



**OSHA**

**NEC<sup>®</sup>**

**NFPA  
70E**

• by Jim Phillips, P.E.

**Fitting the puzzle  
pieces together  
to provide  
worker safety**

The next time you are near the bulletin board at work, look for the poster that has the words "It's the Law" and "OSHA" on it. It has probably been hanging there for a very long time but most people never really notice it or seem to read it. Further down on the poster is the statement "each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees. This statement is known as OSHA's General Duty Clause and is at the heart of linking many of the other standards to OSHA.

What exactly does "It's the law" mean? OSHA standards dictate the requirements of worker safety including everything from scaffolding to confined space, but what does it tell us about electrical safety? How does the general duty clause make other electrical standards such as the *National Electrical Code*<sup>®</sup> (NEC<sup>®</sup>) and NFPA 70E fit into this safety puzzle?

There are so many codes and standards for electrical safety it seems that the requirements become more complicated with each standard's revision. At the center of all the safety standards is OSHA CFR, Title 29, which includes Part 1910 Subpart S, and Part 1926 Subpart K for electrical safety. OSHA standards tend to define safety requirements in more general terms and rely on other industry standards, such as NFPA 70E - 2004 *Standard for Electrical Safety in the Workplace* and NFPA 70 - 2005 *National Electrical Code*, to define the details. These two standards provide specific requirements for electrical safety such as safe installation, maintenance and work practices, the use of signs warning about arc flash, and the detailed selection process for personal protective equipment (PPE).

Each of these standards is directly or indirectly related to each other and to the OSHA standards with language commonly taken verbatim from one standard and used in another. As an example, Chapter Four of NFPA 70E contains many of the same articles and language found in the NEC. These standards all appear to be interlocked with each other like pieces of a puzzle. Let's see how all of these pieces fit together to form the "big safety picture" by looking at a typical scenario that shows the role of each standard.

### Routine Maintenance With Catastrophic Results

It started as a simple component failure in the control circuit of a motor control center. The failure brought production to a grinding halt and a plant electrician immediately responded to replace the faulty part. To save time, he decided to remove it while the equipment was still energized. He thought this should have been a routine replacement, however, as he removed the failed component it made contact with a live conductor on the 480 Volt power circuit and a tremendous arc flash resulted, sending him to the hospital with severe burns.

When an accident like this occurs, OSHA would likely make an investigation of the event and of the employer's facility to determine what happened. Depending on the results of the investigation, OSHA could ultimately issue a citation to the employer. The arc flash hazard that occurred in this case, was first identified in the 1995 edition of NFPA 70E and acknowledged by OSHA. Failure to use the correct safety practices in dealing with this recognizable hazard would be a violation of OSHA's regulations. Under OSHA's General

**You Have a Right to a Safe and Healthful Workplace.**

# IT'S THE LAW!

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthy conditions in your workplace. You or your representative may participate in the inspection.
- You can file a complaint with OSHA within 30 days of discrimination by your employer for making safety and health complaints or for exercising your rights under OSHA Act.
- You have a right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violation.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records or records of your exposure to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.

**1-800-321-OSHA**  
**www.osha.gov**

U.S. Department of Labor • Occupational Safety and Health Administration • OSHA 3094

Posters like this one informing employees of their rights to a safe working environment under the law must be prominently displayed in the workplace.



**Although employers are required by OSHA to provide a safe workplace, employees must do their part by adhering to the requirements of standards such as NFPA 70 and 70E.**

Industry Standard 1910.335, there are specific requirements regarding worker protection from an arc flash that were not used in this case.

A similar situation could arise with OSHA's Construction Standard Part 1926 Subpart K. Although the construction standard does not specifically reference arc flash, it could be addressed under the General Duty Clause which requires an employer to provide an employee with a workplace free from recognized hazards.

