



Arc Flash Protection



Mini-Documentary: [Andrey's Arc](#)

Andrey Valentinovich Krasnov, the Russian electrical worker featured in the mini-documentary, “Arc Flash Protection” survived one of the most potentially deadly hazards in the work world, an arc flash.

An electric arc is a continuous electric discharge of high current between conductors, generating very bright light and intensive heat. An arc flash is the consequence of an electric arc, which can occur where there is sufficient voltage in an electrical system and a path to ground or lower voltage. It is usually caused by a short circuit of energized conductors. The arc blast presents a very serious and potentially fatal hazard because of the risk of severe burn injuries caused by intensive heat, up to 20,000°C.

**5 to 10
arc explosions
requiring worker
hospitalization
occur every day
in the US.**

Source: CapSchell, Inc.

Thankfully, Andrey was wearing protective garments made with DuPont™ Nomex® materials designed specifically for this type of incident. When exposed to the intense heat typical of electric arc, Nomex® carbonizes and thickens. This increases the protective barrier between the heat source and the wearer’s skin and helps minimize burn injury.

DuPont™ Nomex® is inherently flame-resistant, will not melt or drip, and does not support combustion in the air, thus providing excellent arc flash protection. Plus, because the protection is woven right into Nomex® garments, it cannot wear off or wash out over time.

The Nomex® materials used in Andrey’s garments undergo extensive testing under highly demanding conditions. As part of their ongoing commitment to innovation and collaboration, DuPont scientists work with their customers to develop, test and improve the arc flash protective properties of Nomex® fabrics. In Switzerland,



DuPont operates the European Technical Centre, home of the leading-edge DuPont™ Arc-Man® test, to simulate electric arc incidents in a controlled environment. The DuPont™ Arc-Man® enables manufacturers and end-users to test, assess and compare the protection that various materials provide against the thermal effects of an electrical arc. With its real demonstrations, DuPont™ Arc-Man® also helps raise awareness on the devastating effects that an electric arc could have on workers if not properly protected.



Arc-Man Demonstration

How Garments Are Rated for Arc Protection

The arc flash rating is most commonly quantified by the Arc Thermal Performance Value (ATPV), which represents the maximum incident thermal energy in units of energy per surface area (e.g. kJ/m² or cal/cm²) that a fabric can support before the wearer will suffer 2nd degree burns.

The energy break-open threshold (EBT), another fabric characteristic, represents the highest incident energy exposure value on a fabric where the garments do not exhibit break-open. The formation of holes in the fabric caused by break-open would allow heat or flames to pass through. Workers are assumed safe if the arc rating of their clothing (or ATPV value) exceeds the electric arc incident energy as calculated in the worst case scenario of a risk assessment.

The box test is another way to measure the protective performance of clothing against the thermal effects of an electric arc. In this test, the fabric is exposed to an electric arc confined in a specific box with a specific electrode arrangement.

A fabric passes the test if:

- the heat transferred behind the fabric does not cause second degree burns;
- the after flame time is below 5 seconds;
- there is no melting to the inner side of the fabric; and
- a hole caused by the arc is not larger than 5 mm in every direction (in the inner most layer).

At the DuPont European Technical Centre, the Arc-Man® equipment measures the ATPV of protective fabrics and garments in simulated open-electric arc incidents. It exposes the materials to energy levels of up to 70 cal/cm² (continuous exposure to 1.2 cal/cm² may be enough to cause a 2nd degree burn on human skin generated by an open arc) and temperatures up to 20,000°C.

Incident energy is calculated based on several parameters influencing an electric arc, such as current, duration of the arc, electrode material, the gap between the electrodes and the distance of the tested fabrics or garments to the arc.

Arc-Man® can test fabrics on panels, measuring the ATPV value of the fabric system (in cal/cm²) so that it can be compared with the incident energy calculated in the end user's risk assessment. Arc-Man® can also perform complementary garment tests on a torso to show the effect of a garment's design and integrity of manufacture, allowing an assessment of the garment's behavior (e.g., of the closure system, the pockets, etc.). The box test can also be performed at the DuPont™ Arc-Man® testing facility.