

# EFCOG Best Practice # 217

**Best Practice Title:** Implementing the Safety-Related Maintenance Requirements of NFPA 70E – 2018 Chapter 2

**Facility:** DOE Complex

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**Brief Description of Best Practice:** NFPA 70E considers equipment safe for use if the equipment meets criteria for properly installed, properly maintained and when used in accordance with instructions in the listing or labeling and manufacturer's instructions.

Maintenance may involve corrective, preventative, or predictive approaches to achieve a properly maintained condition. Design control, configuration management and administrative controls are also program aspects needed to ensure the safety related maintenance requirements of Chapter 2 are met.

**Why the best practice was used:** Electrical hazards (arc flash and shock) can be impacted by conditions of maintenance.

**What are the benefits of the best practice:** This Best Practice provides recommendations for meeting the intent of NFPA 70E Chapter 2, 2018 Edition.

**What problems/issues were associated with the best practice:** This Best Practice provides consistent guidance for the complex.

**How the success of the Best Practice was measured:** Success will be measured by the use of this Best Practice into complex site operating procedures.

**Description of process experience using the Best Practice:** N/A

# **EFCOG Best Practice # 217**

## **Implementing the Safety Related Maintenance Requirements of NFPA 70E Chapter 2**

NFPA 70E considers equipment safe for use if the equipment meets criteria for properly installed (installed according to the NEC and listing instructions), properly maintained (maintained according to a consensus standard or manufacturer's instructions) and used in accordance with instructions in the listing or labeling and manufacturer's instructions. Conversely, equipment that is not properly installed, maintained, and used in accordance with the listing or labeling or manufacturer's instructions has the potential to adversely impact electrical safety by increasing the likelihood of an electrical shock or arc flash event.

Maintenance is defined as preserving or restoring the condition of electrical equipment and installations, or parts of either, for the safety of employees who work where exposed to electrical hazards.

The employer/owner is responsible to ensure equipment is properly maintained. Normal operation of inadequately maintained equipment increases the risk of equipment failure and an increased risk of injury to the equipment operator and to any employee performing maintenance on exposed conductors and circuit parts.

NFPA 70E 130.5 Arc Flash Risk Assessment, Section 130.5(B), for estimating the likelihood of occurrence and the severity of injury or damage to health, requires the consideration of the electrical equipment operating condition and condition of maintenance. Section 130.5(G), Incident Energy Analysis Method again requires the consideration of the condition of maintenance of overcurrent protective devices, because the condition can have an effect on the device's clearing time, thus increasing the incident energy.

Since inadequate maintenance is a significant risk factor when performing an assessment of electrical risk, this best practice is designed to clarify the intent of the various aspects of safety-related maintenance identified in Chapter 2. Chapter 2 has sometimes been referred to as the forgotten chapter in NFPA 70E. However, its importance cannot be overstated.

Maintenance may involve corrective, preventative, or predictive approaches to achieve a properly maintained condition. Some maintenance is reactive in nature (corrective) such as when restoring a ground system damaged by earthmoving equipment. Manual actuation and periodic testing of a molded case circuit breaker is an example of preventative maintenance since these tasks help to maintain functionality by exercising necessary linkage and redistributing lubricants through the breaker. Thermography is a good example of predictive maintenance as it can provide indication of a future failure.

Some aspects of maintenance involve administrative or other controls to ensure the intent to maintain equipment in a safe configuration is achieved. For example, an administrative control could be employed to maintain a clear access to working space. Working space may also be maintained with design control to ensure new equipment is not installed and located in the footprint of existing equipment. Maintaining updated one-line drawings and diagrams are best implemented at the time new additions or modification are made to systems and is an important configuration management control. Therefore, employers/owners should evaluate whether there is a configuration management program in place to ensure drawings and diagrams are being updated as required.

NFPA 70E Chapter 2 does not prescribe specific maintenance methods or testing procedures. It is left to the contractor to choose from the various maintenance methods available to satisfy the requirements of Chapter 2. The manufacturers' instructions are the primary resource for electrical equipment maintenance, however, there are also numerous consensus standards such as NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*, ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*, and IEEE 3007.2, *IEEE Recommended Practice for the Maintenance of Industrial and Commercial Power Systems*, to aid the contractor in developing an effective maintenance program for their facilities.