### **The Workplace Was More Dangerous in 1970**

Let's step back 35 years to 1970 when the workplace was much more dangerous. Based on OSHA statistics there were 14,000 worker deaths a year from job related accidents. Close to 2.5 million workers would become disabled that year and cases of occupational diseases totaled 300,000. It was pretty clear that something had to be done about these grim statistics. To address worker deaths, disease and disabilities, the United States Congress passed the Occupational Safety and Health Act

of 1970 (Act), which led to the formation of the Occupational Safety and Health Administration (OSHA). The Act covers all employers and employees in the United States and its territories. There are exceptions for self-employed people, farms that have only family members working, and situations where there is regulation by other federal agencies under other federal statutes. There are also OSHA regulations that provide individual states with the capability of developing state safety and health standards.

OSHA, Title 29, Code of Federal Regulations, addresses safety issues for everything from scaffolding to ergonomics, job related disease, construction, and yes, electrical safety. Electrical safety rules are divided into four categories and can be found in two separate parts of the regulations:

#### **Part 1910 Occupational Safety and Health Standard, Subpart S - Electrical**

- Design Safety Standards
- Safety Related Work Practices
- Safety Related Maintenance Requirements (future)
- Safety Requirements for Special Equipment (future)

#### **Part 1926 Safety and Health Regulations for Construction, Subpart K – Electrical**

- Installation Safety Requirements
- Safety Related Work Practices.
- Safety Related Maintenance Practices and Environmental Considerations
- Safety Requirements for Special Equipment

Part 1910 is for general industry and Part 1926 is for the construction industry. Characteristic of OSHA standards, they provide more of the general requirements for electrical safety and often do not give specific detail of how to achieve a specific requirement. The details are left to national consensus standards such as NFPA 70 *National Electrical Code* and NFPA 70E *Standard for Electrical Safety in the Workplace*.

According to OSHA 1910.2(g), a national consensus standard is any standard that has been adopted by a nationally recognized standards-producing organization and was developed and approved with the input of a broad cross section of people affected by the standard. NFPA and other consensus documents would fall into this category, as well as other standards like ASTM and ANSI.

Because it is a federal standard, OSHA regulations are enforceable under federal law. This is why "It's the Law" appears on the OSHA poster. As consensus standards, NFPA standards are not federal standards, however, they are used as part of electrical safety practices and can be referenced as part of an OSHA citation.

To ensure better safety for workers, OSHA has become increasingly more aggressive in its enforcement actions. As of 2004 it has an authorized staff of 2,220 with 1,123 inspectors, and as a result of OSHA standards and enforcement practices, worker deaths reported in 2002 were down by approximately 60 percent to 5,524.

### OSHA's General Duty Clause

When OSHA does not provide specific language for a recognized hazard, the General Duty Clause can be used. The General Duty Clause is found in Section 5(a)(1) of the Occupational Safety and Health Act of 1970, and requires that "each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees."

This clause is the main link between OSHA and other standards such as NFPA 70 and NFPA 70E. "Recognized hazards" can be those hazards that are identified by other industry codes and standards.

would be incorrect. The details of how to select PPE are left to other standards such as NFPA 70E.

### OSHA and NFPA 70E

In the early days of OSHA, the *NEC* was adopted as part of the OSHA standards as the rules for electrical safety and it seemed like a logical approach. However, in subsequent years, procedures dictated by Section 6(b) of the OSHA Act made this practice almost impossible. Section 6(b) requires OSHA to provide public notice, an opportunity for public comment and public hearings as part of adopting or modifying a standard. Using these procedures every time OSHA needed to adopt the latest *NEC* would become a long and intensive process.

Another potential problem with adopting the *NEC* is that OSHA regulations address safety issues regarding the employer and employee in their workplace. The *NEC* addresses the protection of people and property from the hazards of using electricity and although there are many articles related to worker safety, its use is intended primarily for those who design, install and

