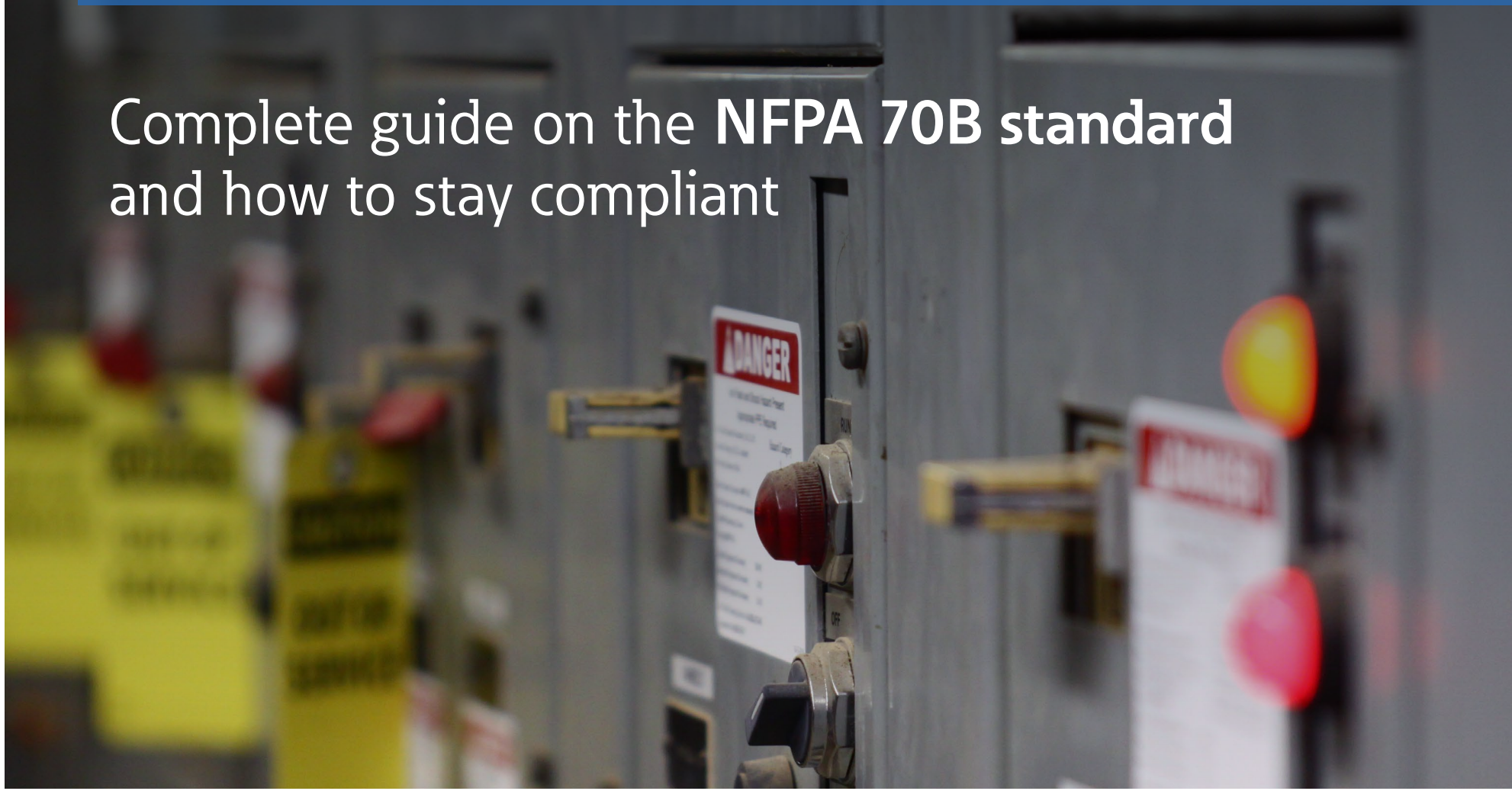
Complete guide on the **NFPA 70B standard** and how to stay compliant



Powering Business Worldwide

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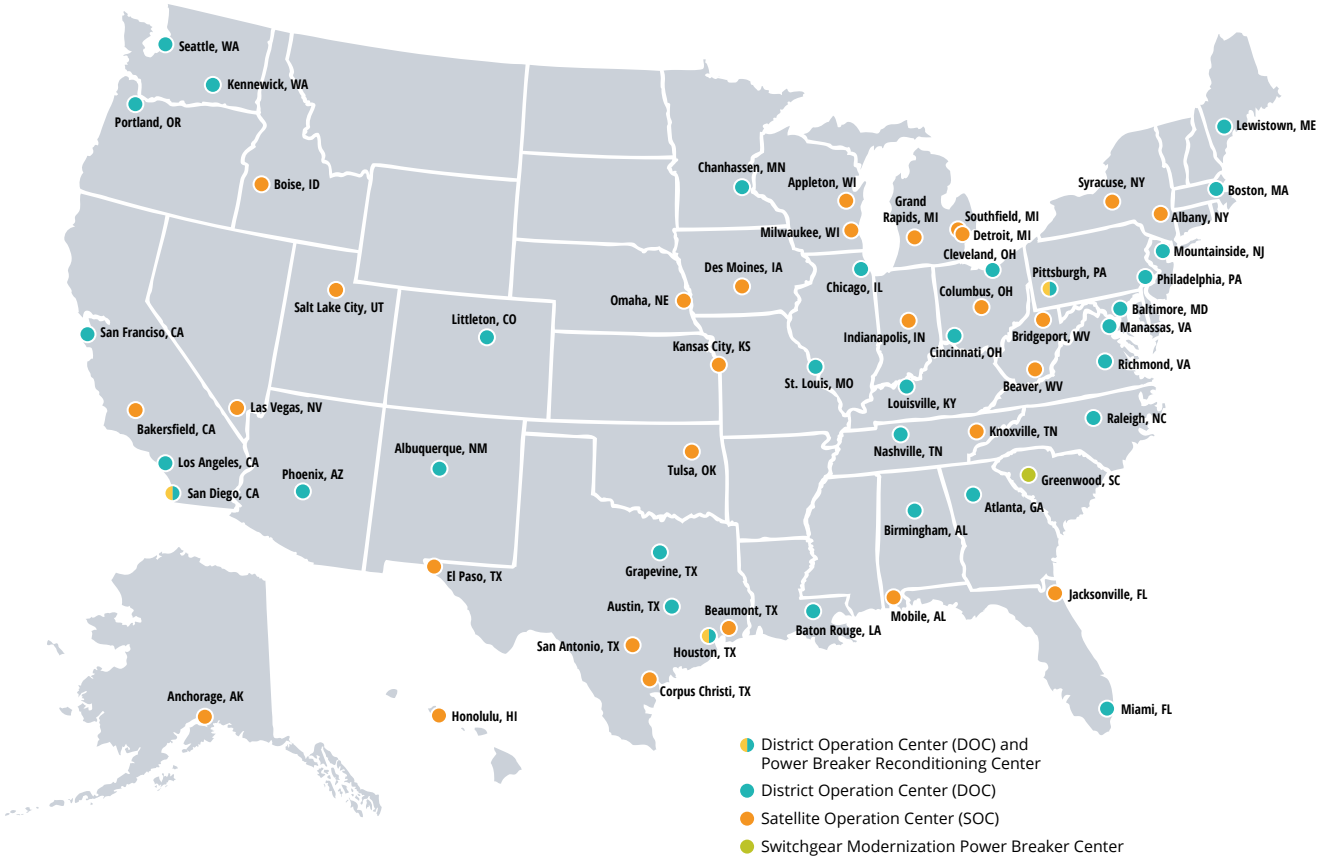
Introduction

