Hand Protection for Electrical Safety

Protective gloves are PPE's first line of defense against low-voltage industrial accidents.

by Lisa Rizzo and Vladimir Ostrovsky

In the realm of personal protective equipment, protective gloves offer the first line of defense against an array of hazards. Most often, they are used to protect the hands against scrapes, cuts, chemical, biological, and electrical hazards--with the goal of avoiding or limiting damage to the fingers, hands, wrists, and lower arms. In some instances, the correct hand protection also helps to guard against death.

When it comes to protecting your hands, there is a great variety of gloves for different applications. For simplicity, the typical categories of glove applications are disposable, chemical-resistant, general-purpose, cut-resistant, and specialty. However, there is another group of gloves that should not be overlooked: electrical insulating gloves. OSHA requires use of these gloves in high- and low-voltage applications for those working on or near energized circuits.

While one immediately thinks of electrical insulating gloves for utility workers, there seems to be a lack of general awareness of the need for electrical safety products within many other industries until there is an "incident." However, there are many resources and products available to provide workers with the proper protection.

Types of Electrical Hazards

Electrical shock, arc flash, and arc blast are hazards associated with working on or in close proximity to energized equipment. All three types can and do occur in industrial facilities--where low-voltage equipment (generally defined as under 600 volts AC) is typically in use--as well as in high-voltage electrical utility plants.

OSHA regulations require that all insulating gloves be electrically tested every six months. Several labs in the United States perform the required testing.

Current that travels through a person's body when it becomes part of an electrical circuit, not voltage, causes damage to internal and external organs and, frequently, death. The effect on a person depends on the amount of current (measured in milliamps or amps) flowing through the body, the current's path through the body, and the length of time the body remains in the circuit. The effect can range from mild tingling sensations to heart paralysis and severe burns of tissue and organs, often resulting in death.

Rubber insulating gloves form the first line of defense to protect against contact with any energized components or electrical lines. Of course, they are only one component of the protective equipment necessary to guard against electrical hazards. Other equipment includes insulated tools, flame-resistant clothing, rubber blankets, and dielectric footwear. This is in addition to any other normally used personal protective equipment, such as a hard hat, fall protection, protective eyewear, and hearing protection. Insulating roll blankets that can be cut to fit each job assignment also reduce risk. Hot sticks should be used for operating switches or handling conductors and static discharge sticks for safely dissipating static or stored energy. Voltage detectors, grounding equipment, and insulated rescue hooks to pull an injured worker from a hazardous area are essential to proper personal protection from electrical hazards.

Many people believe they are safe from electrical hazards if they simply do not touch an electrical circuit. In fact, the majority of the electrical injuries are burns resulting from an arc flash and ignition of flammable clothing.

An electrical arc flash creates a blast, known as an arc blast, which can cause additional damage to people and property through exploding equipment and a high-velocity blast of fragments and molten metal. Such blasts can result even from low-energy arcs in plants that contain flammable gases or vapors or combustible dusts, according to an OSHA booklet entitled "Controlling Electrical Hazards" that was revised and published by the U.S. Department of Labor in 2002 (OSHA 3075).

Regulatory Standards

The first step in electrical safety awareness is understanding the regulations. The three applicable standards are OSHA 29 CFR 1910 Subpart S-Electrical, NFPA 70E-2000 edition, and NEC 2002.

Accessing these standards is easy. OSHA's 29 CFR is available on the Web site of the Occupational Safety and Health Administration, www.osha.gov. The NFPA 70E-2000 *Standard for Electrical Safety Requirements for Employee Workplaces* may be purchased through the National Fire Protection Association's Web site, www.nfpa.org. This consensus standard provides guidance specifically for industrial electricians working with energized equipment. The National Electrical Code® (NEC®) also is available at www.nfpa.org.

In addition, the OSHA booklet mentioned above is a helpful reference for employers and a great resource for use in motivating and training workers to understand and combat electrical hazards.

Hand Protection for Low-Voltage Applications

As previously mentioned, rubber insulating gloves are among the most important articles of PPE for electrical workers. Hazards above 50 volts are recognized by OSHA in 1910.303 (g) (2). OSHA 1920.269 (1) (2) (I) states that employees must avoid contact above 50 volts AC unless they are insulated with rubber gloves meeting the ASTM D120 standard (per OSHA 1910.137 (a)).

