

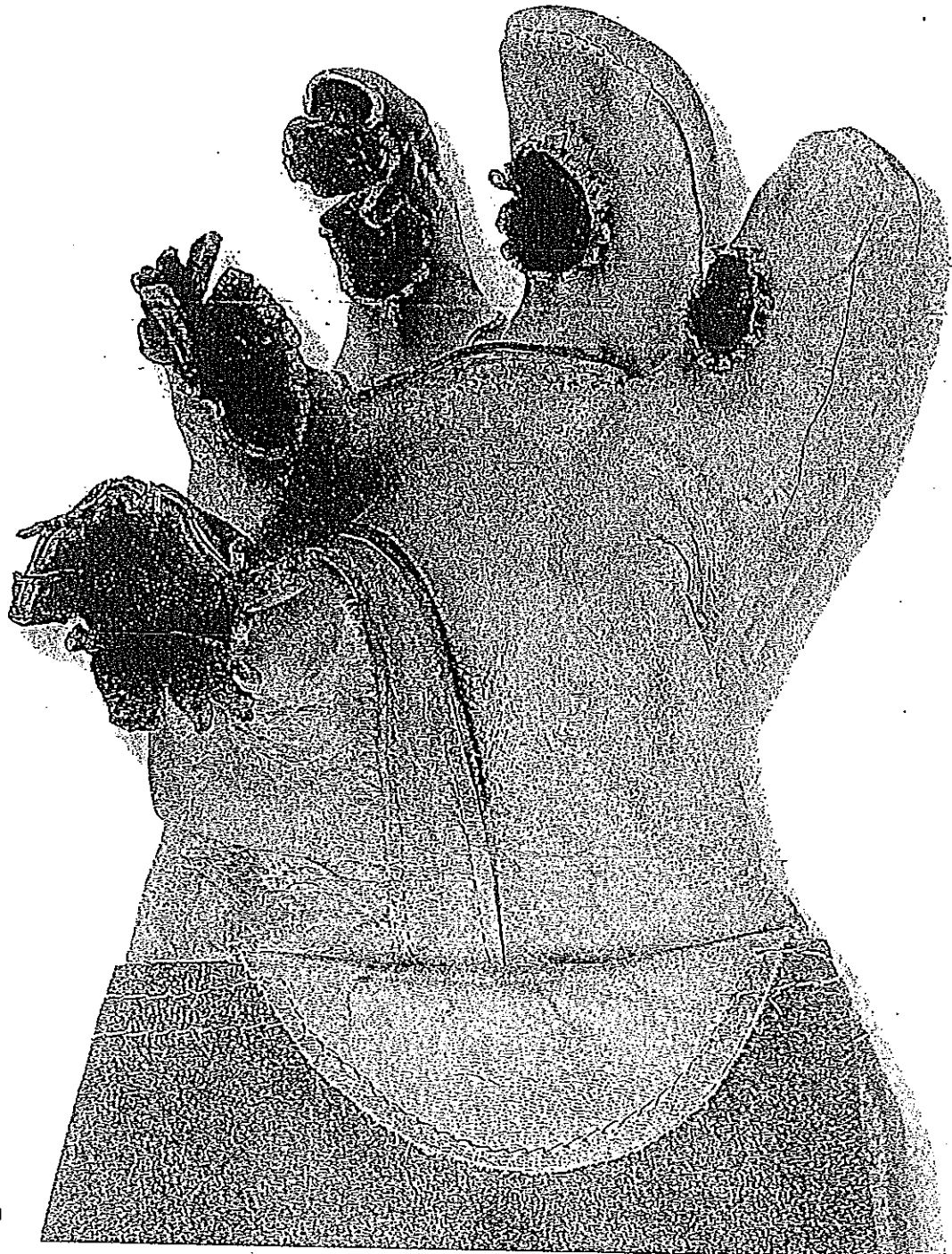
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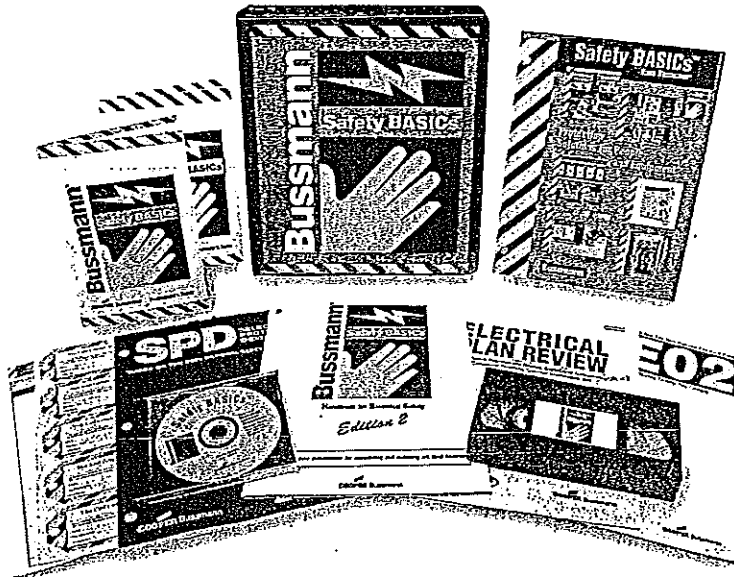
Handbook for Electrical Safety

Edition 2



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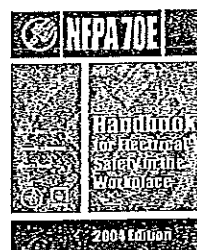


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This book is authored by Ray Jones, the Chairman of the NFPA 70E committee and Ken Mastrullo, the NFPA Staff Liaison for NFPA 70E, and edited by Jane Jones.

