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NFPA 70B Standard for Electrical Equipment Maintenance




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Agenda

- ❖ NFPA Manual of Style
- ❖ NFPA 70-70B-70E “Trilogy”
- ❖ Chapter 1 Administration
- ❖ Chapter 3 Definitions
- ❖ Chapter 4 General Requirements
- ❖ Chapter 7 Fundamental Tests
- ❖ Chapter 9 Maintenance Intervals



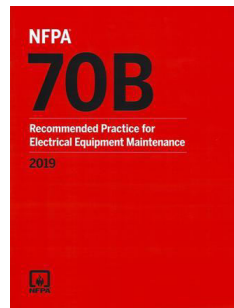
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NFPA 2004 Manual of Style for TC Documents

Recommended Practice: A document that is similar in content and structure to a code or standard but that contains only nonmandatory provisions using the word “should” to indicate recommendations in the body of the text.

2.4.1 Recommended Practices

- 2.4.1.1** A document that is a recommended practice shall include only recommendations and directly supporting text throughout the text
- 2.4.1.2** Where a sentence does not contain a recommendation, it shall be rewritten to include a recommendation or the sentence shall be moved to the annex
- 2.4.1.3** Mandatory language shall not be used



NFPA 2004 Manual of Style for TC Documents

Standard: A document, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and which 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.

1.2.1 Codes and Standards

- 1.2.1.1** The main text of a code or standard shall consist of all mandatory requirements
- 1.2.1.2** All nonmandatory or informational text shall appear either in Annex A or as a separate annex for specialized information



Code vs Standard

A code is a model, a set of rules that knowledgeable people recommend for others to follow. It is not a law but can be adopted into law.

A standard tends to be a more detailed elaboration, the nuts and bolts of meeting a code.

One way of looking at the differences between codes and standards is that a code tells you what you need to do, and a standard tells you how to do it.

CODE VERSUS STANDARD

Model that is adaptable by law	Set of technical definitions, specifications, and guidelines
Clarifies what needs to be done	Clarifies how something should be done
Can be adopted into law	Is not legalized
Examples include International Building Code and ASME Boiler and Vessel Code	Examples include ASTM International standards and ISO standard

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NFPA 70/70B/70E “Trilogy”

NFPA 70 National Electrical Code Scope

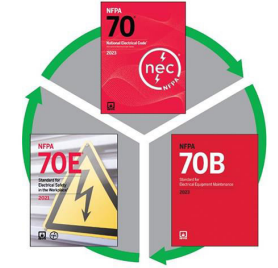
Practical safeguarding of persons and property from hazards arising from the use of electricity

NFPA 70B Standard for Electrical Equipment Maintenance Scope

Practical safeguarding of persons, property, and processes from the risks associated with failure, breakdown, or malfunction and a means to establish a condition of maintenance of electrical equipment and systems for safety and reliability

NFPA 70E Standard for Electrical Safety in the Workplace Purpose

Practical safe working area for employees relative to the hazards arising from the use of electricity



NFPA 70/70B/70E “Trilogy”

NFPA 70 National Electrical Code

- Provides requirements for safe design, installation and inspection
- 70B is referenced 11 times
- 70E is referenced 18 times

NFPA 70B Standard for Electrical Equipment Maintenance

- Provides requirements to help maintain functionality, reliability, and safety of equipment after installation
- NFPA 70 is referenced 61 times
- NFPA 70E is referenced 14 times

NFPA 70E Standard for Electrical Safety in the Workplace

- Helps keep personnel safe while performing electrical installation and maintenance, while also helping meet OSHA requirements
- NFPA 70 is referenced 14 times
- NFPA 70B is referenced 3 times



NFPA 70B Why Bother?