In the following table, NFPA 70E Chapter 2 requirements are identified and the type of maintenance that should be applied is explained.

**CHAPTER 2 SAFETY-RELATED MAINTENANCE REQUIREMENTS**

MAINTENANCE REQUIREMENT	IMPLEMENTING MECHANISM
<p><b>ARTICLE 200</b>  <b>Introduction</b>  <b>Δ 200.1 Scope.</b> Chapter 2 addresses the requirements that follow.                      (1) Chapter 2 covers practical safety-related maintenance requirements for electrical equipment and installations in workplaces as included in 90.2. <u>These requirements identify only that maintenance directly associated with employee safety.</u></p> <p>(2) Chapter 2 does not prescribe specific maintenance methods or testing procedures. It is left to the employer to choose from the various maintenance methods available to satisfy the requirements of Chapter 2.</p> <p>(3) For the purpose of Chapter 2, maintenance shall be defined as preserving or restoring the condition of electrical equipment and installations, or parts of either, for the safety of employees who work where exposed to electrical hazards. Repair or replacement of individual portions or parts of equipment shall be permitted without requiring modification or replacement of other portions or parts that are in a safe condition.</p> <p>Informational Note: Refer to NFPA 70B, <i>Recommended Practice for Electrical Equipment Maintenance</i>; ANSI/NETA MTS, <i>Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems</i>; and IEEE 3007.2, <i>IEEE Recommended Practice for the Maintenance of Industrial and Commercial Power Systems</i>, for guidance on maintenance frequency, methods, and tests.</p>	<p><b>General information. <u>Chapter 2 identifies only the maintenance directly related to employee safety.</u></b></p> <p><b>Specific maintenance methods or testing procedures are not described. Contractor must choose from methods available in industry consensus standards or manufacturer’s instructions.</b></p> <p><b>These methods may involve corrective, preventative, predictive or administrative measures to ensure equipment is <u>preserved or restored.</u></b></p>
<p><b>ARTICLE 205</b>  <b>General Maintenance Requirements</b></p>	
<p><b>205.1 Qualified Persons.</b> Employees who perform maintenance on electrical equipment and installations shall be qualified persons as required in Chapter 1 and shall be trained in, and familiar with, the specific maintenance procedures and tests required.</p>	<p><b>Ensure employees performing maintenance are qualified in accordance with Chapter 1</b></p>
<p><b>205.2 Single-Line Diagram.</b> A single-line diagram, where provided for the electrical system, shall be maintained in a legible condition and shall be kept current.</p>	<p><b>Provide legible drawings. Ensure configuration of drawings is managed to properly maintain drawings.</b></p>

<p><b>205.3 General Maintenance Requirements.</b> Electrical equipment shall be maintained in accordance with manufacturers' instructions or industry consensus standards to reduce the risk associated with failure. The equipment owner or the owner's designated representative shall be responsible for maintenance of the electrical equipment and documentation.</p> <p>Informational Note No. 1: Common industry practice is to apply test or calibration decals to equipment to indicate the test or calibration date and overall condition of equipment that has been tested and maintained in the field. These decals provide the employee immediate indication of last maintenance date and if the tested device or system was found acceptable on the date of test. This local information can assist the employee in the assessment of overall electrical equipment maintenance status.</p> <p>Informational Note No. 2: Noncontact diagnostic methods in addition to scheduled maintenance activities of electrical equipment can assist in the identification of electrical anomalies.</p>	<p><b>When maintenance is needed that maintenance must be performed correctly in accordance with the manufacturer's instructions or an industry consensus standard such as NFPA 70B, NEMA AB 4, NETA, etc.</b></p> <p><b>This general requirement is specific to electrical safety and is not concerned with reliability.</b></p> <p><b>The specific types of equipment specified in chapter 2 fall under this requirement. Conversely equipment that is not listed does not fall under this general requirement.</b></p>
<p><b>205.4 Overcurrent Protective Devices.</b> Overcurrent protective devices shall be maintained in accordance with the manufacturers' instructions or industry consensus standards. Maintenance, tests, and inspections shall be documented.</p>	<p><b>Preventative maintenance and testing is required to verify functionality and arc flash aspects. Maintenance includes visual inspection, mechanical exercise and electrical testing. Best Practice # 203 "Risk Assessment/Operation of Overcurrent Devices" provides guidance for maintenance and testing.</b></p>
<p><b>205.5 Spaces About Electrical Equipment.</b> All working space and clearances required by electrical codes and standards shall be maintained.</p> <p>Informational Note: For further information concerning spaces about electrical equipment, see Article 110, Parts II and III, of <i>NFPA 70, National Electrical Code</i>.</p>	<p><b>This requirement is met by ensuring equipment, materials etc. are not installed or stored in the working space. Design review and use of painted lines, signs and other administrative controls are to be used.</b></p>