Eaton's Electrical Services & Systems

Who are we?

Eaton's Electrical Services & Systems (EESS) can be the ideal complement to an existing in-house electrical maintenance staff or can act as a single point of contact for all your maintenance needs. Our field service representatives are equipped to support any of your electrical distribution equipment—**regardless of the original electrical equipment manufacturer**. As a dedicated service extension, EESS can establish and maintain consistent levels of availability, reliability and performance across your operations.

Where are we located?



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Click to learn more

Our field service capabilities

Electrical maintenance and testing

- Program design and implementation
- Complete scope of testing, evaluation and repair
- Thermographic/IR scan
- Predictive diagnostics
- Expertise in all low- and medium-voltage equipment
- Short-term/long-term maintenance contracts

New equipment services

- Site acceptance testing
- Installation support and supervision
- Electrical worker training
- Ground fault testing
- Interconnect confirmation
- Extended warranty contracts
- Ground grid testing

Equipment modernization

- Reconditioning and repair service
- Relay modernization
- Relay and metering upgrades
- Protective device mitigation upgrades
- Transformer oil processing and repairs
- Protective device upgrades

Crisis response

- 24/7 remote monitoring and support
- Remote troubleshooting
- Crisis response dispatch
- Rapid field service escalation
- Failure prevention and risk reduction
- Single point of contact project management

Introduction

NFPA 70B

Navigating NFPA 70B Guide

Eaton has prepared this guide as a tool to help our customers stay compliant with the changes in NFPA 70B® standard. In companion to this guide, there is a dedicated webpage (www.eaton.com/nfpa70b) that serves as a landing page for all our other NFPA 70B related documentation. Full NFPA codes and standards are free to view on the NFPA website.

Contents of NFPA 70B Guide

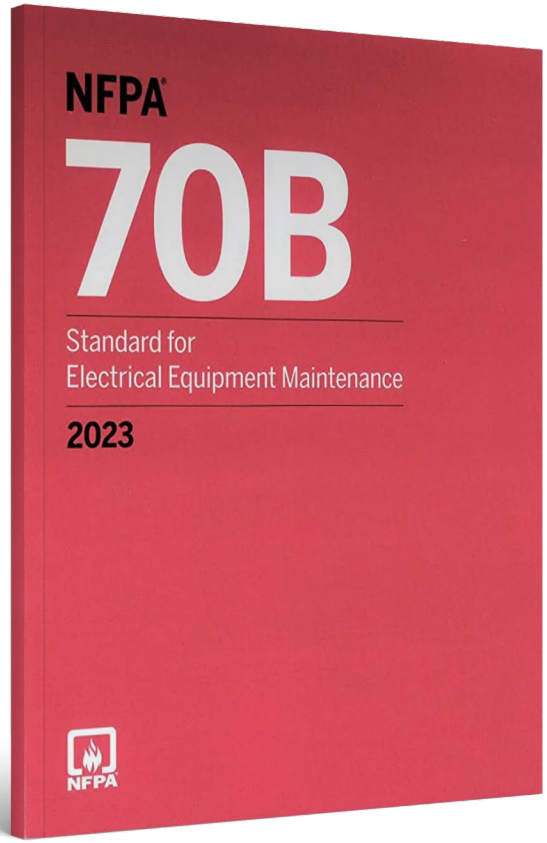
Use this guide throughout your NFPA 70B journey. Reach out today to have a conversation with one of our services experts.

Contact EESS

- The importance of electrical equipment maintenance
- Breakdown of the 2023 NFPA 70B
- Creating an Electrical Maintenance Program (EMP)
- How Eaton can help
- Implementing your maintenance program

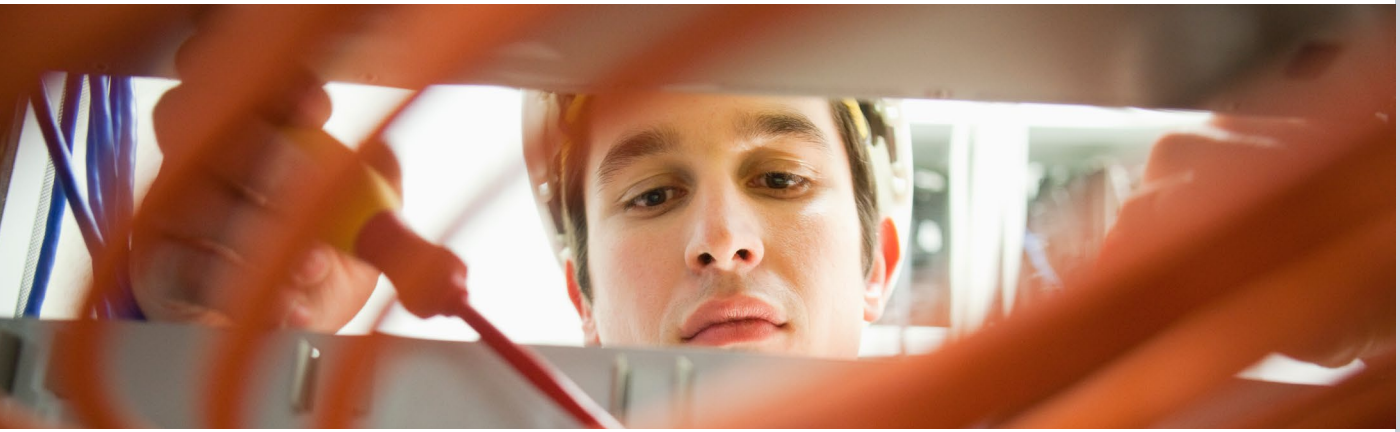
What is NFPA?