Safety

- Reduce employee exposure to possible electrical hazards and ensure safety is at the forefront of your business

Reliability

- Delaying simple repairs can adversely effect equipment operation in the long run resulting in disrupted workflow and a decrease in employee productivity

Energy Efficiency

- Improperly maintained equipment can lead to higher utility bills, excess emissions, and power quality problems



Maintenance: Scheduled vs Unscheduled

MAINTENANCE

SCHEDULED

- Proactively planned actions that ensure the health of the machine
- Supports productivity targets
- Significant cost reduction vs. reactive maintenance
- Requires a coordinated effort between maintenance, parts, and field



UNSCHEDULED

- Reactive maintenance repair actions caused by component failure
- Loss of productivity and subsequent revenue
- Highest repair cost
- Uncoordinated crisis effort between maintenance, parts, and field



70B Standard for Electrical Equipment Maintenance

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| 2 Referenced Publications | 16 Fuses |
| 3 Definitions | 17 Switches |
| 4 General | 18 Power Cables and Conductors |
| 5 Personnel Safety | 19 Cable Tray |
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70B Standard for Electrical Equipment Maintenance

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| | L Case Histories |
| | M Informational References |



Chapter 1 Administration

1.1 Scope

This standard covers the preventive maintenance of electrical, electronic, and communications systems and equipment.

1.2 Purpose

The purpose of this standard is to provide for the practical safeguarding of persons, property, and processes from the risks associated with failure, breakdown, or malfunction and a means to establish a condition of maintenance of electrical equipment and systems for safety and reliability.



Chapter 1 Administration- 1.3 Application

1.3.1

This standard applies to maintenance for electrical, electronic, and communications systems and equipment and is not intended to duplicate or supersede instructions provided by manufacturers. Systems and equipment covered are typical of those installed for industrial plants, institutional and commercial buildings, and large multifamily residential complexes.



1.3.2

Consumer appliances and equipment intended primarily for use in the home are not covered



Chapter 3 Definitions

3.3.10 Commissioning

The process, procedures, and testing used to set up and verify the initial performance, operational controls, safety systems, and sequence of operation of electrical devices and equipment, prior to it being placed into active service. (70, 2023)



3.3.52 Servicing

The process of following a manufacturer's set of instructions or applicable industry standards to analyze, adjust, or perform prescribed actions upon equipment with the intention to preserve or restore the operational performance of the equipment. (70, 2023)



Chapter 3 Definitions

3.3.48 Reconditioned

Electromechanical systems, equipment, apparatus, or components that are restored to operating conditions. This process differs from normal servicing of equipment that remains within a facility, or replacement of listed equipment on a one-to-one basis. (70, 2023)



Chapter 3 Definitions

3.3.16* Electrical Maintenance Program (EMP)

A managed program of inspecting, testing, monitoring, analyzing, and servicing electrical systems and equipment with the purpose of maintaining safe operations and production by reducing or eliminating system interruptions and equipment failures.

A.3.3.16 Electrical Maintenance Program (EMP)

Electrical maintenance relies on knowing the electrical systems and equipment being maintained and on knowing the operating experience, loss exposures, potential for injury, and maintenance resources.



EMC Insurance Business | Home | Loss Control | Tech Sheets | Electrical Preventive Maintenance Program

Electrical Preventive Maintenance Program

Each year, thousands of electrical systems fail during normal operations, costing American businesses millions of dollars in damage and lost production. Two thirds of these electrical system failures could be avoided with routine preventative maintenance. And studies show that the failure rate of electrical equipment is three times higher for systems that are not part of a scheduled electrical preventative maintenance program.

When Should Electrical Maintenance Happen

IEEE recommends conducting regular preventative maintenance on electrical equipment once every three years. Individual locations may require more frequent maintenance due to the physical environment or operational nature of the equipment.

For example, harsh environments where excessive moisture or dust are present need maintenance more frequently. Similarly, equipment that is used intermittently or equipment critical to a key process should receive more frequent preventative maintenance. Use sound engineering judgment to determine if more frequent maintenance is appropriate.

Electrical Equipment Included in an Electrical Preventive Maintenance Program

Each piece of electrical equipment has its own specific maintenance requirements and schedule. But all work associated with electric power systems and equipment should be performed in accordance with accepted industry safety standards and work practices.

