

# Arc flash safety and thermal imaging

## Application Note

By Jim White, Shermco Industries

Talk to any thermographer and he/she will tell you how much wearing arc-rated PPE (personal protective equipment) and equipment slows them down and makes the job “impossible.” At Shermco Industries we have nine thermographers, so we are well acquainted with the issue—very well acquainted.

During committee meetings for the 2004 edition of the NFPA 70E, we discussed the various aspects of performing a thermal scan of energized equipment. At that time we concluded that the arc flash really doesn’t care what task you’re performing; it’s going to be as hazardous with one as it is with the other.

In the 2004 edition of the 70E, thermal imaging is treated as any other task that is worked on or near exposed, energized conductors or circuit parts. In the NFPA 70E we state that the worker must be protected to the level required for the hazard (see sidebar). This could place the thermographer in PPE from HRC0 to HRC4, depending on the hazard.

Figure 1 shows HRC4 PPE and equipment. In a paper presented to the 2008 IEEE/IAS/ Electrical Safety Workshop, Vladimir Ostrovsky noted that such equipment (specifically the hood) reduces oxygen to the wearer, increasing feelings of claustrophobia and difficulty in “catching your breath.”<sup>1</sup> This, combined with the limited light

transmission through the viewing window, makes using a thermal imaging camera difficult while wearing HRC3 and HRC4 PPE.

During the 2009 edition reviews, several proposals were made by personnel and companies that perform thermal imaging and the 70E Committee reconsidered their approach to the problem. Among the considerations discussed were:

- Would the thermographer remove the covers on the energized equipment or would someone else perform that task?
- Would the thermographer break the plane of the enclosure?
- Was there any chance of contact or components/parts falling into the energized equipment?
- How close would the thermographer be to the potential arc source?
- Is the person doing the thermal scan a qualified electrical worker, according to OSHA and the NFPA 70E?



Figure 1. HRC4 Arc-Rated PPE, before and after an arc flash.

## Reduced PPE requirements for thermographers

Based on the input of the writers of the various proposals we received, the 70E Committee came to the conclusion that a worker performing thermal imaging would be allowed to reduce the level of protection required by one number (example – HRC3 to HRC2) if they meet all of the following conditions:

- (1) They were not involved in removing panel covers (those personnel removing covers would be required to wear full arc-flash protective PPE and equipment),
- (2) they did not break the plane of the enclosure,
- (3) the tasks would be completely non-intrusive to the equipment,
- (4) the worker would stand as far from the energized equipment as possible and
- (5) he or she was a qualified electrical worker.

Figure 2 is an excerpt from Table 130.7(C) of the NFPA 2009 standard Tasks for Thermal Imaging.

These adjustments are certainly not going to appease everyone, and the 70E Committee is well aware of that.

The problem is that when there are defects that are apparent using thermal imaging, there is also a very real probability of equipment failure. When that equipment may fail is a question no one is able to answer. I have witnessed equipment in (what seemed like) good condition fail violently, throwing molten metal and parts several feet away. Molded-case circuit breakers are some of the worst offenders, since they can't be internally inspected if they are of the sealed-case type. Even if they can be serviced, such as with insulated-case circuit breakers, they are often not included in electrical maintenance programs.

## Summary

Whether to wear arc-rated PPE is not a personal decision. OSHA 29CFR1910.335(1) directs employers to supply PPE and for employees to wear the supplied PPE if hazards exist. A Hazard/Risk Analysis can indicate whether such PPE is needed and needs to be properly documented. Consider this: What would your life be like after a serious arc-flash incident? How would your family and friends be affected? How would your life change if you were disfigured or disabled?

It is the sincere wish of the NFPA 70E Committee (and myself) that no one be in a position to answer these questions due to an electrical mishap. If it is truly not practical to wear the needed PPE, or if there is simply no available clearance, viewing windows should be considered.