National Fire Protection Association is an International nonprofit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards.



Electrical equipment maintenance

The importance of electrical equipment maintenance



Safety

- Electrical distribution equipment requires maintenance to operate as designed by the manufacturer; foregoing regular equipment maintenance, increasing the risk of equipment failures and hazards to nearby workers and equipment

Total cost of ownership

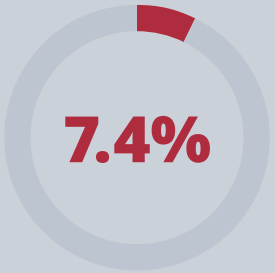
- Improved reliability of the electrical system equals fewer unplanned outages
- Extended equipment life
- Lower cost of ownership with regular electrical maintenance

Compliance

- Several NFPA documents (NFPA 70 (NEC), NFPA 70E, NFPA 110 and NFPA 99) reference maintenance requirements and/or NFPA 70B
- The insurance industry is represented on the technical committee and could link coverage to standard compliance

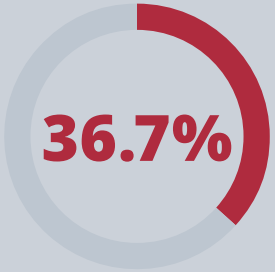
For electrical equipment failures that are caused by inadequate maintenance, the statistics below represented the months since last maintained. As shown, the longer the maintenance interval, the higher the possibility of equipment failure.

Source: IEEE Std 493-1997



<12 months

12–24 months



>24 months

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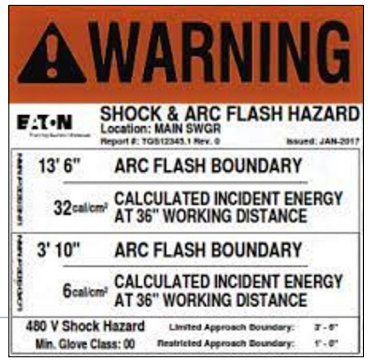
Why focus on safety?

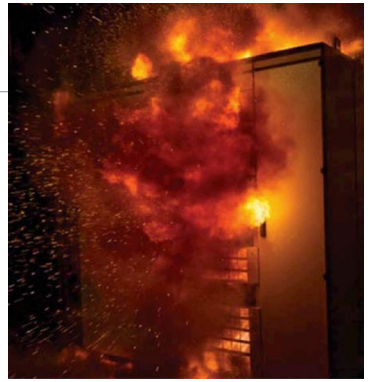
Arc flash hazards

Lack of maintenance can increase fault clearing time of an overcurrent protective device. Increased fault clearing time is directly proportional to incident energy. Equipment operating outside of fault clearing time specifications renders the **arc flash labels** useless and potentially exposes workers to significantly higher arc flash hazards.



Catastrophic failures

Maintenance often leads to early detection of potential failures, which if ignored, can create conditions for **arc flash events**.



Fire hazards

An arc flash event is the energy release that occurs during an electrical fault when current flows through the air between two live conductors, causing a short circuit and producing a powerful explosion marked by searing heat, toxic fumes, blinding light, deafening noise, and massive pressure waves.

Reducing total cost of ownership for electrical equipment

Unplanned outages

Planned outages for equipment maintenance can be an expensive investment, but unplanned outages are even more costly. If your equipment hasn't been maintained in 2+ years, you're 5x more likely to have a failure due to lack of maintenance.

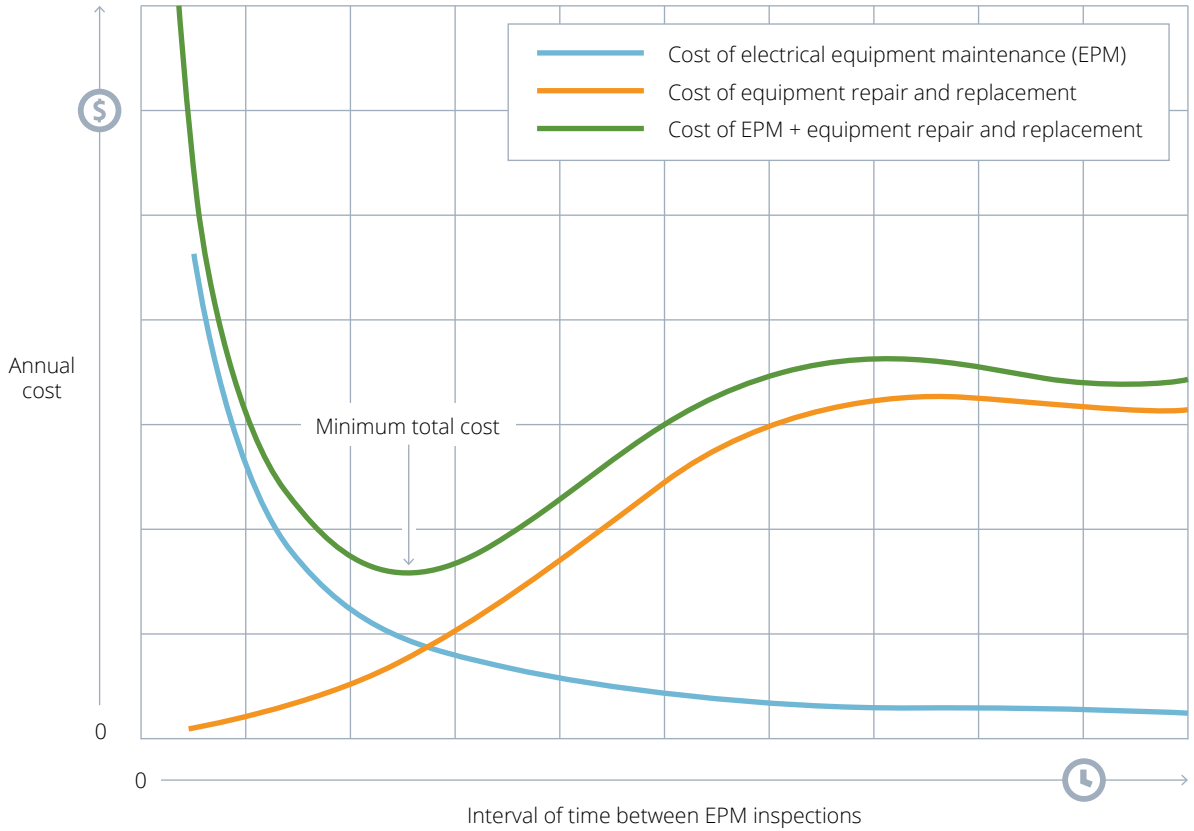
Unplanned outages can have indefinite resolution times, expensive premium time labor, expedited equipment fees, unforeseen downtime, and operational waste.