<p><b>205.6 Grounding and Bonding.</b> Equipment, raceway, cable tray, and enclosure bonding and grounding shall be maintained to ensure electrical continuity.</p>	<p><b>This is a corrective maintenance activity. Grounding or bonding must be preserved to maintain continuity. Maintenance is necessary if grounding or bonding continuity is compromised due to inadvertent contact with equipment. Corrosion due to adverse environment could be an issue that would require periodic corrective maintenance.</b></p> <p><b>Periodic visual inspection is recommended as part of inspection for NFPA 70E, Article 215</b></p>
<p><b>205.7 Guarding of Energized Conductors and Circuit Parts.</b> Enclosures shall be maintained to guard against unintentional contact with exposed energized conductors and circuit parts and other electrical hazards. Covers and doors shall be in place with all associated fasteners and latches secured.</p>	<p><b>Covers and guards must be kept in place except during maintenance. Covers and guards must be replaced (maintained) after LOTO is released. Generally, there is no preventative maintenance required and control is administrative. Corrective maintenance is required if cover is missing. Periodic inspection is recommended.</b></p>
<p><b>205.8 Safety Equipment.</b> Locks, interlocks, and other safety equipment shall be maintained in proper working condition to accomplish the control purpose.</p>	<p><b>Corrective maintenance may be required when indications indicate malfunction. Planned maintenance would require restoration of the safety equipment, interlock, etc. upon conclusion of the maintenance.</b></p>

<p><b>205.9 Clear Spaces.</b> Access to working space and escape passages shall be kept clear and unobstructed.</p>	<p><b>Must maintain clear access and egress. Use administrative controls to ensure access and egress is not impeded by:</b></p> <ul style="list-style-type: none"> <li>• Staging of materials, equipment</li> <li>• Equipment is not installed or stored in the clear space.</li> </ul> <p><b>Design review and use of painted lines, signs or other controls should be applied.</b></p> <p><b>No planned maintenance required.</b></p> <p><b>Periodic inspection is recommended.</b></p>
<p><b>205.10 Identification of Components.</b> Identification of components, where required, and safety-related instructions (operating or maintenance), if posted, shall be securely attached and maintained in legible condition.</p>	<p><b>Identification of components is accomplished in accordance with NEC requirements. This is a configuration management function.</b></p> <p><b>Periodic inspection is recommended.</b></p>
<p><b>205.11 Warning Signs.</b> Warning signs, where required, shall be visible, securely attached, and maintained in legible condition.</p>	<p><b>Signage is provided in accordance with NFPA 70, Article 110.27(e). Must be maintained in legible condition. Posting and maintenance of signage must be replaced if not legible. Periodic inspection is recommended.</b></p>
<p><b>205.12 Identification of Circuits.</b> Circuit or voltage identification shall be securely affixed and maintained in updated and legible condition.</p>	<p><b>Service directories must be completed and updated/maintained if a change in configuration occurs. This is a configuration management function. Periodic inspection is recommended.</b></p>
<p><b>205.13 Single and Multiple Conductors and Cables.</b> Electrical cables and single and multiple conductors shall be maintained free of damage, shorts, and ground that would expose employees to an electrical hazard.</p>	<p><b>Cables must be protected from damage. If inadvertently damaged, maintenance would be performed to correct the problem. There is no periodic maintenance prescribed. Inspections recommended</b></p>

