Chapter 2 Safety-Related Maintenance Requirements

ARTICLE 200
Introduction

200.1 Scope. 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. These requirements identify only that maintenance directly associated with employee safety.

(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.

(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.

Informational Note: Refer to 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*, for guidance on maintenance frequency, methods, and tests.

ARTICLE 205
General Maintenance Requirements

205.1 Qualified Persons. 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.

205.2 Single-Line Diagram. A single-line diagram, where provided for the electrical system, shall be maintained in a legible condition and shall be kept current.

205.3 General Maintenance Requirements. 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.

Informational Note: 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.

205.4 Overcurrent Protective Devices. Overcurrent protective devices shall be maintained in accordance with the manufacturers' instructions or industry consensus standards. Maintenance, tests, and inspections shall be documented.

205.5 Spaces About Electrical Equipment. All working space and clearances required by electrical codes and standards shall be maintained.

Informational Note: For further information concerning spaces about electrical equipment, see Article 110, Parts II and III, of *NFPA 70*, *National Electrical Code*.

205.6 Grounding and Bonding. Equipment, raceway, cable tray, and enclosure bonding and grounding shall be maintained to ensure electrical continuity.

205.7 Guarding of Energized Conductors and Circuit Parts. Enclosures shall be maintained to guard against accidental contact with energized conductors and circuit parts and other electrical hazards. Covers and doors shall be in place with all associated fasteners and latches secured.

205.8 Safety Equipment. Locks, interlocks, and other safety equipment shall be maintained in proper working condition to accomplish the control purpose.

205.9 Clear Spaces. Access to working space and escape passages shall be kept clear and unobstructed.

205.10 Identification of Components. Identification of components, where required, and safety-related instructions (operating or maintenance), if posted, shall be securely attached and maintained in legible condition.

205.11 Warning Signs. Warning signs, where required, shall be visible, securely attached, and maintained in legible condition.

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205.12 Identification of Circuits. Circuit or voltage identification shall be securely affixed and maintained in updated and legible condition.

205.13 Single and Multiple Conductors and Cables. Electrical cables and single and multiple conductors shall be maintained free of damage, shorts, and ground that would expose employees to an electrical hazard.

205.14 Flexible Cords and Cables. Flexible cords and cables shall be maintained to preserve insulation integrity.

(1) Damaged Cords and Cables. Cords and cables shall not have worn, frayed, or damaged areas that would expose employees to an electrical hazard.

(2) Strain Relief. Strain relief of cords and cables shall be maintained to prevent pull from being transmitted directly to joints or terminals.

(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.

205.15 Overhead Line Clearances. 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.

ARTICLE 210
Substations, Switchgear Assemblies, Switchboards, Panelboards, Motor Control Centers, and Disconnect Switches

210.1 Enclosures. Enclosures shall be kept free of material that would expose employees to an electrical hazard.

210.2 Area Enclosures. Fences, physical protection, enclosures, or other protective means, where required to guard against unauthorized access or accidental contact with exposed energized conductors and circuit parts, shall be maintained.

210.3 Conductors. 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

210.4 Insulation Integrity. Insulation integrity shall be maintained to support the voltage impressed.

210.5 Protective Devices. Protective devices shall be maintained to adequately withstand or interrupt available fault current.

Informational Note: Improper or inadequate maintenance can result in increased opening time of the overcurrent protective device, thus increasing the incident energy.

ARTICLE 215
Premises Wiring

215.1 Covers for Wiring System Components. Covers for wiring system components shall be in place with all associated hardware, and there shall be no unprotected openings.

215.2 Open Wiring Protection. Open wiring protection, such as location or barriers, shall be maintained to prevent accidental contact.

215.3 Raceways and Cable Trays. Raceways and cable trays shall be maintained to provide physical protection and support for conductors.

ARTICLE 220
Controller Equipment

220.1 Scope. 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.

220.2 Protection and Control Circuitry. Protection and control circuitry used to guard against accidental contact with energized conductors and circuit parts and to prevent other electrical or mechanical hazards shall be maintained.

ARTICLE 225
Fuses and Circuit Breakers

225.1 Fuses. Fuses shall be maintained free of breaks or cracks in fuse cases, ferrules, and insulators. Fuse clips

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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.

225.2 Molded-Case Circuit Breakers. Molded-case circuit breakers shall be maintained free of cracks in cases and cracked or broken operating handles.

225.3 Circuit Breaker Testing After Electrical Faults. Circuit breakers that interrupt faults approaching their interrupting ratings shall be inspected and tested in accordance with the manufacturer's instructions.

ARTICLE 230
Rotating Equipment

230.1 Terminal Boxes. Terminal chambers, enclosures, and terminal boxes shall be maintained to guard against accidental contact with energized conductors and circuit parts and other electrical hazards.

230.2 Guards, Barriers, and Access Plates. Guards, barriers, and access plates shall be maintained to prevent employees from contacting moving or energized parts.

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, explosionproof, nonincendive, 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.

235.2 Maintenance Requirements for Hazardous (Classified) Locations. Equipment and installations in these locations shall be maintained such that the following criteria are met:

(1) No energized parts are exposed.

Exception to (1): Intrinsically safe and nonincendive circuits.

(2) There are no breaks in conduit systems, fittings, or enclosures from damage, corrosion, or other causes.

(3) All bonding jumpers are securely fastened and intact.

(4) All fittings, boxes, and enclosures with bolted covers have all bolts installed and bolted tight.

(5) All threaded conduit are wrenchtight and enclosure covers are tightened in accordance with the manufacturer's instructions.

(6) There are no open entries into fittings, boxes, or enclosures that would compromise the protection characteristics.

(7) All close-up plugs, breathers, seals, and drains are securely in place.

(8) Marking of luminaires (lighting fixtures) for maximum lamp wattage and temperature rating is legible and not exceeded.

(9) Required markings are secure and legible.

ARTICLE 240
Batteries and Battery Rooms

240.1 Ventilation. Ventilation systems, forced or natural, shall be maintained to prevent buildup of explosive mixtures. This maintenance shall include a functional test of any associated detection and alarm systems.

240.2 Eye and Body Wash Apparatus. Eye and body wash apparatus shall be maintained in operable condition.

ARTICLE 245
Portable Electric Tools and Equipment

245.1 Maintenance Requirements for Portable Electric Tools and Equipment. Attachment plugs, receptacles,

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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.

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 respective ASTM standards.

(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.

250.3 Safety Grounding Equipment.

(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.

(B) Testing. Prior to being returned to service, temporary protective grounding equipment that has been repaired or modified shall be tested.

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*.

(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.

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*.

250.4 Test Instruments. 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)(5).

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