

Face shields: When you're face to face with arcing hazards

By Hugh Hoagland

Every utility mandates the wearing of safety glasses whenever there is a danger from electric arcs. Real-life arc data support that work rule. Some utilities also recommend or require a face shield for some electric arc conditions, but few workers choose to wear them. There are two problems: Wearing the face shield is uncomfortable and there is a concern that a face shield may increase the hazard. Many workers are under the impression that the face shield provides little protection or possibly makes the injury worse. Initial testing by a couple of utilities showed a chimney effect from the face shield when worn alone. This effect was captured in video footage, but has not been substantiated by calorimeter data.

For quite some time, OSHA has had a rule that provided for eye or face protection from electric arc and electrical explosion. OSHA 29 CFR 1910.335(a)(1)(v) states: Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion. There was, however, no reiteration of this provision in the more recent OSHA Standard 1910.269.

Electric arc protection in recent years has focused on clothing. Much effort has been applied to determining weights and construction of natural fibers that resist ignition and on various types of flame-resistant clothing. Most electric utilities that have completed electric-arc hazard

assessments have found that, in some parts of their systems, workers need more than single-layer clothing protection and that electric arcs in these locations pose extreme hazards to the eyes and face.

Not just any old face shield

The good news is that face shields are generally protective of arc hazards. The bad news is that the level of protection offered by a clear face shield is quite limited. In the case of instantaneously cleared arcing

faults below 4 kA, the clear face shield provides minimal protection from second degree burns. But don't take this as a general condemnation of face shields.

At any energy level, face shields can help protect workers from much of the flying metal and molten metal particles produced by the arc (photo). At low arc levels, workers using clear face shields are exposed to burns at about the same rate as they would be with unprotected skin, but at higher arc levels with longer clearing times,

even the clear face shields afford some protection from thermal energy. Up to 30% of the energy can be prevented from reaching worker's skin if the clear face shield is worn with a hood assembly. (This figure is based on data from Oberon Co, New Bedford, MA published by IEEE in 1997 and on-data I performed for Steel Grip Inc, Danville, IL).

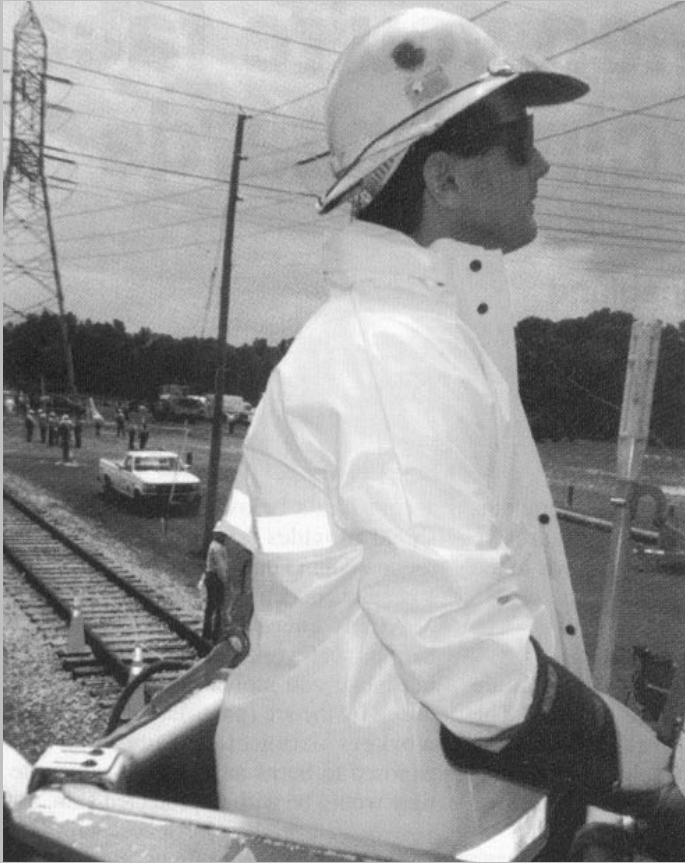
However, even with 30% of the energy blocked, a worker can still experience second or third degree burns. Gold-impregnated face shields offer six times the protection of clear face shields, according to testing conducted by both Oberon and Steel Grip. A No. 5 shade-equivalent to very dark sunglasses-offers three times the protection, according to Oberon's test data. A face shield offers even more protection when worn with a hood assembly. The No. 5 shade tested by Steel Grip is equipped with a hood of 10oz. Nomex® (made by DuPont Co, Wilmington, DE) and provides 30 times the protection of the clear shield.

