



# Flame Resistant - USA Standards

## NFPA 2112

### NFPA® 2112: 2018

This standard specifies the minimum performance requirements and test methods for flame resistant fabric and components and the design and certification requirements for garments for use in areas at risk from flash fires. Flame resistant fabrics must pass a comprehensive list of thermal tests, including the following:

• **ASTM F2700** – Heat Transfer

**Performance (HTP) Test** - This test is a measure of the unsteady state heat transfer properties of garment materials.

• **ASTM D6413** – Vertical Flammability (Flame Resistance) Test - This test is used to determine how easily fabrics ignite and continue to burn once ignited.

• **Thermal Shrinkage Resistance Test** - This test measures a fabric's

resistance to shrinkage when exposed to heat.

• **Heat Resistance Test** - This test measures how fabrics and components react to the high heat that could occur during a flash fire.

• **ASTM F1930-11** – Thermal Manikin Test - This test provides an overall evaluation of how the fabric performs in a standardized coverall

design after three-second thermal exposure.

• **FTMS 191A** – Thread Melting Resistance Test - Thread used in flame resistant garments must withstand temperatures of up to 500°F.





## NFPA 70E

### NFPA® 70E: 2015

This standard addresses electrical safety related work practices for employee workplaces and requires employees working on or near energized parts and equipment to wear flame resistant clothing that meets the requirements of ASTM F1506.

The NFPA 70E standard gives guidance for selecting the appropriate PPE according to the level of risk involved

in a particular job. Risk areas are categorized by the expected level of incident energy in the event of an electric arc. According to the table there are four categories, ARC 1 (which is low risk) through 4 (which is high risk and requires FR clothing with a minimum ARC rating of 40cal/cm<sup>2</sup>). The higher the ARC rating value, the greater the protection.

ARC Rated PPE	Clothing description	Required minimum Arc rating of PPE/ cal/cm <sup>2</sup>
	ARC 1: Arc rated FR Shirt and FR Pants or FR Coverall	<b>4</b>
	ARC 2: Arc rated FR Shirt and FR Pants or FR Coverall	<b>8</b>
	ARC 3: Arc rated FR Shirt and FR Pants or FR Coverall, and Arc flash suit selected so that the system Arc rating meets the required minimum	<b>25</b>
	ARC 4: Arc rated FR Shirt and FR Pants or FR Coverall and Arc flash suit selected so that the system Arc rating meets the required minimum	<b>40</b>

## ASTM F1506-10a

### ASTM® F1506-10A

This performance specification covers the flame resistance of textile materials to be used for wearing apparel for use by electrical workers exposed to momentary electric arc and related hazards

These textile materials must meet the following performance requirements:

- A general requirement that thread and components used in garment construction shall not contribute to the severity of injuries to the wearer in the event of a momentary electric arc and related thermal exposure.  
- A set of minimum performance specifications for knit and woven fabrics including strength, colorfastness, flame resistance

before and after washing and arc test results.

- Testing for flame resistance in accordance with ASTM test method D6413 vertical flame test.

- When tested as received in accordance with ASTM test method F1959 arc performance, the fabric may not have more than 5.0 seconds after flame time when

tested.

Garments must be labeled with the following: - Tracking code.  
- Statement that the garments meet the requirements of F1506.  
- Manufacturer's name, size information.  
- Care instructions and fiber content.  
- ARC rating (ATPV) or (EBT).

## ASTM F1959/F1959M-12

### ASTM® F1959/F1959M-12: 2013

#### Standard Test Method for Determining the ARC Rating of Materials for Clothing

FABRIC ONLY TEST. This test method is the same as outlined under EN 61482-1-1. Pre treatment may vary.

## Laundering of FR Fabrics

The Flame Resistant finish is retained for the normal life cycle of the garment provided that the care instructions are adhered to.

### Washing / Drying Procedure:

**Pretreatment:** If stains are difficult to remove, they can be treated before putting into the washing machine with a liquid detergent applied directly to stains and lightly rubbed. Heavier and stubborn stains should be pretreated with a commercial stain removal product at the earliest opportunity and sufficient time allowed for the pretreatment to penetrate and loosen the stain. Never use chlorine bleach or washing detergents containing bleach as these will reduce the flame resistance properties of the fabric. Fabric softeners, starches and other laundry additives are not recommended as they can mask the flame resistance performance and may also act as a fuel in case of combustion.

