

Myths and Facts on Complying with NFPA 70E's Clothing Requirements

By Hugh Hoagland | Electrical Contracting & Engineering News, February, 2002

Stop. Don't switch garments for electric arc protection before you read this article. Companies are now claiming to have new compliant "Switching Suits." But they may be selling you gear you don't need. The NFPA 70E safety standard has many turns and twists, and inconsistencies the committee is attempting to address. People are regularly confusing the many compliant options. Your best bet is to research the market and know the available solutions before you purchase or remove protective clothing from your system. There are many good flame resistant suits and clothing that have been called into question in the past few months, without warrant, using the NFPA 70E standard to support the concern.

Many companies and electrical contractors are switching, working energized parts and equipment covered under the new voluntary NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces 2000 Edition (available online or in print from the National Fire Protection Association (NFPA) at <http://www.nfpa.org/>). There has been much confusion about what complies and what does not comply in terms of arc suits/high amperage protective gear and protective clothing systems. The confusion comes from misinterpretations of the standard and from misleading sales literature. There doesn't need to be confusion. The standard's intent is clear, and the muddled language, which attempts to follow NFPA's rule of avoiding design restrictions can be cleared up with assistance from those who design and test garments.

It has come to my attention over the past several months, that one manufacturer claims that their arc suits, to quote their sales literature, "are the only arc suits, which meet every aspect of the NFPA 70E Standard for Electrical Safety." When questioned, the company representative responded, "I stand by my statement ... I haven't seen any that do." If only he had seen the competing suits that have been on the market for the past two years, or any of the new advances in the suits decreasing cost by 50 percent while also reducing the weight of the garments. There are also many other clothing options that meet the 70E standard such as: using multiple layer systems, or arc resistant raingear for the suit with a flame resistant uniform, or coveralls with a compliant hood assembly.

Let's look at some myths and facts related to the new standard.

Myth: Flame resistant clothing may not contain nylon or polyester.

Fact: Some people have mistaken a paragraph prohibiting the use of these materials in non-flame resistant clothing to apply to flame resistant. A recent change to NFPA 70E called a Tentative Interim Amendment (TIA) has stated now clearly that the prohibition to cotton nylon blends refers to non-flame resistant materials, not to the new cotton nylon blends like Indura UltraSoft.

Myth: Flame resistant clothing should never contain rayon.

Fact: This myth most likely comes from the OSHA 1910.269 standard portion (l)(6)(iii) that lists rayon along with nylon, polyester and acetate as materials that melt. Rayon is actually synthetic cellulose (like wood pulp or cotton) and does not melt. But if rayon is not flame-retardant treated, it can readily ignite thus its prohibition in the arc. If flame-retardant treated, it can work very well in the electric arc and provide more comfort to the materials it is blended with.

Myth: Switching Suits are very heavy and cost \$1,000.

Fact: Some are and do, but recent advances allow for very light-weight jackets to perform at double the Hazard/Risk Category of previous materials with the same weight and still cut the cost dramatically. These suits are running from \$275 to \$1,000 now and protect from 25 to 100 cal/cm². If you are wearing FR clothing underneath, consider testing your system. You might be able to keep the workers cooler or save money by using a 40 cal/cm² hood and a jacket with 10 cal/cm² protection over your FR uniform, and still get more than 40 cal/cm² protection on the body. Some of the arc resistant raingear systems mentioned later in this article can do this or the switching suit companies can sell the lower protection value suits tested with your FR uniform to provide the protection level you need rather than using a heavier or more expensive suit than your hazard assessment requires. You should have data to back this up. Not all the manufacturers have this data. If you have enough workers to justify doing the test, you can have the testing done. . You don't have to use the same protection Hazard/Risk Category hood with the jacket/pant if your uniform provides additional protection. You can use a higher Hazard/Risk Category of protection on the hood so that you match the head and face protection to the body protection.

Myth: Flame Resistant(FR) labeled clothing is all I need in the electric arc.

Fact: FR is a misnomer. It would be better to use arc resistant. Clothing which meets the ASTM 1506-2000 or rainwear that meets the ASTM F1891-01, a standard that will not allow melting and dripping in the electric arc. I would spec clothing meeting these versions or the latest version. FR without an arc resistance rating usually means passing a vertical flame test. There are many materials that meet vertical flame criteria but do badly in the electric arc, and some FR-labeled apparel materials even ignite, continue to burn and melt onto workers. Look for the specific standards for your industry.

Myth: I must use a switching suit or arc suit to meet Hazard Category 4 of NFPA 70E

Fact: The standard requires minimum 40 cal/cm² all around protection. How you choose to achieve that meets the intent of the standard. Some do it with flame resistant uniforms, cotton undergarments and an arc resistant rainsuit with a hood, which reduces the number of flame resistant garments they have to buy. Others use coveralls and a hood with the right FR clothing and a hood. If you meet your hazard analysis protection criteria, you are meeting the intent of the standard. The clothing tables are meant as examples but if tested, the cal/cm² and the total body coverage are the critical measure of compliance.