Extended equipment life

Proper maintenance is not only periodic inspection to ensure everything is operational but requires electrical testing, cleaning, and lubrication. Consistently operating, cleaning, lubricating, and testing the equipment ensures a longer life and the ability to predict failures and end-of-life with comparative test data.

Cost of electrical maintenance

This figure illustrates how the lowest total annual cost of ownership is realized when the maintenance interval keeps the sum of equipment repairs and maintenance program costs at a minimum; figure does not consider cost of lost revenue for unplanned outages.



Source: NFPA Today, 2020

Electrical equipment maintenance

Staying compliant

NFPA codes and standards

NFPA 70E Standard for Electrical Safety in the Workplace

NFPA 70E requires that electrical maintenance be done to prove equipment is in working order to validate incident energy calculations. **Not following the standard can result in penalties from OSHA in the event of an incident.**

NFPA 70B Standard for Electrical Equipment Maintenance

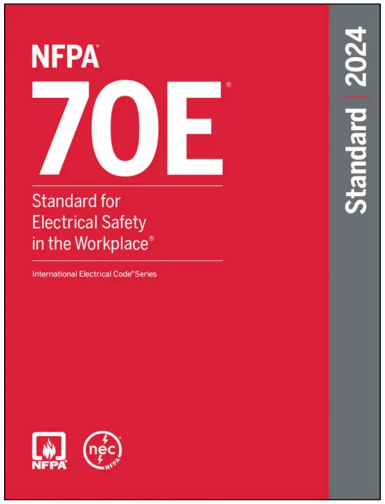
NFPA 70B newly changed from a recommended practice to a standard. **Not following the standard can result in penalties from OSHA in the event of an incident.**

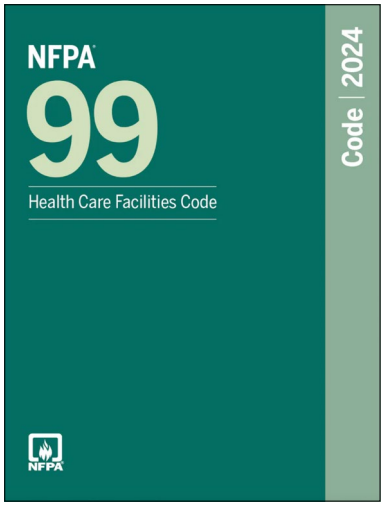
NFPA 99 Healthcare Facilities Code

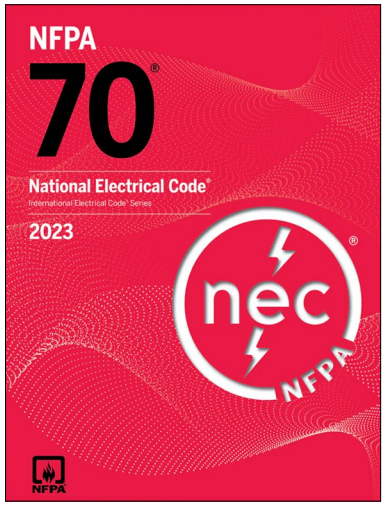
NFPA 99 requires healthcare facilities to have an electrical maintenance program for key equipment. **Not following the guidelines can result in penalties and funding removal by The Joint Commission.**

Insurance policies

Many insurance companies either require an electrical maintenance plan be in place to qualify for insurance or may offer higher or lower policy premiums based on this status.







What is NFPA 70B?

A new standard for electrical equipment maintenance

In 2023, NFPA 70B has changed guidelines on maintenance of electrical equipment to requirements.

This means:

- It is a requirement to have a managed program that includes inspecting, testing, and servicing electrical equipment
- NFPA 70B/70E will be used as reference by OSHA to enforce citations
- Insurance companies are more likely to enforce electrial equipment maintenance requirements
- Equipment maintenance intervals are published for product type and based on equipment condition
- An incident energy analysis (arc flash study) needs to be maintained as part of an electrical maintenance program

What is a consensus standard?

These are standards that are created through procedures accredited for the consensus decision-making, openness, balance of interests represented, and fairness by the American National Standards Institute (ANSI).

Who serves on the committee?

Standard drafting committees are appointed by a standards council and with each member ranging in a variety of backgrounds. Being appointed is based on technical expertise, professional standing, and commitment to safety.

Government adoption

The United States typically uses consensus standards to help further public policy. Local, state, and federal government have the option to adopt these standards that have been developed.

What is NFPA 70B?

Differences in codes, standards, and recommended practices

Code

A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.

Standard

An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law.

Nonmandatory provisions shall be located in an appendix or annex, footnote or fine-print note, and are not to be considered a part of the requirements of a standard.

When used in a generic sense, such as in the phrases “standards development process” or “standards development activities”, the term “standards” includes all NFPA standards, including codes, recommended practices and guides.

Recommended practice

A NFPA recommended practice is similar in content and structure to a code or a standard, but that contains only nonmandatory provisions using the word “should” to indicate recommendations in the body of the text.

What is NFPA 70B?