## To ensure better safety for workers

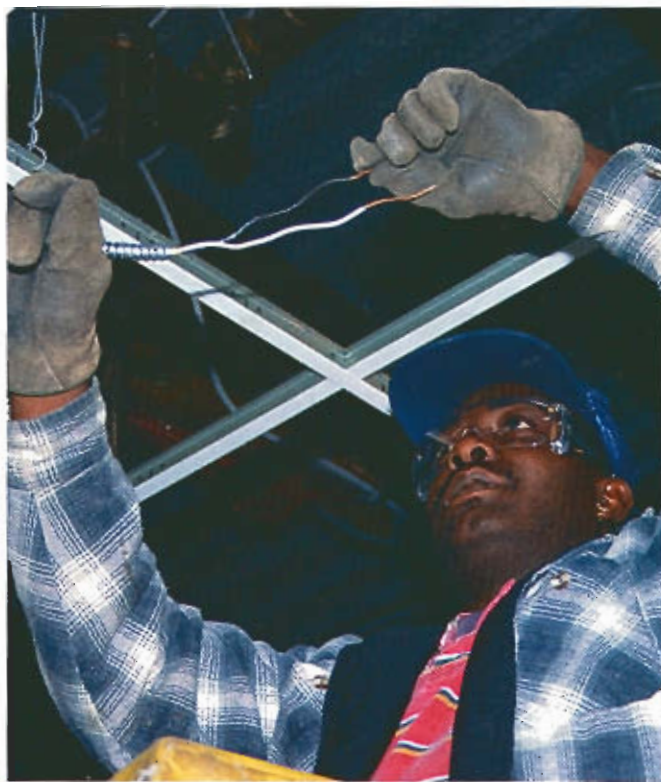
**OSHA has become increasingly more aggressive in its enforcement actions.**

NFPA 70E and other related industry consensus standards have been used to demonstrate whether an employer acted reasonably when there is a possible OSHA enforcement action taken. So although NFPA 70E is not directly part of OSHA standards, it can be used as evidence of whether an employer acted reasonably in complying with OSHA standards and addressing "recognized hazards" based on the consensus community.

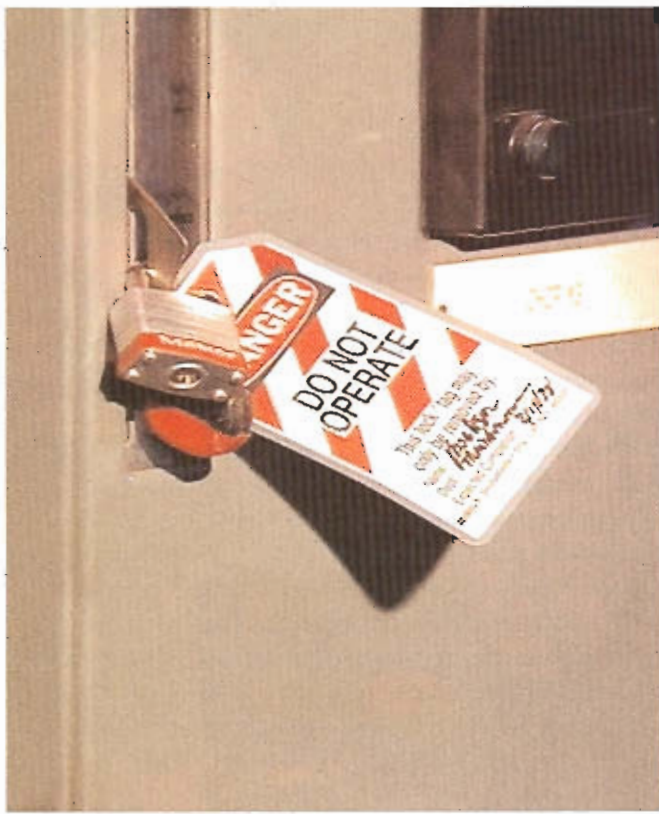
There are more specific links within the OSHA standards as well. A typical example is found in 1910.335, *Safeguards for personnel protection*, which requires:

*"(a)(1)(i) Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed."*

This regulation requires that employees must be properly protected from potential electrical hazards, by using adequate PPE, but it does not provide specific detail of what specific personal protective equipment is necessary to achieve the objective. It might be considered that based on this generalized statement, the selection of the correct PPE is open to interpretation. However, this



**The Occupational Safety and Health Act of 1970 covers all employers and employees in the United States and its territories with few exceptions.**



**Whenever possible, work should only be performed on de-energized equipment that has been locked out and tagged to prevent it from being accidentally re-energized**

For uniformity, the topics of the four chapters of NFPA 70E parallel the topics used in OSHA 1910 Subpart S and 1926 Subpart K.

