

ArcWear™ Arc Resistant Outerwear

Summary of relevant information contained in OSHA 1910.269 (I)(6)(iii) (Effective January 31, 1994)

The Employer shall ensure that each employee who is exposed to the hazards of flames or electric arcs does not wear rainwear or clothing that could increase the extent of injury. Example: Melting and dripping rainwear can melt onto the worker's skin and cause a more severe burn injury. In this case, the melting and dripping increases the extent of the injury.

Summary of relevant information contained in ASTM F 1891-02b *Standard Specification for Arc and Flame Resistant Rainwear*

Scope: This specification establishes applicable test methods, minimum physical and thermal performance requirements, suggested sizing and recommended purchasing information for rainwear for use by workers who may be exposed to the thermal hazards of momentary electric arcs and open flames. The objective of this specification is to prescribe fit, function, and performance criteria for rainwear that meets a minimum level of thermal and physical performance when exposed to a laboratory-simulated electric arc or flame exposure.

Key Definitions:

Arc Rating: A term used to indicate the protection level of a garment. With rainwear, it will almost always be equal to the ATPV.

Arc Thermal Performance Value (ATPV): The incident energy on a material that results in sufficient heat transfer through the material for a 50% probability of the onset of a second-degree burn on human tissue.

Breakopen Threshold Energy (E_{BT}) or Breakopen Threshold Energy Above Stoll (E_{BTAS}): The energy needed to cause the material to breakopen.

Calorie: The energy required to raise 1 gram of water one degree C.

Heat Attenuation Factor (HAF): The percent of arc flash heat energy blocked by the material.

Stoll Curve: Curve used to predict the onset of a second-degree burn on human tissue.

Design Test: One made on a sample treated as representative of an industrial product. Not intended to be re-done unless components of the material change.

Performance Requirements: Requirements shall be met initially as manufactured as well as after five cleanings.

Leak Resistance: Material must withstand water pressure of 30 psig without leaking. The seams of the rainwear must not exhibit any evidence of leakage when exposed to water at 3 psig for (2) two minutes.

Tear Resistance: Material shall have a trapezoidal tear resistance of 6 lbs in the warp direction and 6 lbs in the fill direction.

Markings and Reflective Materials: These materials attached to the rainwear shall be permanent and electrically non-conductive, and shall not degrade the performance of the rainwear.

Flame Resistance: Rainwear material shall be flame resistant and shall not melt and drip when tested in accordance with ASTM D6413-99 and shall exhibit no more than a 2 second after flame time and less than a 6" char length.

Arc Thermal Performance: Rainwear material shall be tested in accordance with ASTM F1959-05a, a design test, after 3 washings and 1 drying. Testing parameters are set at 8 kA arc current, 12" arc gap, 12" distance from the arc and stainless steel electrodes with a diameter of 0.75 inch. The following information is determined:

- Arc Thermal Performance Value (ATPV) – determine and report value; no minimum value established for conformance. A higher ATPV means it takes more arc energy to cause a second degree burn. ATPV is expressed in calories per centimeter squared (cal/cm^2).
- Heat Attenuation Factor (HAF) – determine and report value; no minimum value established for conformance. A higher HAF means that more arc energy is prevented by the rainwear material from getting to the next layer of clothing. HAF is expressed as a percentage (%).
- Breakopen Threshold Energy (E_{BT}) – if ATPV cannot be determined due to fabric breakopen occurring at a lower energy than burn injury, determine E_{BT} and report value; minimum value established at $5 \text{ cal}/\text{cm}^2$. A higher E_{BT} means it takes more arc energy to break open the material. E_{BT} is expressed in calories per centimeter squared (cal/cm^2).
- Arc Rating is based on either ATPV or on E_{BT} which ever is lower. When based on ATPV it is expressed as
- Breakopen Threshold Energy Above Stoll (E_{BTAS}) – determine when breakopen occurs at a higher energy than burn injury and report; minimum value established at $5 \text{ cal}/\text{cm}^2$. A higher E_{BTAS} means that it takes more arc energy to break open the material. E_{BTAS} is expressed in calories per centimeter squared (cal/cm^2).
- Material response characteristics shall be reported for two typical exposures at least equal to the Arc Rating and two typical exposures at least two times the Arc Rating. Characteristics are: Afterflame time, breakopen, charring, melting, dripping, electric arc ignition, embrittlement, and shrinkage.
- Melting/Dripping – material can show NO evidence of melting and dripping at an exposure at least equal to twice the Arc Rating.

Labeling Requirements:

- **Manufacturer Label:** States size, catalog number, manufacturer's name and notation of conformance to F1891, and the label is permanently affixed in each rainwear item.
- **F1891 Label:** States the Arc Rating (ATPV) or Arc Rating (E_{BT})
- **Care Label:** States instructions for cleaning and care and shall be readable throughout the life of the garment.
- **Packaging Label:** States name of manufacturer, size, material, catalog number, date code and ASTM designation.