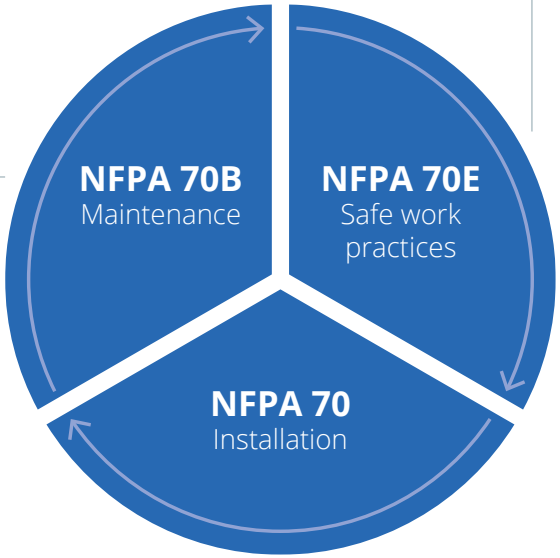
Codes and standards of the NFPA safety wheel

NFPA 70E
Standard for electrical safety in the workplace

- Requires an incident energy calculation
- Safe work practices
- Includes arc flash safety, which has connectivity to maintenance requirements
- Acts as basis of standards for many enforceable practices by OSHA

NFPA 70B
Standard for electrical equipment maintenance

- Electrical equipment maintenance
  - Not intended to duplicate or supersede manufacturing instruction
- National consensus standard
  - Updated in 2023 from a recommended practice
- Acts as basis of standards for many enforceable practices by OSHA
- Often a requirement for insurance companies



NFPA 70
National Electrical Code

- Installation requirements
- Contains some maintenance requirements
- Adopted as law (Code)

NFPA 70E and NFPA 70B

NFPA 70E defines "Normal Operating Condition" based on the following:

- The equipment is properly installed
- The equipment is properly maintained
- The equipment is used in accordance with instructions included in the listing and labeling, and in accordance with manufacturer's instructions
- The equipment doors are closed and secured
- All equipment covers are in place and secured
- There is no evidence of impending failure

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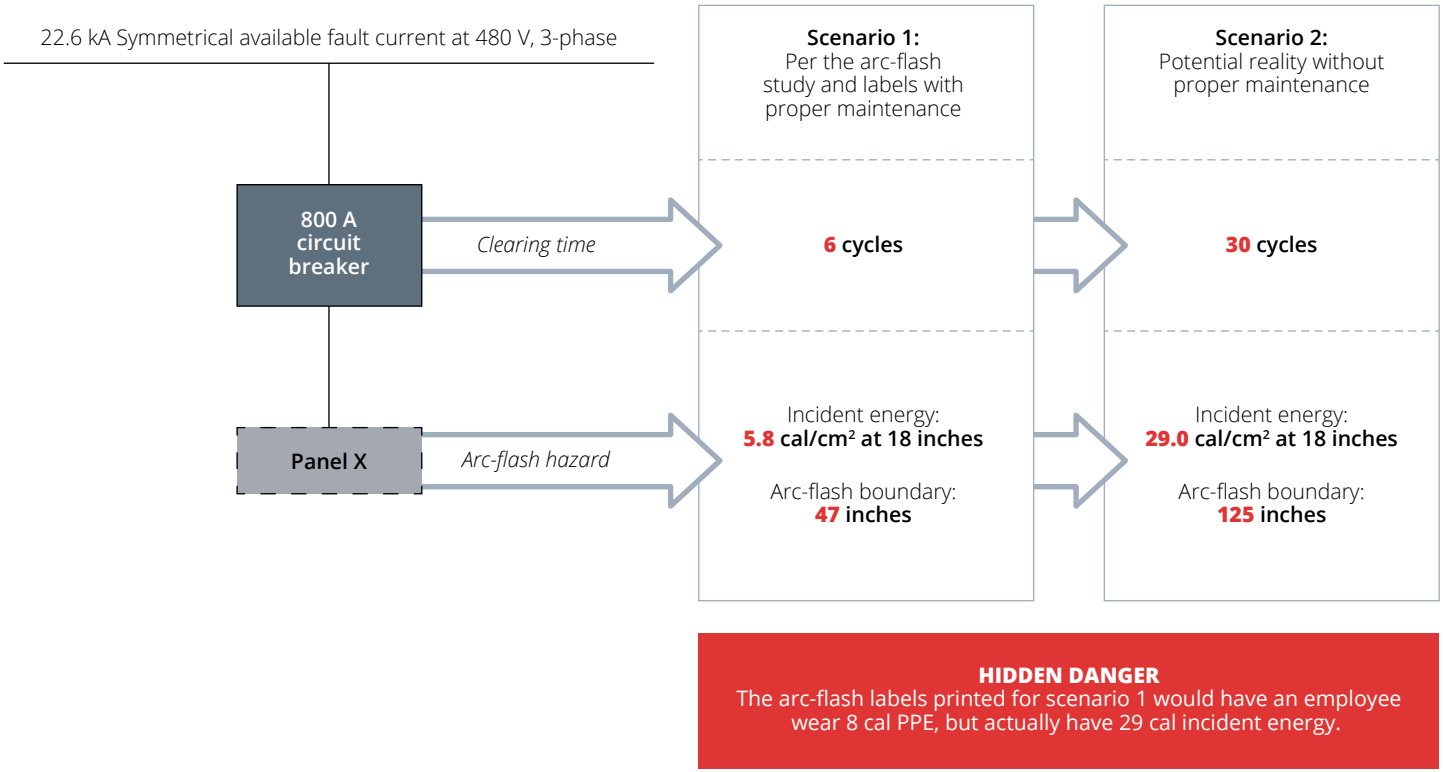
What is NFPA 70B?

How improper maintenance affects incident energy



HIDDEN DANGER
The arc-flash labels printed for scenario 1 would have an employee wear 8 cal PPE, but actually have 29 cal incident energy.

Conclusion

- NFPA 70E allows "normal operation condition" of equipment only when **properly maintained**
- Incident energy depends on proper operation of overcurrent protection
- Increased clearing time of an overcurrent device, due to insufficient maintenance, will increase the hazard to an electrical worker should an arc flash occur

Developing an EMP

Defining the requirements of NFPA 70B

Chapter 4 of NFPA 70B lists the general requirements, which include an electrical maintenance program, responsible personnel, and analysis guidelines of electrical equipment.

General requirement summary

- **Follow manufacturer's guidelines, if available**
  In the absence of manufacturer's instructions, equipment shall be maintained in accordance withindustry consensus standards
- **You shall have an electrical maintenance program (EMP)**
  The equipment owner shall implement and document an overall EMP that directs activity appropriate to the safety and operational risks
- **A new focus on equipment condition**
  The EMP shall include elements that consider the current condition of electrical equipment and systems, as well as the potential safety and operational risks to maintenance and operational personnel
- **Maintenance shall be performed by a trained professional**
  A qualified person responsible for conducting electrical maintenance shall be trained in the specific maintenance tasks, test methods, test equipment, PPE usage (as applicable), and hazards associated with the electrical equipment or system being serviced

Back to TOC

Developing an EMP

Defining an electrical maintenance program (EMP)

What is an EMP?

An EMP is a managed program of inspecting, testing, monitoring, analyzing, and servicing electrical equipment with a purpose of maintaining safe operations.

