the char length. Below are the criteria for classification under this standard.

Performance Criteria	M1	M2	M3	M4
Duration of Combustion (seconds)	≤ 5	> 5	> 5	> 5
Char Length (mm)	< 250	< 350	< 600	< 600
Presence of Droplets	none	none	none	yes

There is also a classification of M0. The reason this rating is not included in the performance criteria is because this rating defines the product as fireproof, meaning that it should not result in any combustion, char length, or droplets. Below are the definitions of each classification.

Classification	Criteria for Rating
M0	Fireproof
M1	Permanently non-flammable
M2	Low flammability
M3	Average flammability
M4	High flammability

The classification requirement varies by type of building material. Typically, M1 or higher is the desired classification for window shade fabric in France. A rating of M4 is automatically applied to any material that does not meet a classification of M3 or higher. In terms of FR performance, a rating of M4 is considered a failure and the product should be defined as Non-FR.

DIN 4102 Parts 15/16 (often referred to as B1): Brandschacht (fire shaft) Flammability Standard

This standard is required for textiles in Germany. It is the most stringent flammability standard for upholstery fabrics in the country. The fabric is held in a vertical position with a flame source applied to the bottom of the specimen. In order to be classified as B1, the residual length (part of the specimen that escaped burning) must measure a minimum of 150 mm and the temperature of the smoke emitted from the burning of the specimen cannot exceed 200°C.

BS5867 Part 2: British Standard Specification for Fabrics for Curtains, Drapes and Window Blinds

Referred to as the “Type B” test, this is the predominant FR standard required in Great Britain. There is a Type A test that is less stringent and a Type C test that is considered the highest standard. Type C tests are generally used for fabrics that will be laundered, such as clothing. Type B is sufficient for drapery material. This test positions the fabric vertically in a metal frame with the flame applied to the bottom of the specimen. To meet the performance criteria for this standard, the fabric must not burn through to the edges of the metal frame and there should be no presence of burning droplets.

Additional Fire Standards

Fire standards vary widely by region. Some countries may have more stringent standards than others. The US standards tend to be less stringent than other parts of the world, because US building codes often require methods of extinguishing fires through the use of permanent fixtures such as sprinkler systems. Other regions (e.g. Europe) may have older buildings in which these systems cannot be installed, therefore relying on an interior material

to extinguish itself. The most common international standards have been documented, but there may be more localized standards that are required for specific projects.

Due to the fact that regulations in the United States vary widely by state, there are a variety of other fire standards that may be applicable to specific regions in the US. For example, the city of Boston, MA requires an FR standard called BFD IX-1 “Boston Fire Department Classification Fire Test” for certain types of buildings. There are also additional FR standards for large cities like New York, and additional tests for states like California depending on the application and type of building.

Mermet tests all products to the most common FR standards for the commercial window shade industry (NFPA 701, California Title 19, and CAN/ULC-S109). These standards cover the majority of Mermet’s market in North America. Because Mermet’s products can have multiple uses and applications, fabrics that require special testing to comply with an unusual application and/or to ensure compliance with international and regional building codes are performed as requested.