Tasks Performed on Energized Equipment	Hazard/Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
<b>Panelboards or Other Equipment Rated 240 V and Below – Note 1</b>			
Perform infrared thermography and other non-contact inspections outside	0	N	N
<b>600 V Class Switchgear (with power circuit breakers or fused switches) – Note 4</b>			
Perform infrared thermography and other non-contact inspections outside	2	N	N
<b>Metal Clad Switchgear, 1 kV Through 38 kV [ROP 297b][ROC 549]</b>			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	3	N	N

Figure 2. NFPA 70E 2009 Insertions for Thermal Imaging.

Jim White is the Training Director for Sherco Industries in Irving, Texas and a level IV NETA technician. Jim represents NETA on NFPA 70E and B committees, as well as the Arc Flash Hazard Work Group, and is Chairman of the 2008 IEEE Electrical Safety Workshop.

1. Ostrovsky, Vladimir, W.H. Salisbury and Company, "Advancements in Electrical PPE for the Worker", presented to the 2008 IEEE/IAS/Electrical Safety Workshop.

2. National Fire Protection Association, 2009 70E, Standard for Electrical Safety in Employee Workplaces.

## NFPA 70E (2004 and 2009 edition) PPE Requirements

No way, José! That's often what we hear from thermographers about wearing arc-flash protective PPE when we conduct qualified electrical worker training. Unfortunately, there are many thermographers who do not understand the hazards they face. This lack of understanding the hazards would cause them to be considered "unqualified" as electrical workers by OSHA, regardless of their experience.

The 2009 of the NFPA 70E provides guidelines for electrical protective PPE and equipment. Article 130.3 states, "A flash hazard analysis shall determine the Arc Flash Protection Boundary and the personal protective equipment that people within the Arc Flash Protection Boundary shall use."

### Article 130.7 has numerous requirements, including, (C) Personal Protective Equipment.

**(1) General.** When an employee is working within the Flash Protection Boundary he/she shall wear protective clothing and other personal protective equipment in accordance with 130.3. All parts of the body inside the Arc Flash Protection Boundary shall be protected.

**(2) Movement and Visibility.** When flame-resistant (FR) clothing is worn to protect an employee, it shall cover all ignitable clothing and shall allow for movement and visibility.

**(3) Head, Face, Neck, and Chin (Head Area) Protection.** Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with energized electrical conductors or circuit parts or from flying objects resulting from electrical explosion. Employees shall wear nonconductive protective equipment for the face, neck, and chin whenever there is a danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosion. If employees use hairnets and/or beardnets, these items must be non-melting and flame resistant.

**(4) Eye Protection.** Employees shall wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

**(5) Body Protection.** Employees shall wear FR clothing wherever there is possible exposure to an electric arc flash above the threshold incident-energy level for a second-degree burn, 5 J/cm<sup>2</sup> (1.2 cal/cm<sup>2</sup>).

### **(6) (a)(b)(c) Hand and Arm Protection from Shock.**

Employees shall wear rubber insulating gloves where there is danger of hand and arm injury from electric shock due to contact with energized conductors or circuit parts. Rubber insulating gloves shall be rated for the voltage for which the gloves will be exposed. Hand and arm protection shall be worn where there is possible exposure to arc flash burn. The apparel described in 130.7(C)(13)(c) shall be required for protection of hands from burns. Arm protection shall be accomplished by apparel described in 130.7(C)(5). Electrical protective equipment shall be maintained in a safe, reliable condition. Insulating equipment shall be inspected for damage before each day's use.

**(7) Foot Protection.** Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as primary electrical protection.

### **(8) Standards for Personal Protective Equipment.**

Personal protective equipment shall conform to the standards given in Table 130.7(C)(8).

I've been told (over and over and over) how the 70E is difficult to understand and even more difficult to implement. I think the intent in the articles above are very clear and the OSHA requirements, which are federal law, are just as clear. We need to take the time to read them carefully and, if that is not adequate, attend a training program where the instructor is qualified to explain them. The new edition (2009) is well worth the small asking price.

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