An EMP shall include:

- Survey and analysis of electrical equipment and systems to determine maintenance requirements and priorities
- Identification of personnel responsible for implementing each element of the program
- An electrical safety program that addresses the condition of maintenance
- Developed and documented maintenance procedures for all equipment within the scope of the EMP
- Plan of inspections, servicing, and suitable tests
- Maintenance, equipment, and personnel documentation and records-retention policy
- Process to prescribe, implement, and document corrective measures based on collected data
- Process for incorporating design for maintainability in electrical installations
- Program review and revision process that considers failures and findings for continuous improvement

How to develop an EMP

Step 1
Identify who is responsible for implementing the EMP

Why: Personnel group or person **will manage each aspect of the EMP**—design, review, and implementation.

Step 3
Develop, document, and execute maintenance plan for equipment

Why: Defines **equipment maintenance intervals and testing procedures**. If no manufacturer's guidelines are provided, NFPA 70B provides intervals and test procedures for all equipment.

Step 5
Review and analysis of maintenance results and trends

Why: Helps determine process for implementing **corrective measures** and incorporating design for **maintainability** along with any other continuous improvement measures.

Step 2
Perform a survey and analysis of all electrical equipment

Why: Builds an **inventory of equipment** and determines the equipment's **condition of maintenance**.

Step 4
Develop a documentation and records-retention policy

Why: Ensures that all **test records and maintenance procedures are documented**. Equipment trends can be determined using historical results.

Back to TOC

Developing an EMP **with Eaton**

Step 1
Identify who is responsible for implementing the EMP

How: EESS provides **Electrical Worker Training (EWT)** that can help train your team on new standards.

Step 3
Develop, document, and execute maintenance plan for equipment

How: EESS is a world-class service organization that can **perform testing and maintenance on any leading manufacturer's equipment**. We can also help determine your equipment maintenance intervals and NFPA testing procedures.

Step 5
Review and analysis of maintenance results and trends

How: Eaton has a broad offering that can help you **stay NFPA compliant**, including power monitoring, switchgear modernization, and new equipment services.

Step 2
Perform a survey and analysis of all electrical equipment

How: With a **Power Systems Assessment**, a field service expert performs a site and program level evaluation of your three-phase electrical equipment.

Step 4
Develop a documentation and records-retention policy

How: With each equipment maintenance order with Eaton, **a comprehensive report is provided**, which details any findings from the inspection and testing.

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Determining test procedures

Fundamental tests for electrical equipment

NFPA 70B identifies fundamental tests that **shall** be performed on electrical equipment, in addition to equipment-specific maintenance and testing procedures.

Bolted bus connections and conductor terminations

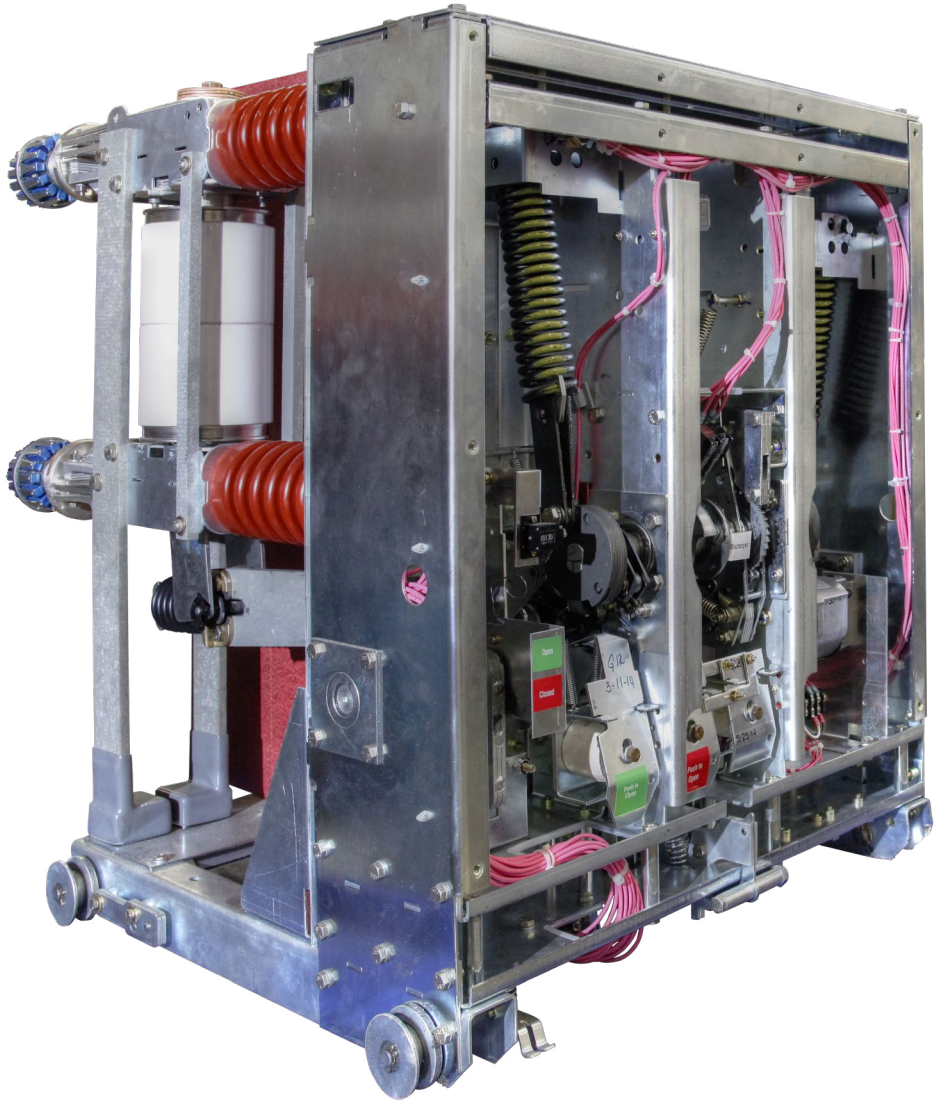
The quality of these connections shall be verified using either infrared thermographic (IR) scans, permanently mounted thermal sensors, contact resistance test set, or torque verification. Verification interval is determined by equipment condition.

Insulation resistance quality

For equipment rated up to 1000 V, the electric insulation shall be verified using a DC insulation resistance test set.

Infrared thermography (IR scans)

IR scans shall be used when required to verify temperature differences between electrical components and ambient temperature and with similar components under the same loading.



Determining test procedures

Low-voltage switchgear example

First, one must determine the condition of the low-voltage switchgear.