	<p>under NFPA 70E, Article 215 ensure cables are free from damage, shorts and grounds.</p>
<p><b>205.14 Flexible Cords and Cables.</b> Flexible cords and cables shall be maintained to preserve insulation integrity.</p> <p>(1) Damaged Cords and Cables. Cords and cables shall not have worn, frayed, or damaged areas that would expose employees to an electrical hazard.</p> <p><b>(2) Strain Relief.</b> Strain relief of cords and cables shall be maintained to prevent pull from being transmitted directly to joints or terminals.</p> <p>(3) Repair and Replacement. Cords and cord caps for portable electrical equipment shall be repaired and replaced by qualified personnel and checked for proper polarity, grounding, and continuity prior to returning to service.</p>	<p><b>An inspection by the user is required by the user in accordance with NFPA 70E Article 110.5(C) before each use. If evidence of damage is found the cord or cable must be removed from service and repaired or replaced.</b></p> <p><b>If strain relief is compromised cord must be removed from service and repaired or replaced</b>  <b>Repairs must be performed by qualified personnel.</b></p> <p><b>Periodic inspection is recommended.</b></p>
<p><b>205.15 Overhead Line Clearances.</b> For overhead electric lines under the employer’s control, grade elevation shall be maintained to preserve no less than the minimum designed vertical and horizontal clearances necessary to minimize risk of unintentional contact</p>	<p><b>Maintenance of overhead lines clearances is required if grading is performed. There is no preventative maintenance required.</b></p> <p><b>An administrative consideration for project management if work is performed in the right-of-way.</b></p>
<p><b>ARTICLE 210</b>  <b>Substations, Switchgear Assemblies, Switchboards, Panelboards, Motor Control Centers, and Disconnect Switches</b></p>	
<p><b>210.1 Enclosures.</b> Enclosures shall be kept free of material that would expose employees to an electrical hazard.</p>	<p><b>Administratively control is used to meet requirement. Qualified persons administer this requirement during maintenance.</b>  <b>Consider environment and determine proper interval for planned maintenance.</b></p>



<p><b>210.2 Area Enclosures.</b> Fences, physical protection, enclosures, or other protective means, where required to guard against unauthorized access or unintentional contact with exposed energized conductors and circuit parts, shall be maintained.</p>	<p><b>A corrective maintenance issue. Fences, enclosures, and gates are maintained by qualified persons during maintenance evolutions. Area enclosures must be repaired and maintained if damaged. This is a corrective maintenance activity and there is no preventative maintenance necessary.</b></p>
<p><b>210.3 Conductors.</b> Current-carrying conductors (buses, switches, disconnects, joints, and terminations) and bracing shall be maintained to perform as follows:  (1) Conduct rated current without overheating  (2) Withstand available fault current</p>	<p><b>Static current carrying conductors are verified during the installation. Gear must be repaired if damaged. Check for tightness. Thermography is recommended.</b></p>
<p><b>210.4 Insulation Integrity.</b> Insulation integrity shall be maintained to support the voltage impressed.</p>	<p><b>Conductors are verified during the installation. Gear must be repaired if damaged. There is no preventative maintenance required.</b></p>
<p><b>210.5 Protective Devices.</b> Protective devices shall be maintained to adequately withstand or interrupt available fault current.</p> <p>Informational Note: Improper or inadequate maintenance can result in increased opening time of the overcurrent protective device, thus increasing the incident energy.</p>	<p><b>Protective devices are required to be maintained. Various consensus standards NFPA 70B, NETA MTS, etc. and manufacturer’s instructions provide guidance for verifying functionality after a fault. Preventative maintenance should be performed. Where protective devices have incident energies exceeding 1.2 cal/cm<sup>2</sup>, instantaneous and 300% overcurrent tests are recommended to validate functionality and associated arc flash calculations and PPE prescribed.</b></p>

<p><b>ARTICLE 215</b> <b>Premises Wiring</b></p>	
<p><b>215.1 Covers for Wiring System Components.</b> Covers for wiring system components shall be in place with all associated hardware, and there shall be no unprotected openings.</p>	<p><b>Turnover inspection is recommended after installation. Covers are replaced after completion of maintenance evolutions. There is no preventative maintenance required. Periodic inspection is recommended.</b></p>
<p><b>215.2 Open Wiring Protection.</b> Open wiring protection, such as location or barriers, shall be maintained to prevent unintentional contact.</p>	<p><b>Guarding by location or elevation is maintained and considered during maintenance. There is no preventative maintenance required. Periodic inspection is recommended.</b></p>
<p><b>215.3 Raceways and Cable Trays.</b> Raceways and cable trays shall be maintained to provide physical protection and support for conductors.</p>	<p><b>Proper location and installation ensures cables are physically protected from damage. If damage occurs due to a falling object corrective maintenance is required.</b></p> <p><b>Cable trays are equipment grounding conductors. Bonding and grounding continuity must be maintained/repaired if compromised. This a corrective maintenance activity and there normally is no preventative maintenance necessary.</b></p> <p><b>Periodic inspection is recommended.</b></p>
<p><b>ARTICLE 220</b> <b>Controller Equipment</b></p>	
<p><b>220.1 Scope.</b> This article shall apply to controllers, including electrical equipment that governs the starting, stopping, direction of motion, acceleration, speed, and protection of rotating equipment and other power utilization apparatus in the workplace.</p>	<p>NA</p>