NFPA 70E plays such a vital role with OSHA that in the preamble of the 1990 update of OSHA Subpart S, NFPA 70E was mentioned numerous times. In the 2000 edition of the OSHA regulatory agenda NFPA 70E was considered as a significant resource in the 2004 update to the OSHA Subpart S regulation.

### **How Does the NEC Fit Into the Puzzle?**

Not too long after Thomas Edison built the first commercial electric lighting and power generating station on Pearl Street in Lower Manhattan in 1890, the first electrical code was created to address concerns of safety. The NEC is the oldest of the electrical standards with its origin dating back to 1897, just 7 years after electricity became commercially available. In 1911 the NFPA became the sponsor of the NEC and has been responsible for it ever since.

The NEC differs from OSHA and NFPA 70E standards because much of its language relates to construction and installation practices including sizing, selection and installation of equipment and components. Although the Code is not intended to be a design standard, it is a

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inspect electrical installations. Many of the NEC articles do not directly address worker safety and the possibility existed that there could ultimately be a conflict between OSHA standards and the NEC or other standards.

In 1976, the NFPA formed a new electrical standards development committee at the request of OSHA to develop an electrical safety standard that would serve OSHA's needs. The new NFPA standard 70E-Standard for Electrical Safety Requirements for Employee Workplaces was first published in 1979 and originally contained only Part 1 – Installation Safety Requirements. Its creation was based on existing articles found in the NEC that are directly related to worker safety. Since its introduction in 1979, the standard has gone through many revisions and has evolved into its present format of four separate chapters including:

- Chapter 1 – Safety Related Work Practices
- Chapter 2 – Safety Related Maintenance Requirements

major requirement for the safe use of electricity. According to the NFPA “This Code is purely advisory,” however, most states and municipalities adopt the entire NEC and require electrical design and installation to be in conformance with its requirements.

NFPA 70E adopts the NEC language and many of the articles relating to installation safety requirements found in Chapter Four are based on articles in the NEC. In addition, many of the requirements related to personal safety found in the NEC are also found in OSHA standards.

As an example of where almost identical wording is used in the NEC, NFPA 70E and OSHA Part 1910 Subpart S, consider the depth of the working space in front of live parts. The NEC Article 110 Requirements for Electrical Installations Table 110.26(A)(1) Working Spaces defines minimum clear distances between working space and live parts. This same table is found in NFPA 70E as Table 400.15(A)(1) and it is also in OSHA 1910.303(g)(1)(i) as Table S-1.

## Best Electrical Safety Practice – De-energize

The best approach to electrical safety is to perform work only on de-energized equipment that has been properly locked out and placed in a safe condition. This should always be considered the ultimate safe work practice for electrical systems when it is possible.

NFPA 70E uses the same language in Chapter One, *Safety Related Work Practices*, as the OSHA regulations. It states that all equipment and circuits shall be de-energized before working on them unless the employer can demonstrate that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. This premise is the foundation for a workplace free of recognized hazards. When a worker does have to work on energized equipment or circuits, they shall analyze the hazard, provide a proper protective scheme, and train the worker in the safety related procedures and work practices necessary for their safety. According to NFPA 70E live work can only be performed by qualified individuals with a written permit and strict adherence to OSHA and the other consensus standards.