It is important to train workers to select gloves rated for their particular applications. For example, gloves may be selected that meet ASTM D120 standards for protection against circuits up to 500 volts AC (Class 00) or for protection against circuits up to 1,000 volts AC (Class 0). Similarly, gloves also are rated for use in applications where protection against higher voltages is required. Class 1 gloves can be used up to 7,500 volts AC, Class 2 up to 17,000 volts AC, Class 3 up to 26,500 volts AC, and Class 4 up to 36,000 volts AC.

Cotton glove liners may be used inside to absorb perspiration and to improve wearer comfort. Wool and thermal liners also are available for use in cold outdoor applications. Various styles of liners are offered by glove manufacturers.

Leather protector gloves should be worn over electrical insulating gloves to provide needed mechanical protection against abrasion or cuts. Even a small puncture in an electrical insulating glove will allow electrical current to reach the hand. Before purchasing a protector glove, make sure it complies with ASTM F696, which is required by OSHA. Also, it is important for the purchaser of the protector gloves to ensure there is enough clearance between the top of the protector gloves' cuffs and the top end of the beads of the rubber insulating gloves. ASTM F696 outlines specifications for the minimum clearance distances required.

OSHA regulations require that all insulating gloves be electrically tested every six months in accordance with OSHA 29 CFR 1910.137. There are several labs in the United States that perform the required testing. Glove manufacturers usually can assist with finding a test lab to meet your needs. In addition, gloves must be visually inspected before each use to check for tears, rips, and punctures. Portable glove inflators are available to simplify visual inspection.

Selecting Proper PPE

NFPA 70E provides guidance for selecting gloves and other personal protective equipment. Two methods are specified: 1) performing an arc flash hazard analysis and documenting the incident energy exposure, and 2) alternatively, using the "Hazard Risk Category Classifications" table to choose the PPE level required for the task.

In the first case, the analysis involves determining plant operating modes, finding bolted short-circuit values, finding distance between phases, finding arc clearing times, determining working distance, and calculating the incident energy and the flash boundary. Software is available to assist with this analysis. Flame-resistant (FR) clothing and PPE, based on the incident energy exposure associated with the specific task, must be used by employees (OSHA 1910.269 (l) (6)).

As an alternative to a detailed flash hazard analysis, the PPE requirements of NFPA 70E Part II 3-3.9 may be used. As a rule, for most low-energy work at 240 volts or below, natural-fiber, non-melting clothing is adequate. Some higher-risk tasks require FR clothing.

Most work on or near systems rated 480 volts and above requires at least one layer of FR clothing worn over natural-fiber clothing. High incident-energy tasks require FR flash suits and flash hoods. While insulating gloves and FR clothing with specific ratings matched to the application are vital to protection from electrical hazards, it is incumbent upon employers to first consider alternatives that reduce or minimize electrical hazards. The first and best alternative is to always work on de-energized equipment or circuits that are equipped with locked out, tagged out devices. In addition, a safety program that educates and motivates workers to avoid the hazards is essential.

Most work on or near systems rated 480 volts and above requires at least one layer of FR clothing worn over natural-fiber clothing.

Electrical Safety Program

Employers--in addition to ensuring electricians are equipped with the proper protective clothing and equipment--should design an electrical safety program to make other employees aware of the electrical hazards that may be encountered in their plant. The program should cover electrical safety work practices for both qualified persons (those trained in avoiding the electrical hazards of working on or near exposed, energized parts) and unqualified persons. In addition, those escorting visitors within a plant should be trained to explain the necessity of strictly obeying warning signage and staying outside flash protection boundaries.

As well as motivating people to comply, partly by thoroughly explaining the risks, employers also should explain basic procedures to follow should an accident occur.

While protective gloves offer a first line of defense against electrical hazards, a full range of protective equipment, dielectric tools, lockout or tagout devices, and other safety equipment and safety procedures are necessary to minimize the danger of many low-voltage electrical hazards.

Lisa Rizzo, Q.S.S.P., is Product Manager-Hand Protection for North Safety Products, a major manufacturer of safety products that is based in Cranston, R.I. Vladimir Ostrovsky is national trainer-electrical safety/Midwest regional manager for W.H. Salisbury. He is a member of the American Society for Testing and Materials, a member of the National Fire Protection Association, a committee member of NFPA 70B, and a trainer for the National Joint Apprenticeship and Training Committee of the National Electrical Contractors Association and the International Brotherhood of Electrical Workers.