The following is a list of electrical equipment typically covered by electrical preventative maintenance:



Chapter 3 Definitions

3.3.18 EMP Coordinator

The individual Responsible for coordinating the implementation and operation of the EMP

3.3.37 Maintenance Interval

The fixed frequency of inspecting, testing, monitoring, analyzing, and servicing electrical equipment that is determined by the type, criticality, and perceived condition of the equipment.



Chapter 4 General Requirements

4.1.1

Equipment shall be maintained in accordance with the manufacturer's instructions and applicable codes and standards

4.1.2

This standard is not intended to duplicate or supersede manufacturer's instructions

4.1.3

In the absence of manufacturer's instructions, equipment shall be maintained in accordance with industry consensus standards

Maintenance

WARNING

DANGER

Recommended Lead Time

- 1. Inspect and test electrical equipment...
- 2. Inspect and test electrical equipment...
- 3. Inspect and test electrical equipment...
- 4. Inspect and test electrical equipment...
- 5. Inspect and test electrical equipment...
- 6. Inspect and test electrical equipment...
- 7. Inspect and test electrical equipment...
- 8. Inspect and test electrical equipment...
- 9. Inspect and test electrical equipment...
- 10. Inspect and test electrical equipment...



Chapter 4 General Requirements- Electrical Maintenance Program (EMP)

4.2.1

The equipment owner shall implement and document an overall EMP that directs activity appropriate to the safety and operational risks

4.2.2.1

The EMP shall include elements to verify that electrical equipment or systems have been inspected to comply with applicable installation codes and standards



Chapter 4 General Requirements- EMP

4.3.1

The EMP shall identify an EMP coordinator

4.3.2

Personnel assigned to EMP duties shall be qualified for the assigned tasks



Chapter 4 General Requirements- EMP

4.3.3

A QP responsible for conducting electrical maintenance shall be trained in the specific maintenance tasks, test methods, test equipment, PPE usage, and hazards associated with the electrical equipment or system being serviced

4.3.3.1

A person who is undergoing on-the-job training for the purpose of obtaining the skills and knowledge necessary to be considered a QP, and who in the course of such training demonstrates an ability to perform specific duties safely at his or her level of training, and who is under the direct supervision of a QP shall be considered to be a QP for the performance of those specific duties.



Chapter 4 General Requirements- Impact of Additions/Rework to Retrofitting Equipment

4.7.1*

Safety certifications shall be maintained for repaired or rebuilt equipment

A.4.7.1

Rework, remanufacturing, or retrofitting of equipment typically involves replacement or refurbishing of major components of equipment or systems. Repairs or modifications not authorized by the OEM might void the equipment warranties and third-party certifications. Equipment can be reconditioned under rebuild programs provided the reconditioning follows established guidelines. The AHJ can assess the acceptability of reconditioned equipment to determine if a re-evaluation of the modified product by the organization that listed the equipment is necessary.



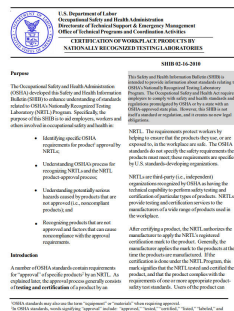
Chapter 4 General Requirements- Impact of Additions/Rework to Retrofitting Equipment

4.7.2*

When repairing, rebuilding, or remanufacturing equipment, the work shall be conducted by a QP or organization to assure that no changes are made to the equipment that might prevent the equipment from meeting the applicable performance and safety requirements

A.4.7.2

See also NFPA 791 and OSHA Safety & Health Information Bulletin (SHIB), "Certification of Workplace Products by Nationally Recognized Testing Laboratories."



Chapter 7 Fundamental Tests

7.2.1

The quality of undisturbed bolted electrical bus connections, conductor terminations, and conductor connectors shall be verified using one or more of the methods described in 7.2.1.1 through 7.2.1.4.