Obviously, the No. 5 shade is not practical for many



For severe arcing conditions, complete switchwear, faceshield, and hood are prudent requirements. This face shield is supplied by Steel Grip Inc, Danville, IL.

Warning: Your rainwear may not provide adequate arc protection



The ASTM F-18 Committee on Electrical Protective Equipment, for Workers passed a new consensus standard on March 25 for exposed to, electric arc. This standard specifies a mannequin which rainwear breaks open when exposed to at, momentary electric arcs or open flame, in accordance with Since January 1997, there has been no applicable standard for testing arc resistance stance of rainwear, because ASTM, F-18 determined that much of the so-called flame-resistant (FR) rainwear performs very poorly under electric arc conditions.

Much of the rainwear sold in the US and Canada with an FR label only passes a Federal Test Method Standard (FTMS 191A-5903) which easily passes rainwear with melting characteristics, Much of that rainwear, when exposed to electric are , melts, drips, and splatters, greatly increasing the risk of severe injuries., The other problem with this type of rainwear is that it breaks, open, exposing the clothing under lf to the electric arc. If that clothing is not flame resistant, ignition can result, with dire consequences. Word from federal OSHA may be forthcoming, but, prudent electric utilities should examine rainwear their workers are wearing now, to be certain it complies with the current OSHA standard, using the new ASTM, standard as a guide. Market estimates indicate that over 50% of the electric utility workers in the US are Wearing rainwear that does not comply with the new ASTM standard.

Rainwear must protect from more than rain. Much of the rainwear now on the market may increase injuries in the event of an electric arc by melting or breaking open This raingear from, of NASCO Inc, Washington, IN, is made of PVC, Nomex® and Kevlar®

How much protection from arcs do face shields provide?

Face shield type	A 50% probability of second degree burn	Percent of energy prevented from reaching mannequin face	Material response
No face shield	1.2 cal/cm ²	0	N/A
Clear, polycarbonate, 80 mil, UV filters	1.2 cal/cm ²	Low-level arcs <20 Higher level arcs >50	Did not melt at 50 cal/cm ²
Gold reflective, polycarbonate, 80 mil, UV filters with hood assembly	7.3 cal/cm ²	Higher level arcs >80	Did not melt at 50 cal/cm ²
Shade No. 5, propionate shade with hood assembly	>30 cal/cm ²	>80%	Did not melt at 50 cal/cm ²
New slightly shaded face shields	>45 cal/cm ²	>80%	Did not melt at 50 cal/cm ²

Author Note: Table updated with new information since publication

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applications, but the tests show that there are options for protection. The decreased visibility of the gold and No. 5 shields may be a worthy sacrifice at some arc-hazard levels.

Where are face shields needed?

Network systems offer ground fault potential of up to 200,000 amp with long clearing times. Workers in these situations are required to wear flame-resistant, multi-layer clothing to ensure that their clothing does not contribute to any injuries. But if nothing is done to protect the face, a 50 cal/cm² arc, which might not kill the properly clothed worker, will still severely bum the eyes and face. Some utilities have chosen to require that face shield, hood assembly, and switchwear are worn in network faults until energized parts are either covered or de-energized and grounded. This practice compromises worker comfort, but is well worth the extra safety. Motor control centers and substation switching are other high amperage applications in which some utilities are using face shields, hood assemblies, and switchwear to offer additional protection to workers.

Eyeglasses are a given for eye protection. Numerous electric utilities have a firm belief in wearing safety glasses. Much anecdotal evidence is available that safety glasses can save eyes when workers are exposed to electric arc. Test data are also beginning to show that there are work situations where face shields alone or in conjunction with a hood assembly give more protection than previously thought possible. So if your company is looking at hazard assessments, considering a clothing policy, or simply looking for ways to increase safety, consider face shields and hood assemblies for your worst electric arc hazards. Many utilities are making them available for network and switching work. Look for some interesting developments in design and protection in the next year. **EW**

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Factors to consider

In assessing whether or not to use a face shield in a particular task, consider the following criteria:

1. Arc test data available to determine, at a minimum, that the face shield chosen will not melt or disfigure under the potential arc conditions? Tests should be performed at 40 cal/cm² or higher.

2. Protective value of the face shield. There is no ASTM standard for this determination, but a good rule of thumb from existing data is shown in the table (*Author note: a new standard test method is in development in ASTM*).

3. Are hazards increased by the face shield itself because of fogging, decreased peripheral vision, increased heat, or discomfort?