<p><b>220.2 Protection and Control Circuitry.</b> Protection and control circuitry used to guard against unintentional contact with exposed energized conductors and circuit parts and to prevent other electrical or mechanical hazards shall be maintained.</p>	<p><b>If covers are removed for repairs or maintenance they must be reinstalled to ensure protection from energized circuit conductors is maintained.</b></p> <p><b>Preoperational check is required. Corrective maintenance is needed if preoperational check indicates a failure of the control circuitry.</b></p>
<p><b>ARTICLE 225</b> <b>Fuses and Circuit Breakers</b></p>	
<p><b>225.1 Fuses.</b> Fuses shall be maintained free of breaks or cracks in fuse cases, ferrules, and insulators. Fuse clips shall be maintained to provide adequate contact with fuses. Fuseholders for current-limiting fuses shall not be modified to allow the insertion of fuses that are not current-limiting. Non-current limiting fuses shall not be modified to allow their insertion into current limiting fuseholders.</p>	<p><b>Corrective maintenance activities must be performed in accordance with manufacturer’s instructions or consensus standards.</b></p> <p><b>Periodic inspection recommended.</b></p> <p><b>Thermography is recommended as a predictive maintenance activity.</b></p> <p><b>Fuses should not be pulled to complete visual inspection.</b></p>
<p><b>225.2 Molded-Case Circuit Breakers.</b> Molded-case circuit breakers shall be maintained free of cracks in cases and cracked or broken operating handles.</p>	<p><b>Preventative maintenance includes, inspection, exercise and electrical testing. MCCBs are required to be maintained. Various consensus standards NFPA 70B, NETA MTS, etc. and manufacturer’s instructions provide guidance for preventative maintenance should also be performed. Where protective devices have incident energies exceeding 1.2 cal/cm<sup>2</sup>, instantaneous and 300% overcurrent tests are recommended to validate arc flash calculation and PPE prescribed.</b></p>

	<p>There is typically no corrective maintenance other than replacement. MCCBs do not contain internally serviceable parts. They are replaced when there is failure or evidence of impending failure.</p>
<p><b>225.3 Circuit Breaker Testing After Electrical Faults.</b> Circuit breakers that interrupt faults approaching their interrupting ratings shall be inspected and tested in accordance with the manufacturers instructions.</p>	<p>Fault condition must be corrected. Molded case circuit breakers must be replaced or retested after opening due to a fault prior to placing back into service. NEMA AB-4 provides guidance for testing.</p> <p>If the MIMCB fails test(s) they need to be replaced.</p>
<p><b>ARTICLE 230</b>  <b>Rotating Equipment</b>  <b>230.1 Terminal Boxes.</b> Terminal chambers, enclosures, and terminal boxes shall be maintained to guard against unintentional contact with exposed energized conductors and circuit parts and other electrical hazards.</p>	<p>If covers for boxes, enclosures are removed for repairs or maintenance they must be reinstalled to ensure protection from energized circuit conductors is maintained. This is not a preventative maintenance activity.</p> <p>Periodic inspection is recommended.</p>
<p><b>230.2 Guards, Barriers, and Access Plates.</b> Guards, barriers, and access plates shall be maintained to prevent employees from contacting moving or energized parts.</p>	<p>If guards are removed for repairs or maintenance they must be reinstalled to ensure protection from energized circuit conductors is maintained. This is a part of regularly scheduled maintenance. Preventative maintenance is not prescribed otherwise.</p> <p>Periodic inspection is recommended.</p>

**ARTICLE 235**

**Hazardous (Classified) Locations**

235.1 Scope. This article covers maintenance requirements in those areas identified as hazardous (classified) locations.  
Informational Note No. 1: These locations need special types of equipment and installation to ensure safe performance under conditions of proper use and maintenance. It is important that inspection authorities and users exercise more than ordinary care with regard to installation and maintenance. The maintenance for specific equipment and materials is covered elsewhere in Chapter 2 and is applicable to hazardous (classified) locations.