**Washing:** Always wash contaminated workwear separately, do not mix with non workwear. Flame Resistant fabric can usually be washed at high temperatures however it is the components (ie. the reflective tape, badging, etc.) on a finished garment that dictates the maximum washing temperature that the garment can be washed at. Always follow the washing temperature on the garment label. Always wash and dry garments inside out to minimize surface abrasion and help maintain the surface appearance of the fabric. Zippers should be closed during washing.

**Load Size:** To ensure a more efficient, cleaner wash, avoid overloading the machine so the garments can move freely through the wash and rinse cycles.

**Drying:** Tumble drying is not usually recommended as the temperature used is often too high and can cause garment shrinkage. It is vital that cotton or cotton mix garments are not over dried. Over drying is the main cause of excessive garment shrinkage. Do not hang in direct sunlight. This can cause fading.

# Flame Resistant- European Standards



IEC 61482-2  
ATPV or  $E_{\text{BT50}} = \text{xxx cal/cm}^2$   
or  
Class 1 or Class 2

or

IEC 61482-2  
ATPV or  $E_{\text{BT50}} = \text{xxx cal/cm}^2$   
and  
Class 1 or Class 2

## IEC 61482-2:2009

This standard specifies requirements and test methods applicable to materials and garments for protective clothing against the thermal effects of an electric arc event. Two international test methods have been developed to provide information on the resistance of clothing to the thermal effects of electric arcs. Each method gives different information. To comply with the standard either or both tests must be carried out.

### Box Test Method EN61482-1-2.

The fabric/garment is exposed to an electric arc confined in a specific box with a specific electrode arrangement for 0.5 seconds. Class 1 is to a current of 4kA arc, Class 2 is to a current of

7kA arc. Test conditions for class 1 & 2 try to stimulate typical exposure conditions for a short circuit current of 4kA and 7kA respectively.

### Open Arc Method EN61482-1-1.

This test method aims to establish the ATPV (Arc Thermal Performance Value) or EBT (Energy Breakopen Threshold) of a fabric. The ATPV is the amount of energy required to cause a 2nd degree burn through the material prior to break-open (50% probability).

The EBT is the amount of energy where the material breaks-open (50% probability). This is normally the upper thermal limit of the fabric where the fibers are damaged

and the material loses mechanical strength.

Both ATPV and EBT are expressed in calories per  $\text{cm}^2$ . EN 61482-1-1 tests the fabric with an 8kA arc for various incident durations. Workers are assumed to be safe if the ARC rating of their clothes exceeds the electric arc incident energy calculated in the worst case scenario of a risk assessment.

Garments can be layered to achieve an overall ATPV or EBT Rating. For example a thermal layer may achieve an EBT of 4.3  $\text{Cal/cm}^2$ , and an outer coverall may achieve an ATPV of 13.6  $\text{Cal/cm}^2$ . However the combination ATPV/EBT ratings will

be greater than the sum of the two single layers, as the air gap between the two layers affords the wearer additional protection.

Another parameter measured during the open arc test is the HAF value (Heat Attenuation Factor) - this describes the amount of heat blocked by the fabric.



## EN ISO 11612: 2015

The performance requirements set out in this international standard are applicable to garments which could be worn for a wide range of end uses, where there is a need for clothing with limited flame spread properties and where the user can be exposed to radiant or convective or contact heat or molten metal splashes.

This test uses standard methods and conditions to predict the performance of fabric/garments in the event of

contact with heat or flames. Garment features such as seams, closures and logos must be tested as well as the fabric. Tests must be carried out on pre-treated components according to the manufacturers care label.

### Specific testing is listed below:

- Dimensional change
- Limited flame spread (A1+A2)\*
- Convective heat (B) - 3 levels
- Radiant heat (C) - 4 levels
- Molten aluminum splash (D) - 3

levels

- Molten iron splash (E) - 3 levels
- Contact heat (F) - 3 levels (temperature 250 degrees Celsius)
- Heat resistance at a temperature of 180 degrees Celsius.
- Tensile strength (must meet a minimum of 300N) Tear strength (must meet a minimum of 10N)
- Bursting strength
- Seam strength

Garment design requires that coverage must be provided from the neck to the wrists and to the ankles. Optional testing includes water vapor resistance and manikin testing for overall burn prediction.

\*This test must be carried out on fabric and seams.