## Electrical Hazards In the Workplace

NFPA 70E not only incorporates sections from the NEC directly into its text, it also provides safe work practices after the installation has been completed. The dangers associated with working on live electrical equipment fall into two main categories. The first is the hazard of an electric shock that can cause the victim to stop breathing, go into ventricular fibrillation, and receive damage to internal organs. Most of the electrical safety standards have historically addressed this first category. The second category is the hazard created due to the explosion that can occur during an arcing short circuit, which can release a tremendous amount of energy. This energy, is defined in calories per square centimeter ( $\text{cal}/\text{cm}^2$ ), and can cause physical damage and death from severe burns caused by the extreme heat, blindness from the flash and molten metal, hearing loss, and other physical damage from the extreme pressure of the blast. The incident energy can be determined by calculations or table found in the 70E standard.

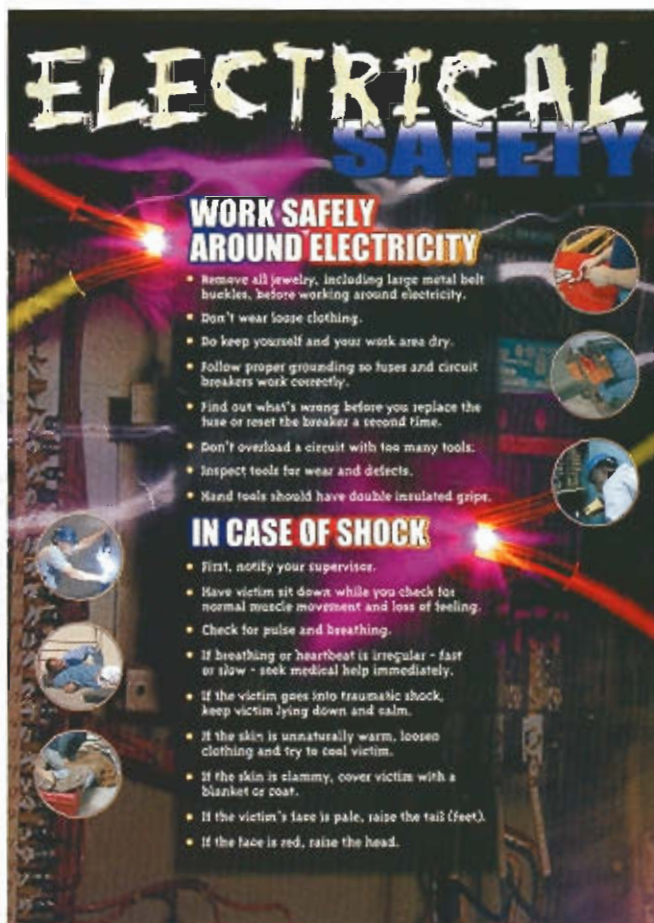
This incident energy level is then used to define what level of PPE is required for live work. Based on the calculated  $\text{cal}/\text{cm}^2$ , required PPE can range from safety glasses, gloves, long sleeve shirt and long pants to a full multi-layer flash suit, hearing and eye protection, foot protection and hard hat.

NFPA 70E defines the “flash protection boundary” as the minimum distance from an arc source where a person could receive a “curable” burn if there was an arc flash. The idea behind this boundary and the curable burn (defined as a second degree burn) is that a person

standing beyond this distance should survive without long term injury. Crossing the flash protection boundary requires the correct level of PPE based on the calculated incident energy at that arc source’s location.

## The Pieces Fit, Puzzle Solved!

So, here it is – the puzzle is solved! OSHA is at the center of all safety requirements in the workplace and is federally enforceable – “It’s the Law.” Safety violations are governed by the regulations of OSHA Title 29 CFR but, in many cases, OSHA only provides general rules regarding safety. Based on OSHA’s general duty clause, consensus standards such as NFPA 70E must be used for the details and are proof that an employer was being reasonable in providing a safe workplace. Although NFPA 70E was developed to specifically assist OSHA in the area of electrical safety, portions of the NEC are incorporated into NFPA 70E. Each of these pieces of the puzzle fits together to form the big picture in electrical safety. This strategy provides for a safe installation and safe work practices necessary for worker safety, and the NEC and NFPA 70E are a practical consensus-based solution to the OSHA regulations. ⚡



Attention-getting posters like this one, although not required by law, remind employees to practice safety and instruct them what to do in case of an emergency.