Other maintenance will ensure that the form of construction and of installation that makes the equipment and materials suitable for the particular location are not compromised.

Informational Note No. 2: The maintenance needed for specific hazardous (classified) locations depends on the classification of the specific location. The design principles and equipment characteristics, for example, use of positive pressure ventilation, explosion proof, non-incendive, intrinsically safe, and purged and pressurized equipment, that were applied in the installation to meet the requirements of the area classification must also be known. With this information, the employer and the inspection authority are able to determine whether the installation as maintained has retained the condition necessary for a safe workplace.

**Verified during the design and installation.**

**Maintenance needed is based on the classification and listing instructions.**

<p><b>235.2 Maintenance Requirements for Hazardous (Classified) Locations.</b> Equipment and installations in these locations shall be maintained such that the following criteria are met:</p> <p>(1) No energized parts are exposed.</p> <p>Exception to (1): Intrinsically safe and nonincendive circuits.</p> <p>(2) There are no breaks in conduit systems, fittings, or enclosures from damage, corrosion, or other causes.</p> <p>(3) All bonding jumpers are securely fastened and intact.</p> <p>(4) All fittings, boxes, and enclosures with bolted covers have all bolts installed and bolted tight.</p> <p>(5) All threaded conduit are wrenchtight and enclosure covers are tightened in accordance with the manufacturer’s instructions.</p> <p>(6) There are no open entries into fittings, boxes, or enclosures that would compromise the protection characteristics.</p> <p>(7) All close-up plugs, breathers, seals, and drains are securely in place.</p> <p>(8) Marking of luminaires (lighting fixtures) for maximum lamp wattage and temperature rating is legible and not exceeded.</p> <p>(9) Required markings are secure and legible.</p>	<p><b>The integrity of components must be maintained to meet original design specifications.</b></p> <p><b>The safety requirements of this section are invoked if corrective maintenance is needed.</b></p> <p><b>There is no preventative maintenance required.</b></p> <p><b>Perform any corrective maintenance in accordance with listing instructions.</b></p> <p><b>Periodic inspection is recommended.</b></p>
<p><b>ARTICLE 240</b></p> <p><b>Batteries and Battery Rooms</b></p> <p><b>240.1 Ventilation.</b> When forced or natural ventilation systems are required by the battery system design and are present, they shall be examined and maintained to prevent buildup of explosive mixtures. This maintenance shall include a functional test of any associated detection and alarm systems.</p> <p>Informational Note: “Natural ventilation” implies there are no mechanical mechanisms. Maintenance includes activities such as inspection and removal of any obstructions to natural air flow.</p>	<p><b>Functional tests are required of detection and alarm systems where provided.</b></p> <p><b>Test should be performed in accordance with the manufacturer’s instructions.</b></p> <p><b>Maintenance includes activities such as inspection and removal of any obstructions to natural air flow.</b></p> <p><b>See NFPA 70E, Article 320 for additional information.</b></p>

<p><b>240.2 Eye and Body Wash Apparatus.</b> Eye and body wash apparatus shall be maintained in operable condition.</p>	<p><b>OSHA 1910.151(c) requires a monthly functional test to ensure operability.</b></p>
<p><b>ARTICLE 245</b>  <b>Portable Electric Tools and Equipment</b>  <b>245.1 Maintenance Requirements for Portable Electric Tools and Equipment.</b> Attachment plugs, receptacles, cover plates, and cord connectors shall be maintained such that the following criteria are met:  (1) There are no breaks, damage, or cracks exposing energized conductors and circuit parts.  (2) There are no missing cover plates.  (3) Terminations have no stray strands or loose terminals.  (4) There are no missing, loose, altered, or damaged blades, pins, or contacts.  (5) Polarity is correct.</p>	<p><b>User is required to perform inspection before each use (see NFPA 70E Article 110.5(C). If inspection reveals a deficiency, the equipment must be removed from service and repaired/replaced.</b></p> <p><b>Equipment must be repaired and maintained prior to placing back into service.</b></p>