## EN ISO 11611: 2015

This international standard specifies minimum basic safety requirements and test methods for protective clothing for use in welding and allied processes (excluding hand protection).

The international standard specifies two classes with specific performance requirements.

**Class 1** is protection against less hazardous welding techniques and situations, causing lower levels of spatter and radiant heat.

**Class 2** is protection against more hazardous welding techniques and situations, causing higher levels of spatter and radiant heat.

### Specific testing is listed below:

- Tensile strength
- Tear strength
- Bursting strength
- Seam strength
- Dimensional change
- Requirements of leather
- Limited flame spread (A1 + A2)
- Molten droplets
- Heat transfer (radiation)

- Electrical resistance



## EN 1149: 2008

Protective Clothing - Electrostatic Properties - Part 5. Material Performance and Design Requirements.

This is the harmonized European standard for protective clothing-protection against the danger caused by static electricity. This standard is

not applicable for protection against mains voltages.

- **EN1149-1:1996** Test method for surface conducting fabrics.
- **EN1149-3:2004** Charge decay test method for all fabrics.
- **EN1149-5:2008** Performance requirements.



## ATEX Directive










The ATEX Directive defines what equipment is permitted in an environment where an explosive atmosphere may exist.

Portwest recommends using garments certified to EN 1149 for added protection in an ATEX environment.

Portwest garments have not been assessed under the ATEX directive which currently excludes PPE.











# USA Fabric Reference Chart

	STYLES	COMPOSITION	WEIGHT	WEAVE / FINISH	NFPA <sup>®</sup> 2112	NFPA <sup>®</sup> 70 E	ASTM F1506-10A	
	UAF73	93% Meta-aramid, 5% Para-aramid, 2% Carbon Fiber	4.5 oz	Plain Weave	✓			
	UFR21	99% Cotton, 1% Carbon Fiber	7 oz	Twill		✓	✓	
	FR94, UFR88, FR89	88% Cotton, 12% Nylon	7 oz	Twill	✓	✓	✓	
	FR95	88% Cotton, 12% Nylon	7oz	Twill	✓	✓	✓	
	UBIZ1, UBIZ5, BZ31	100% Cotton, FR Finish	9.5 oz	Twill	✓	✓	✓	
	UFR81, FR09	60% Modacrylic, 39% Cotton, 1% Carbon Fiber	9 oz	Knit				
	UMV21	60% Modacrylic, 39% Cotton, 1% Carbon Fiber	5.5oz	Knit		✓	✓	
	FR96	60% Modacrylic, 40% Cotton	8oz	Knit				
	FR01 FR02	100% Cotton	7 oz	Interlock Knit				
	FR44 FR41, FR43	100% Polyester, FR & Antistatic, PU Coated	7.5 oz	PU Coated				
	US773	98% Polyester, 2% Antistatic Carbon Fiber, Breathable, PU Coated	7.5 oz	PU Coated				
	S783, S771	98% Polyester, 2% Antistatic Carbon Fiber, Breathable, PU Coated	7.5 oz	PU Coated				
	FR75	100% Polyester, Warp Knit	3.5 oz	Knit				



**CERTIFIED TO  
USA STANDARDS**

	ASTM F1959	ANSI/ISEA 107 - 2015	 EN 1149	 EN ISO 11612	 EN ISO 11611	 IEC 61482-2	 EN ISO 14116	 EN ISO 20471	 EN 13034	 EN 343
	ARC 1 5.9 Cal/cm <sup>2</sup>		✓	✓						
	ARC 2 8.2 Cal/cm <sup>2</sup>									
	ARC 2 8.2 Cal/cm <sup>2</sup>			✓						
	ARC 2 9 Cal/cm <sup>2</sup>	✓								
	ARC 2 11.2 Cal/cm <sup>2</sup>			✓	✓					
	ARC 2 16 Cal/cm <sup>2</sup>		✓	✓		✓				
	ARC 1 4.9 Cal/cm <sup>2</sup>	✓								
	ARC 2 9 Cal/cm <sup>2</sup>	✓								
	ARC 2 12 Cal/cm <sup>2</sup>			✓						
		✓	✓				✓	✓	✓	✓
		✓	✓				✓	✓	✓	✓
			✓				✓		✓	✓
		✓					✓	✓		

**\*NOTE: The term HRC has been replaced by ARC.**