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Safety BASICS™

Handbook for Electrical Safety

(Cooper Bussmann Awareness of Safety Issues Campaign)

EDITION 2

This is an unproven compilation of technical materials that has been assembled by the developers for the benefit of training others about electrical safety, including electrical arc-flash hazards. It is being presented to illustrate the critical nature of electrical safety practices. While not the only method(s) or answer(s), or perhaps not even the best method(s) or answer(s), in the opinion of the developers/presenters the content is an accurate, acceptable, and positive way to present the subject material. The National Fire Protection Association's *NFPA 70E, Standard for Electrical Safety in the Workplace*, introduces safe work practices to mitigate the hazards identified by this work. By creating awareness of the potential hazards and describing workable solutions by which the hazards can be controlled, minimized or eliminated, it is hoped that injury will be reduced and lives will be saved.

Use of the information contained in the Safety BASICS™ program material is at your own risk.

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Special thanks go to Ray A. Jones, PE, and Jane G. Jones, with Electrical Safety Consulting Services, Inc., (ESCS, Inc.), who provided consultation services for the Safety BASICs program material.

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Ray has authored or co-authored many technical papers covering safety systems and processes, several of which have been published in *IEEE Transactions on Industry Applications*, and earned awards from IEEE. He is a frequent lecturer and contributor at the IEEE-IAS Petroleum and Chemical Industry Committee Electrical Safety Workshop and other IEEE tutorials.

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Ray and Jane wrote the book *Electrical Safety in the Workplace*, published by NFPA in 2000, and coauthored *The Electrical Safety Program Book* with Ken Mastrullo in 2003.

To learn more about services offered by ESCS, Inc., contact Ray Jones at 919-557-7711, ray.jones@ieee.org, or jandrjones@worldnet.att.net.

I. Introduction

An increasing number of organizations are actively promoting electrical safety for employees. The National Fire Protection Association's *NFPA 70E, Standard for Electrical Safety in the Workplace*, an American National Standard, is updated on a three-year cycle. The Institute of Electrical and Electronics Engineers (IEEE) publishes the Yellow Book, the *IEEE Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems*, and IEEE 1584™, the "IEEE Guide for Performing Arc-flash Hazard Calculations." Cooper Bussmann makes available an "Arc-flash Calculator Guide," see Annex G and an arc-flash calculator on its website (www.bussmann.com). The University of Chicago Trauma Center has a unit that specializes in electrical burns and related injuries. Its interests are not only on improving treatment methods but also in providing insight into electrical injuries and awareness of how to avoid electrical hazards. Major manufacturers and entire industries are seeing benefits of becoming more involved in promoting employee safety awareness programs.

The purpose of this Safety BASICS™ handbook is to do the following:

- Increase awareness of safety issues for individuals who work on or near electrical equipment as well as system operators and equipment designers/specifiers.
- Provide safety principles to be used for protecting individuals from potential injuries and even death caused by electrical hazards.
- Provide some means to perform flash hazard analysis.
- Provide some design, system upgrades and work practice suggestions that enhance electrical safety in the workplace.

This material is designed to provide the reader with an overview of hazards associated with exposure to electrical energy. It highlights standards and standard organizations, and offers guidance on safety procedures and a number of key principles that can help to minimize exposure to electrical hazards. Knowing how to minimize the exposure to electrical hazards or reducing the hazard itself can help to reduce future injuries and even deaths.

The Safety BASICS program is for the supervisor, manager, electrician, engineer, and the designer/specifier of equipment used in the electrical system. The IEEE makes it very clear that, "Engineers engaged in the design and operation of electrical systems protection should familiarize themselves with the most recent OSHA regulations and all other applicable regulations related to human safety." To the IEEE, providing adequate safety means going beyond the minimum requirements of consensus standards.

Perhaps a statement in the IEEE "Buff Book" says it best: "Safety has priority over service continuity, equipment damage or economics."

II. Consensus Standards

Consensus standards are seen as generally accepted engineering practices and can be used for litigation purposes when entered as evidence in a legal proceeding. In case of an incident where litigation is involved, the design and safety practices used are compared with these standards. In some cases, this type of enforcement is more critical than if the government were the enforcing agent.

In the United States, consensus standards are normally written by volunteers and published by standards-developing organizations (SDOs). The content of consensus standards is the result of work done by a blue-ribbon panel of experts and defines the industry's best generally available knowledge. Consensus standards fall into several different classes. Some consensus standards are product oriented; others define testing requirements, cover installation or design issues, or are people oriented. Many become legally mandated by governmental organizations.

Whether a national consensus standard is mandated and enforced by governmental action or not, the judicial system tends to use these standards as generally recognized and accepted engineering practices for litigation purposes. To understand the significance of this point, consider the text used in the OSH Act: "the (Labor) Secretary shall...by rule promulgate as an occupational safety or health standard any national consensus standard..." The legal profession uses relevant national consensus standards in court cases, where the standard is entered into evidence.

Each SDO and standard has a principle objective. To correctly apply any individual consensus standard, both the SDO objective and the standard objective should be clearly understood. The standard then should be applied with this understanding in mind. For instance, the National Fire Protection Association (NFPA) is primarily concerned with fire protection and personal safety. Therefore, NFPA standards should be embraced when these objectives are considered important. Some NFPA standards are product oriented; others are installation oriented. These standards should be applied as discussed in the scope of the document.

The NFPA publishes two critical standards. One is *NFPA 70*, otherwise known as the *National Electrical Code® (NEC®)*, and the other is the *Standard for Electrical Safety in the Workplace (NFPA 70E)*. The NFPA has many other standards, but these are two of the most important electrical standards. The premier standards publishing organization in the U.S. is the