**ARTICLE 250**

**Personal Safety and Protective Equipment**

**250.1 Maintenance Requirements for Personal Safety and**

**Protective Equipment.** Personal safety and protective equipment such as the following shall be maintained in a safe working condition:

- (1) Grounding equipment
- (2) Hot sticks
- (3) Rubber gloves, sleeves, and leather protectors
- (4) Test instruments
- (5) Blanket and similar insulating equipment
- (6) Insulating mats and similar insulating equipment
- (7) Protective barriers
- (8) External circuit breaker rack-out devices
- (9) Portable lighting units\*
- (10) Temporary protective grounding equipment
- (11) Dielectric footwear
- (12) Protective clothing
- (13) Bypass jumpers
- (14) Insulated and insulating hand tools

**250.2 Inspection and Testing of Protective Equipment and Protective Tools.**

(A) Visual. Safety and protective equipment and protective tools shall be visually inspected for damage and defects before initial use and at intervals thereafter, as service conditions require, but in no case shall the interval exceed 1 year, unless specified otherwise by the applicable state, federal, or local codes and standards.

Δ (B) Testing. The insulation of protective equipment and protective tools, such as items specified in 250.1(1) through 250.1(14), that is used as primary protection from shock hazards and requires an insulation system to ensure protection of personnel, shall be verified by the appropriate test and visual inspection to ascertain that insulating capability has been retained before initial use, and at intervals thereafter, as service conditions and applicable standards and instructions require, but in no case shall the interval exceed 3 years.

**Personal Safety and Protective Equipment is inspected by the user prior to use.**

**If inspection reveals deficiency then equipment must be maintained before it can be returned to service.**

**Items 1-14 are verified by the appropriate visual inspection or test in accordance with the applicable standard.**

**Some types of safety equipment do not have an applicable test protocol. The following items are subject only to visual inspection:**

- **Leather protectors,**
- **insulating mats,**
- **Protective barriers**
- **External circuit breaker rackout devices,**
- **Portable lighting units.**
- **Protective clothing,**
- **Bypass jumpers,**



<p><b>250.3 Safety Grounding Equipment.</b></p> <p>(A) Visual. Personal protective ground cable sets shall be inspected for cuts in the protective sheath and damage to the conductors. Clamps and connector strain relief devices shall be checked for tightness. These inspections shall be made at intervals thereafter as service conditions require, but in no case shall the interval exceed 1 year.</p> <p>(B) Testing. Prior to being returned to service, temporary protective grounding equipment that has been repaired or modified shall be tested.</p> <p>Informational Note: Guidance for inspecting and testing safety grounds is provided in ASTM F2249, Standard Specification for In-Service Test Methods for Temporary Grounding Jumper Assemblies Used on De-Energized Electric Power Lines and Equipment.</p> <p>(C) Grounding and Testing Devices. Grounding and testing devices shall be stored in a clean and dry area. Grounding and testing devices shall be properly inspected and tested before each use.</p> <p>Informational Note: Guidance for testing of grounding and testing devices is provided in Section 9.5 of IEEE C37.20.6, Standard for 4.76 kV to 38 kV-Rated Ground and Test Devices Used in Enclosures.</p>	<p><b>Safety grounds are tested and maintained periodically as the standard requires.</b></p> <p><b>Review listing instructions for ground trucks</b></p> <p><b>G&amp;T devices are often stored for long periods and infrequently used. They need to be stored in a clean, dry area and inspected and tested before each use.</b></p> <p><b>NOTE: The manufacturers typically require inspection prior to use and identify testing protocol but don't specify a frequency. NFPA 70E and the IEEE standard specifies testing before each use.</b></p>
<p><b>250.4 Test Instruments.</b> Test instruments and associated test leads used to verify the absence or presence of voltage shall be maintained to assure functional integrity. The maintenance program shall include functional verification as described in 110.4(A)(E).</p>	<p><b>Visual inspection of leads, connector, probes, etc. required prior to use in accordance with NFPA 70E 110.4(A)(E).</b></p> <p><b>Must remove from service the damaged item if any defects or evidence of damage is found.</b></p> <p><b>Functionality of test instruments must be verified prior to and after taking voltage taking measurements in accordance with NFPA 70E Articles 110.4(A)(E) and 120.5(7).</b></p>