7.2.1.2 Thermal Sensors

Permanently mounted thermal sensors shall be permitted to monitor the in-use temperature of electrical connections and terminations.

SEM3T Thermal Monitoring

Modular monitoring solution for thermal sensing installed inside electrical equipment to continuously monitor the thermal condition of critical joints in energized electrical equipment. This enables permanent, non-invasive, and 24x7 detection of hotspots at an early stage of development.



(cont)



Chapter 7 Fundamental Tests

7.2.1.3 Contact Resistance Test

7.2.1.3.1

A calibrated tester shall be used to obtain contact resistance test values.

7.2.1.3.2

Where contact resistance tests are used, the resistance values shall not exceed the maximum values published by the manufacturer.

7.2.1.3.3

If contact resistance values exceed the maximum values published by the manufacturer, the cause for the excess values shall be investigated.



(cont)



Chapter 7 Fundamental Tests

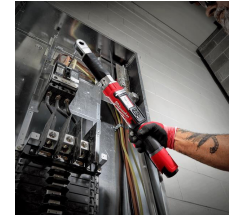
7.2.1.4 Torque Verification

7.2.1.4.1

When using a calibrated torque wrench to confirm the torque of previously installed threaded hardware, the retightening value shall not exceed 90% of the manufacturer's specified initial torque value

7.2.1.4.2

Where initial threaded hardware torque value data is not available, torque values shall be in accordance with Table 7.2.1.4.2(a), (b), or (c)



Chapter 7 Fundamental Tests

Table 7.2.1.4.2(a) Bolt-Torque Values for Electrical Connections, US Standard Fasteners – Cadmium or Zinc Plated	
Bolt Diameter (in.)	Torque (Pound-Feet)
1/4	6
5/16	11
3/8	20
7/16	32
1/2	48
9/16	70
5/8	96
3/4	160
7/8	240
1.0	370

Notes:
 (1) Consult the manufacturer for equipment supplied with metric fasteners.
 (2) The table is based on national coarse thread pitch.
 (3) The grade is SAE 5.
 (4) The minimum tensile (strength) is 105,000 lb/in.².

Table 7.2.1.4.2(b) Bolt-Torque Values for Electrical Connections, US Standard Fasteners – Silicon Bronze		
Bolt Diameter (in.)	Torque (Pound-Feet)	
	Nonlubricated	Lubricated
5/16	15	10
3/8	20	15
1/2	40	25
5/8	55	40
3/4	70	60

Notes:
 (1) Consult the manufacturer for equipment supplied with metric fasteners.
 (2) This table is based on national coarse thread pitch.
 (3) This table is based on bronze alloy bolts having a minimum 70,000 lb/in.² tensile strength.



Chapter 9 Maintenance Intervals

9.1.2.1

Once the initial frequency for inspection and tests has been established based on the intervals listed in Table 9.2.2 and the equipment condition assessment, this frequency shall be adhered to for at least two maintenance cycles unless unexpected failures occur

9.1.2.1.1

For equipment that has unexpected failures, the cause of the failure shall be used to determine if the maintenance interval for the equipment needs to be reduced

Inspection Interval



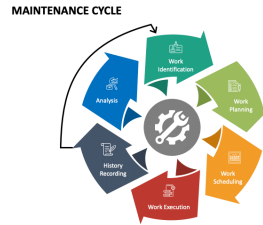
Chapter 9 Maintenance Intervals

9.1.2.1.2*

If more than two inspections are completed without requiring additional service, the equipment owner shall be permitted to resume the original inspection period.

9.1.2.2

If more than two inspections are completed without detecting equipment problems, the maintenance cycle shall be permitted to be extended to longer intervals than listed in Table 9.2.2.



