

December 11, 2017

RE: PPE ARC FLASH TESTING – Kinetics Lab



The day began with a 60minute tour of the Kinetics facility/laboratory. This facility conducts performance testing of equipment and garments that may be subjected to high voltage electricity. Whether it is arc flash, electrocution, or a lightning strike, they can recreate these situations in a safe and clinical setting. For our purposes, we are here to attain an Arc Rating value for our structure PPE. This is a requirement of NFPA 70E for all adornments worn by workers who may, in the course of their work duties, be exposed to an electrical arc flash. It is important to note that an **Arc Flash Rating** is unique to thermal conditions resulting from electrical hazards and is not the same as a **Flame Resistance rating(FR)** which is used for standard structure fire fighting operations. In both cases, the primary purpose of the clothing is to resist ignition (as tested by ASTM D-6413, also known as Vertical Flame Test). If flammable clothing is ignited by an arc flash, flash fire, molten metal, etc, the hazard to the wearer instantly becomes much greater, because a clothing fire will last much longer than the initial hazard, and will typically burn the victim over a much larger body surface area and more deeply, and is more likely to result in airway and lung damage. By not continuing to burn after the initial hazard is over, FR clothing limits burn injury to, at most, only the body surface area directly impacted by the hazard (and it's this reduction of TBSA –total body surface area- burn that's most directly linked to survival). The second goal of FR clothing is to insulate the wearer from the thermal hazard, thus reducing or eliminating any 2nd or 3rd degree burn through the garments, even in areas directly impacted by the hazard. This is where arc rating comes into the picture.

All Arc Rated clothing is flame resistant; the official arc rating standard (ASTM 1959) requires fabrics be FR to even qualify for testing. Once an FR fabric is submitted for arc rating, 21 samples are subjected to arc flash, and sensors measure heat transfer through the fabric. Stoll curve modeling then predicts whether or not a second degree burn would result, and calculates the energy likely to cause a 2nd degree burn through that fabric 50% of the time. This number, expressed in calories, then becomes the arc rating for that fabric and any garment made from it. More simply put, arc rating measures insulation of FR fabrics to arc flash. The arc rating can be reported as ATPV (Arc Thermal Performance Value) or Ebt (Energy Breakopen threshold). The final result of an Arc Flash rating is generally a number between 8 and 100. The higher the number, the greater the protection. An HRC (Hazard Risk Category) is another more simplified way to categorize Arc Rated clothing. Categories 1 – 4 are used, and as with an Arc Rating better protection is assigned to higher categories/higher HRC.

Today's testing lasted approximately 6 hours and while the official Arc Flash rating for our PPE will not be available for a couple of weeks, we are told it looks to be CAT 4, with an Arc Rating of 62-72cal. This chart below offers a look at the value of our rating.

Arc Hazard Risk Category	Arc Thermal Performance Value Expressed in Calories of Energy Protection
Category 1	8-12
Category 2	12-20
Category 3	20-40
Category 4	40+

The mannequin test is an option that allows for more realistic testing and positioning of fabric and accessories such as SCBA mask, helmet, etc.



*Figure 2: Simulated arc flash. PPE is subjected to 80KA for 70cycles/1.3seconds*



*Figure 1: SFD Structural PPE with Facepiece, Flash Hood and Helmet. Metal rods in the foreground create the electrical arc flash.*

The effects of the arc flash on the PPE is clear, but recall that the point of the test is to see how the person's skin is affected, not how the gear looks after the test. This test shows damage to the PPE, but as you will see below, the undergarment is minimally affected. This is considered effective protection for this test and provides an initial Arc Flash rating of 62-72 cal. For comparison, the average amount of energy absorbed by your structural PPE in a flash fire is around 8 cal. This is considerably less than the average arc flash energy of 60 – 90 cal. The difference is in the duration of thermal energy.



*Figure 3: Effect of Arc Flash on PPE. The front of this coat is unaffected.*



*Figure 4: Same coat as in figure 1&3. This would be considered successful arc flash protection*



*Figure 5: Minimal impact on member's uniform underneath the PPE*