Myth: All faceshields are acceptable for the electric arc.

Fact: Most faceshields reduce arc injuries. Clear faceshields have shown to be less effective than shaded ones. Anecdotal evidence suggests good results with faceshields and better results with hood enclosed faceshields. More evidence is needed to give a firmer answer but faceshields can help without a hood up to their ignition/melting Hazard/Risk Category. I recommend no more than 20 cal/cm² exposure with a faceshield, even with a balaclava hood underneath. Some recommend less. I also recommend you not use acetate shields. Most of my testing experience with them is negative including melting and ignition. For Hazard/Risk Categories 40 cal/cm² and above, I recommend an arc-tested faceshield. I also recommend them for any situation where lighting permits their use.

Myth: FR rainwear equals arc resistant rainwear.

Fact: This is totally false. FR means very little in rainwear and nothing in arc or flash fire resistance. Most "FR" rainwear melts in the flame but is treated to suppress the flame. However, in the energies in flash fires and electric arcs, this flame suppression usually doesn't work and the melting is not suppressed at all. This means that in many scenarios, the "FR" rainwear will increase the injury to the worker. Use "arc resistant" rainwear that meets the ASTM F1891-01a or the ASTM F1891-00 standard. Both of these eliminate dangerous melting materials.

Myth: Rubber gloves are dangerous in the electric arc.

Fact: This probably comes from linking rubber to plastic. Rubber is naturally occurring and rarely has been a problem in the electric arc. I have never seen a continued ignition in rubber goods or leather, nor have I seen accidents where either contributed to injury. (Rubber usually chars rather than melts and though leather does substantially shrink in the electric arc, rubber gloves and leather protectors have been very successful in protecting workers from arc exposures. When in doubt, have your glove combinations tested in the arc hazard most common in your industry. There is no fixed standard but test scenarios have been set up in the past.

Myth: If heavy cotton is good enough for welders, it is good enough for electricians.

Fact: Heavy cotton is not necessarily good enough for welders since it will ignite under certain conditions, while FR clothing will not ignite under welding conditions. Unfortunately there is no real standard for welding clothing in the United States. Flame resistant cotton, flame resistant wool and Kevlar/FR Rayon blends have been used successfully for welding. For welding in the rain, some companies have used rainsuits with FR Neoprene over Nomex, Indura FR cotton and Nomex-Kevlar successfully. Welding leathers are also a great companion to any of the FR materials since they are very protective and can also protect the FR clothing from excessive wear and tear.

Myth: FR Clothing must have an ATPV/Arc Rating of over 5 before it can be used in a protective clothing system, so I can't use my 4.5 oz Nomex IIIA for electric arc.

Fact: This would be right if you are referring to a single layer Hazard/Risk Category 1 suit. (For now, there is a move afoot in the committee to change this to 4 cal/cm² because many companies use 4.5 oz Nomex IIIA systems in layered assemblies). The intent was that 5 cal/cm² would be the minimum used

in a single layer system (this will likely change to 4 cal/cm² since it will include all common single layer systems. It would also be nice if they lowered the Hazard/Risk Category 2 to 7 cal/cm² since this would allow several single layer systems to meet Hazard/Risk Category 2). Adding a 4.5 oz Nomex IIIA coverall or any other arc resistant coverall is a good idea for additional protection. Materials used in multiple layered systems do not need to have 5 cal/cm² of protection each. Using a 4.5 oz. Nomex IIIA system just requires using natural fiber garments to meet the Hazard/Risk Category 2 requirement.

Myth: Clothing must be tested to the PS58 ASTM test method for electric arc ATPV or EBT and may not have the new ASTM 1506-2000 designation.

Fact: The TIA also changed the F1506-98 standard to the F1506-2000 standard but internal inconsistencies still exist calling for the old PS58 standard, which can give higher results than the new test method called for in F1506-2000. I recommend F1506-2000 since it uses the new F1959-99 test method that gives an Arc Rating and is superior to the now defunct PS58 method.

