

Advanced Materials Properties

High Visibility ANSI 107 Requirements:



- Class 2 jackets can be combined with Class E pants or overalls to make a Class 3 suit.
- Reflective trim must meet various requirements with regard to placement and configuration.
- Acceptable colors are: Fluorescent Lime-Yellow & Fluorescent Orange.
 - Colors must meet chromaticity and luminance requirements both initially and after 40 ultra-violet fading unit tests.
- Rainwear must meet minimum water penetration and repellency requirements.
- Minimum requirement established for breathable classification. Contact NASCO for details.

	Minimum Area Requirement		Width		Amount (linear feet)
	Meters ²	Inches ²	Millimeters	Inches	
Class 1	0.10 m ²	155"²	25 mm	1"	12.92'
			35 mm	1-3/8"	9.39'
Class 2	0.13 m ²	201"²	50 mm	2"	8.375'
			35 mm	1-3/8"	12.2'
Class 3	0.22	310"²	50 mm	2"	12.92'

Electric Arc Resistance



ASTM F1891

- **Arc Rating:** The amount of energy needed to create the 50% probability of a second degree burn injury.
- **Heat Attenuation Factor:** The percent of the energy which is blocked by a material.
- **Breakopen Threshold:** The amount of energy that results in a 50% probability that the fabric will breakopen.

Requirements

- Material must be flame retardant (ASTM D6413), self-extinguish <2 seconds, <6" char length.
- Must determine Arc Rating (ASTM F1959) – report results, no minimum required.
- Must determine Heat Attenuation Factor (ASTM F1959) – report results, no minimum required.
- Must determine Breakopen Threshold (ASTM F1959) – report results, minimum of 5 cal/cm².
- Must not melt, drip or ignite at two (2) times arc rating.

NFPA 70E

- NFPA 70E Standard for Electrical Safety Requirements for Employee Workplace, includes codes, standards and recommended practices and guides for safe work practices.
- Covers protection to workers from electrical hazards associated with installation, maintenance or repair of electrical systems. This standard excludes the transmission and distribution of electric power by utility companies.
- Requires workplace to conduct a hazard assessment then provide personal protective equipment (PPE) based on that assessment. Hazard risk categories have been established to help employers select proper PPE.
- Hazard Risk Categories are:

HRC	Minimum Arc Rating
1	4
2	8
2*	8 with Face Protection
3	25
4	40

Chemical Penetration Resistance



Permeation vs. Penetration

- Permeation resistance testing measures the passage of chemicals (liquids or gases) through a material at a molecular level and requires sensitive analytical equipment to detect chemical breakthrough. It is intended for use with vapor-protective, gas-tight, EPA level A garments. The primary purpose is to isolate the wearer from a surrounding hazardous chemical environment.
- Penetration resistance testing evaluates if liquids physically penetrate materials using visual observation for detection. It is intended for use with liquid-splash, liquid-tight, EPA level B or C garments. The primary purpose is to keep liquids from contacting the wearer's skin.

ASTM F903 Test Method

- 5 minutes at ambient pressure
- 1 minute at 2 psig
- 54 minutes at ambient pressure
- Test yields a pass or fail result

Breathability



Breathable Raingear vs. Non-Breathable Raingear

- Non-breathable raingear is designed to keep water out but also keeps perspiration in. It creates an internal environment that stores heat which leads to workers becoming wet from perspiration even though no rain passed through.
- Breathable raingear is designed to collect and transmit perspiration out of the garment. This leaves the worker dry from both the transmitted perspiration and the rain.
- Breathability is measured in 2 ways:
 - Moisture Vapor Transmission Rate (MVTR) - The amount of vapor that evaporates through the material per ASTM E96.
 - Total Heat Loss (THL) - The ability of a material to release heat as it is built up per ASTM F1868.
- For a material to be considered breathable, it must have a:
 - Moisture Vapor Transmission Rate (MVTR) of greater than 5000 g/m²/24 hours.
 - Total Heat Loss (THL) of 300 watts/m²/24 hours

Flash Fire Resistance ASTM F1930



- **Limited Flame Resistance (LFR) vs. Flash Fire Resistance (FFR)**
 - LFR measures a fabric's ability to self-extinguish within 2 sec. of removal of the ignition source per ASTM D6413. LFR is a function only of the fabric. LFR is valuable to determine how a fabric will react to a small and simple flame.
 - FFR measures the predicted burn injury from a simulated flash fire per ASTM F1930. FFR is a function of both the fabric and the design of the garment worn.
 - FFR is valuable to determine how protective a garment is and to what extent the worker wearing that garment may be injured.
- **Burn Injury Survivability:** The ability of an individual to survive burn injury is dependant primarily on 2 factors: percent of burn injury and age. As both increase, the chance of survival decreases. In an industrial setting, because you cannot control the age of the worker, you must control the severity of the burn. The industry objective is to reduce the burn injury as low as possible thus increasing the survivability.