	Physical condition	Criticality condition	Operating environment condition
Condition 1	• The equipment appears in like new condition • The enclosure is clean, free from moisture intrusion, and tight • No unaddressed notification from the continuous monitoring system has occurred • There are no active recommendations from predictive techniques • Previous maintenance has been performed in accordance with the EMP	Failure of the equipment or system will not endanger personnel.	The equipment is used in an operating environment for which it is rated.
Condition 2	• Maintenance results deviate from past results or have indicated more frequent maintenance in accordance with manufacturer's published data • The previous maintenance cycle has revealed issues requiring the repair or replacement of major equipment components • There have been notifications from the continuous monitoring system since the prior assessment • There are active recommendations from predictive techniques		
Condition 3	• The equipment has missed the last two successive maintenance cycles in accordance with the EMP • The previous two maintenance cycles have revealed issues requiring the repair or replacement of major equipment components • There is an active or unaddressed notification from the continuous monitoring system • There are urgent actions identified from predictive techniques	Failure of the equipment or system will endanger personnel.	The equipment is used in an environment with harsh chemicals, contaminants, or extreme operating conditions for which it is not specifically rated or evaluated.
Sample assessment	This gear has been new and had site acceptance testing performed: **Condition 1**	Equipment will not endanger personnel: **Condition 1**	Located in climate-controlled room: **Condition 1**

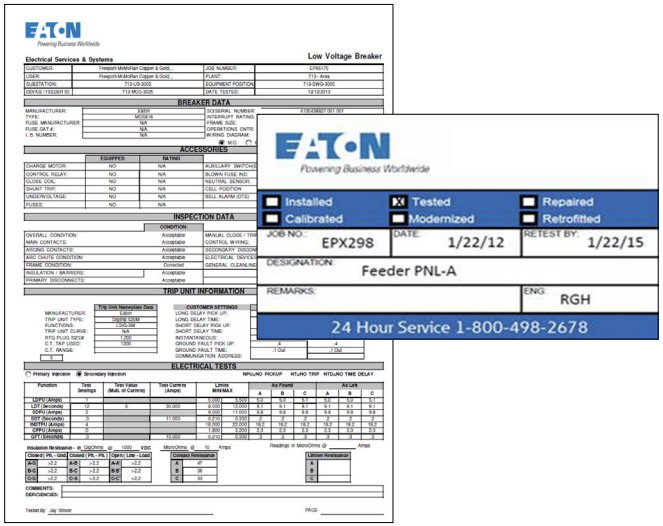
This equipment is identified as Condition 1

Determining test procedures

Low-voltage switchgear example (continued)

How to determine the condition of maintenance:

- Test forms
- Service labels
- Documentation



Next, we can use the condition assessment to determine the maintenance interval.

Without the presence of manufacturer's guidelines, we will follow the NFPA maintenance intervals and procedures. With this equipment deemed Condition 1, the maintenance intervals can be seen below.

		Equipment condition assessment		
Product	**Scope of work**	**Condition 1**	**Condition 2**	**Condition 3**
Switchgear	Visual inspection	12 months	12 months	6 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
	Mechanical servicing	60 months	36 months	12 months
	Electrical testing	60 months	36 months	12 months
	Special	60 months	36 months	12 months

Determining test procedures

Low-voltage switchgear example (continued)

Lastly, we can refer to NFPA 70B Chapter 12 to determine maintenance procedures.

We will focus only on the visual inspection of the equipment because that has the shorter maintenance interval at 12 months.

No.	Visual inspection task	1000 V or below test type	Greater than 1000 V test type
1	Inspect external physical condition	1	1
2	Inspect anchorage and grounding	1	1
3	Ensure maintenance devices and tools are available for equipment servicing	1	1
4	Verify circuit breakers, fuses, protective relays, and other type of overload elements are the right sizes and types and correspond to the drawings and the power system studies	1 or 2	1 or 2
5	For connected communicating addressable devices, verify the device addresses are set in accordance with documentation	1 or 2	1 or 2
6	Verify instrument transformer ratios are correct as installed	2A	2A
7	Inspect insulators for damage or contaminated surfaces	2	2
8	Verify air filters or screens are clean and in place	1 or 2	1 or 2
9	Check all ventilation openings for obstructions and correct operation of any flap or automatic cover intended to assist in arc-resistant ratings	2	2
10	Inspect arc-resistant equipment to ensure all doors are secured and in place	1 or 2	1 or 2
11	Verify switch phase barriers are in place and in good condition	2	2
12	For individual components, refer to the appropriate chapter(s) of this standard	NA	NA
13	Visually inspect environmental controls, where provided	1 or 2	1 or 2

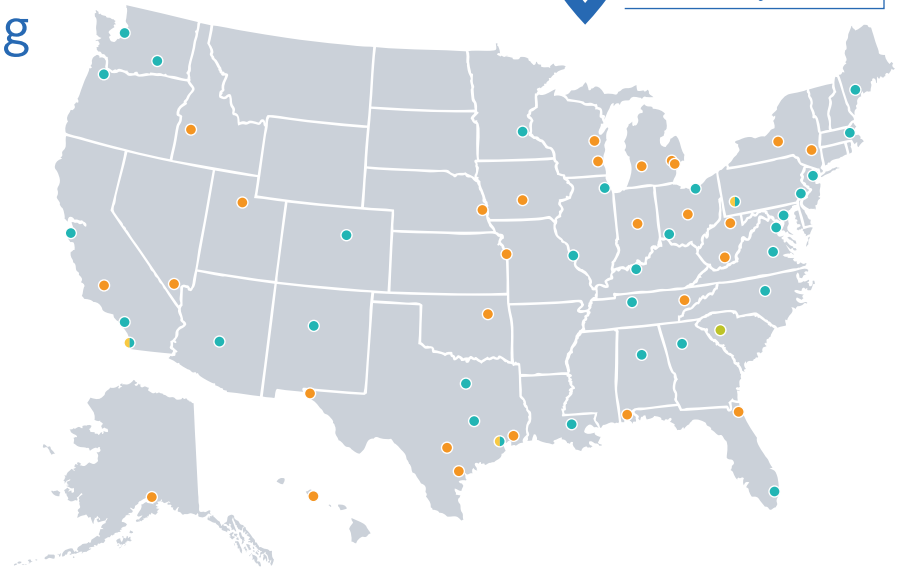
Conclusion

These visual inspection tasks shall be completed at the 12-month interval by a trained professional per NFPA 70B guidelines. Call Eaton's EESS to get started.