According to my testing and information based on the manufacturer's construction, testing and labeling the following suits meet NFPA 70E. Some so-called switching suits and jackets do not meet the full intent of the standard, (though much of the research justifying using switching suits was based on "non-compliant" suits). The IEEE Yellow Book stories (www.ieee.org) were derived from accident investigations based on an early non-compliant NFPA 70-2000 SteelGrip "green suit" with clear faceshields with no accidents producing burns when wearing this suit.) I don't recommend using a long coat alone in high amperage or long duration electric arcs, but there are many suits that meet Hazard/Risk Category 3 and 4 including:

1. Ago Industries, (519) 452-3780, <http://www.ago1.com>

17 oz/yd² of Kevlar/PBI and Indura materials that have an arc rating of over 40 cal/cm²

2. NASCO, 1-800-767-4288, <http://www.nascoinc.com>

8 oz/yd² ArcLite ProSeries with 4.5 oz Nomex IIIA or heavier flame resistant shirt and cotton underwear w/ NEW 40 cal/cm² hood) Arc Rating (ATPV)= >40 cal/cm² 9 oz/yd² PetroLite (Yellow or Orange with 4.5 oz Nomex IIIA or heavier flame resistant shirt w/ NEW hood Arc Rating Arc Rating (ATPV)= 53 cal/cm²

3. NSA, 1-800-553-0672, www.safeapro.com

11.7 oz/yd² Kevlar/Nomex system reached an Arc Rating (ATPV) of 37 cal/cm² 7.5 oz Kevlar over multiple E89 and Nomex IIIA 13.2 oz/yd² Kevlar/Nomex system reached an Arc Rating (ATPV) of 65 cal/cm² 7.5 oz Kevlar over multiple E89 and Nomex IIIA 15.7 oz/yd² Kevlar/Nomex system reached an Arc Rating (ATPV) of 75 cal/cm² 8 oz Kevlar over multiple E89 and Nomex IIIA 17.5 oz/yd² Double Layer Indura UltraSoft system reached an Arc Rating (ATPV) of 34 cal/cm²

4. Oberon Company, 1-800-322-3348, <http://www.oberoncompany.com>

16 oz/yd² ArcSuit 6 oz. Nomex IIIA over 12 oz. Proban 31 cal/cm² (NOTE: Proban FRC is guaranteed FR for only 25 washings) 17 oz/yd² ArcSuit Multi-layer 50 cal/cm² 26 oz/yd² ArcSuit Multi-layer 100 cal/cm²

5. SteelGrip, 1-800-397-8390, <http://www.steelgripinc.com>

9.8 oz/yd² system Arc Rating (ATPV) = 25 cal/cm² Nomex IIIA/Kevlar 10.7 oz/yd² system Arc Rating (ATPV) = 40 cal/cm² Nomex IIIA/Kevlar 17.5 oz/yd² Indura UltraSoft/Nomex IIIA/Kevlar system reaching an Arc Rating (ATPV) = 55 cal/cm² 23 oz/yd² system Arc Rating (ATPV) = 100 cal/cm² Tuffweld/Nomex IIIA/Kevlar

NFPA 70E requires the following for flash suits (next version will have a better definition).

- Arc Resistant Shield. "The entire flash suit, including the window, shall have energy absorbing characteristics"
- Manufacturer's Instructions. The garment manufacturer's instructions for care and maintenance of FR apparel
- F1506-1998 compliant garments (some still use F1506-1998 but F1506-2000 is better)
- FR thread
- full body protection for the Hazard/Risk Category hood/faceshield assembly
- Some confusion of whether you use "flash pants" or "flash bib". Either could be ok. I prefer a bib since the openness of the jacket could allow flames up onto the body. NFPA standards are not supposed to be design restrictive. Many companies are using a long coat and leggings for ease of donning and doffing. This could meet the "intent" of the standard but the wording seems to require bib (or pant) and jacket.
- Double Layer switching suit (this should not be taken literally since it was the most commonly available when the standard was issued. Many of the suits are multi-layer and some are single layer. Performance and coverage of the design, along with breathability of the suit should be considered. Heat stress and oxygen depletion (in the hood) have been an issue in some of the compliant suits).
- Arc Rating (ATPV or EBT tested in accordance with ASTM PS58 which is superceded by ASTM F1959 and is no longer published. Some have tested at 12,000 Amps in accordance with PS58 but this gives higher ATPV and EBT values which would not be supported by testing according to the latest standard and following best practices in arc testing). I recommend data based on 8,000 Amps testing only. If in doubt, ask the manufacturer for a data report. Some have them on

their websites now. You may not be able to compare PS58 data with the newer F1959 data. The new standard is more conservative.

More options and concerns

There are other special needs and concerns that might enter into your buying decision such as:

- Special needs ie. Aluminum or Steel Splash or Welding
- Whether to discontinue use of older suits
- Rainwear
- Winterwear
- high visibility vests
- fall protection harnesses (don't use polyester. Nylon or Kevlar(r) have proven to be the best).

Most users of NFPA 70E have begun to use coveralls or full FR uniforms with 5-10 cal/cm² Arc Ratings and are adding a hood, faceshield or coverall or a full switching suit when needed. Others are using arc resistant raingear with a hood or a faceshield when required to meet the standard. Choose the best option for your industry, but use NFPA 70E to protect electrical workers from the hazards of electric arc, and you have won half of the battle. Kevlar/PBI, Tuffweld, Proban, Indura UltraSoft and Nomex IIIA are registered trademarks.

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