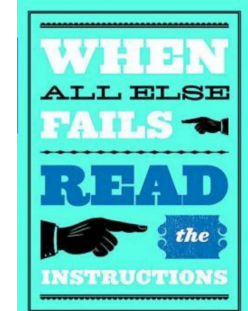
Chapter 9 Maintenance Intervals

9.2.1*

The manufacturer's recommendations shall be followed for each of the maintenance scopes specified in this standard for the required intervals.

9.2.2*

Where the manufacturer's recommendations are not provided, or available and failure, breakdown, or malfunction of the equipment will present an unacceptable risk for personnel or the environment, equipment maintenance shall be performed at not greater than the intervals specified in Table 9.2.2, in accordance with the equipment condition assessment in Section 9.2, and as modified by the other parts of this chapter.



Chapter 9 Maintenance Intervals

9.2.2.1

The intervals in Table 9.2.2 shall only be required if referenced by a specific section in another chapter

9.2.2.2

The maintenance interval for electrical equipment shall be permitted to be altered based on the potential risk to personnel or facility operations due to a failure of the equipment to operate as expected

9.2.2.3

Any deviations from the maintenance intervals described in Table 9.2.2 to extend the maintenance intervals and the justification for the deviation shall be documented in the EMP



Chapter 9 Maintenance Intervals

Product		Equipment Condition Assessment		
Scope of Work	Condition 1	Condition 2	Condition 3	
All equipment	Infrared thermography	12 months	12 months	6 months
Battery ESSs	Visual inspection	60 months	36 months	12 months
	Cleaning	60 months	36 months	12 months
	Lubrication		Reserved	
	Mechanical servicing		Reserved	
Busways	Electrical testing	60 months	36 months	12 months
	Visual inspection	60 months	60 months	12 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
Cable trays	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



Chapter 9 Maintenance Intervals

9.3

Equipment that is included in the electrical EMP shall be assessed for current equipment condition in accordance with 9.3.1.1 through 9.3.1.3.



Chapter 9 Maintenance Intervals

9.3.1.1

Equipment Physical Condition 1 shall be permitted where all the following criteria apply:

- (1) The equipment appears in like new condition
- (2) The enclosure is clean, free from moisture intrusion, and tight
- (3) No unaddressed notification from the continuous monitoring system has occurred
- (4) There are no active recommendations from predictive techniques
- (5) Previous maintenance has been performed in accordance with the EMP



Chapter 9 Maintenance Intervals

9.3.1.2

Equipment Physical Condition 2 shall be assigned where all of 9.3.1.1 apply, and where any of the following criteria apply:

- (1) Maintenance results deviate from past results or have indicated more frequent maintenance in accordance with manufacturer's published data
- (2) The previous maintenance cycle has revealed issues requiring the repair or replacement of major equipment components
- (3) There have been unaddressed notifications from the continuous monitoring system since the prior assessment
- (4) There are active recommendations from predictive techniques



Chapter 9 Maintenance Intervals

9.3.1.3

Equipment Physical Condition 3 shall be assigned where changes in operation are noted or where any of the following criteria applies:

- (1) The equipment has missed the last two successive maintenance cycles in accordance with the EMP
- (2) The previous two maintenance cycles have revealed issues requiring the repair or replacement of major equipment components
- (3) There is an active or unaddressed notification from the continuous monitoring system
- (4) There are urgent actions identified from predictive techniques



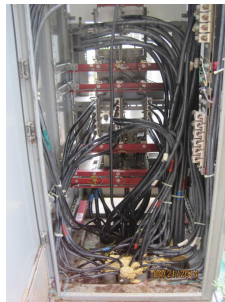
Chapter 9 Maintenance Intervals

9.3.1.4.1

Equipment that poses an imminent risk of injury or negative health effects to personnel shall be designated as nonserviceable in accordance with 8.7.1.3

9.3.1.4.2

Access to nonserviceable equipment by unqualified persons shall be restricted



Chapter 9 Maintenance Intervals

9.3.1.5 Nonconforming Equipment

Equipment exhibiting characteristics that do not conform to any of the above conditions shall be identified as requiring corrective measures before returning it to a normal operating condition



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