Ways Eaton can help

Electrical equipment maintenance and testing

See **page 3** for location information



Eaton's Electrical Services & Systems (EESS) provides world-class service at any location across the United States.

Ability to perform maintenance and test any equipment

- More than 60 locations and over 1,500 field services experts, nationwide
- Electrical maintenance testing on any manufacturer's equipment

On-site training and 24/7 technical support

- Electrical worker training (EWT) can train on equipment-specific procedures or safety procedures
- Remote services can assist with troubleshooting 24/7 through our virtual platform that puts a field service expert just a phone call away

Determining maintenance intervals

EESS can help determine your maintenance intervals for your electrical equipment. By using the NFPA conditional assessment, maintenance intervals chart, and facility testing history, a detailed maintenance schedule can be provided by substation.

Interested?
Contact EESS

Ways Eaton can help

Power system assessment

EESS offers a high-level assessment of a site's electrical program and equipment with a final deliverable of a standardized report and site-specific recommendations.

Visual inspection of all three-phase equipment

Includes: Condition, arc flash labels, compliance, lock-out/tag-out (LOTO) locations, safety interlocks, technology improvements, and spare parts.

Discussion to discover potential electrical program gaps

Includes: Safety programs and LOTO, electrical worker training, arc flash training, maintenance program, and one-line drawing accuracy.

Power system assessment and NFPA

Let EESS be an advisor in your NFPA journey. The power system assessment reviews site programs to determine NFPA compliance and can also identify a gap in your electrical maintenance program.

Interested?
Contact EESS

Ways Eaton can help

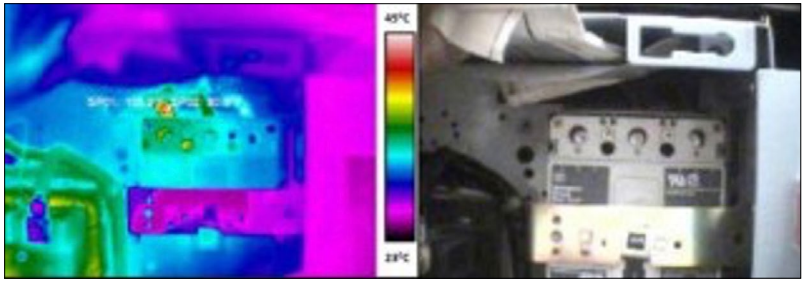
Thermography scans and thermal monitoring

Chapter 7 of NFPA 70B lists the fundamental tests for electrical equipment. Thermography scans (or IR scans) or thermal monitoring are listed to ensure proper bolted bus and conductor connections.

IR scans

What: Thermal imaging used to detect heat patterns emitted at a bolted connection.

When: Equipment must be scanned when equipment is operational. No outage required.



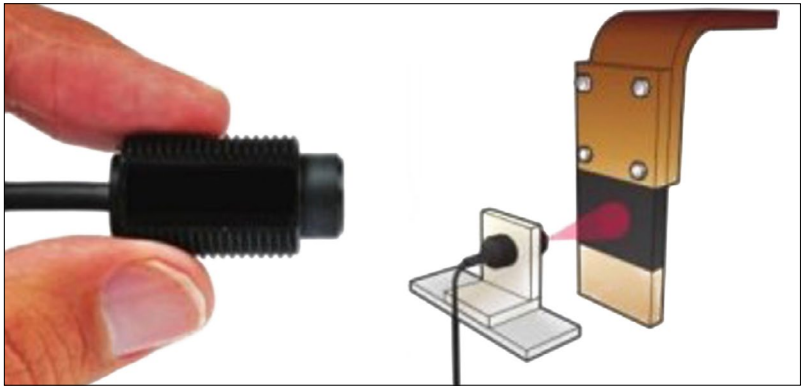
The thermal image (left) shows an elevated temperature and possible loose connection at the A Phase terminal. The visual image is on the right.

Interested?
Contact EESS

Thermal monitoring

What: Mounted device inside of switchgear that detects a rise in temperature at device's focus area.

When: Continuous monitoring. Outage required for installation.



Sensor mounted inside equipment that can provide 24/7 thermal monitoring.

Ways Eaton can help

Switchgear modernization

Upgrading your equipment can extend the life of your electrical system and prevent any unwanted outages. With switchgear modernization, you can also extend your maintenance intervals.

Power breaker reconditioning and remanufacturing

Eaton's Class 1 reconditioning can restore circuit breakers to their maximum capability, regardless of original manufacturer.

Switchgear retrofill and conversions

Conversion solution for metal-enclosed and metal-clad switchgear can be custom engineered to satisfy specific application requirements, while the useful life of switchgear is extended using newer interrupting technologies and additional improvements.

Custom panel shop

Our UL 508A certified custom panel shops provide engineering, design, and/or replacements, made to specifications, including switchgear doors, custom enclosures, industrial control panels, remote breaker control panels, PLC cabinets, remote operator stations, and logic control panels.

Did you know?

Eaton's enhanced VCP-W mechanism has a maintenance interval of 10,000 operations or 10 years, whichever comes first. The NFPA 70B maintenance interval for a typical medium-voltage breaker is 5 years, under normal operating conditions.

Interested?
Contact EESS

Back to TOC

Ways Eaton can help

Power monitoring and health status

NFPA 70B includes language that allows continuous monitoring and predictive techniques to drive maintenance intervals, as compared to the tables provided in the standard.

Intelligent trip units

These units dramatically streamline traditional breaker inspection procedures, with an at-a-glance health indicator and powerful data analytics that detail the condition of the breaker for easy predictive maintenance and enhanced system reliability, with detailed reports on operations, short-circuits, overloads, temperature, and more.

Transfer switch controllers

Many of these devices can perform remote load testing, time-stamped event summaries, and high-speed event waveform captures with detailed event logging to simplify maintenance.

Other continuous monitoring devices

There are add-on devices you can implement to provide continuous, non-invasive online monitoring for generators, motors, switchgear, unit substation dry-type transformers, bus duct, and cable connections; these devices provide constant tracking of partial discharge activity and predictive monitoring to help users make better safety and maintenance decisions.

Interested?
Contact EESS

Back to TOC

Key takeaways

Electrical equipment maintenance is directly related to the safety of the electrical worker.

Maintenance of overcurrent protective devices is of particular concern because they determine incident energy calculations and required PPE.

The owner of the electrical equipment is responsible for maintenance.

Maintenance requirements and intervals can be found in electrical equipment manuals or NFPA 70B, if not available.

For more information, visit
Eaton.com/NFPA70B

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