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# NFPA 70B The New Standard!

**Presented by:**

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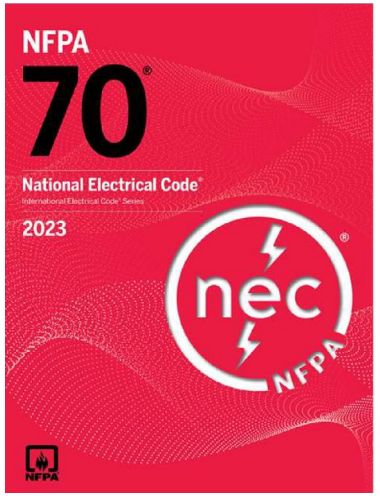
## 2.4 References for Extracts in Mandatory Sections.

NFPA 70®, National Electrical Code®, 2023 edition.
NFPA 70E®, Standard for Electrical Safety in the Workplace®, 2021 edition (2024is now out)

**These are the most recent revision cycles:**

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# 4.2 Electrical Maintenance Program (EMP).

**4.2.1 General.**
The equipment owner shall implement and document an overall EMP that directs activity appropriate to the safety and operational risks.
**4.2.2 Inspection.**

**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.
**4.2.2.2**
Equipment-specific maintenance tasks shall be developed utilizing the information gathered during the inspection.


## 4.2.3 Condition of Maintenance.

The EMP shall include elements that consider current condition of maintenance of
electrical equipment and systems as well as the potential safety and operational risks to maintenance and operational personnel. (New Annex S in NFPA-70E)

**What EXACTLY does it mean to consider the condition of maintenance?**

- Follow the manufacturer's instructions and recommendations
- NFPA-70B is now the maintenance standard providing a road map when manufacture instructions are
  absent or incomplete.
- Do not miss maintenance cycles. (adverse affects on safety and longevity)
- NFPA-70E & 70B requires an ongoing, documented electrical maintenance program with concise record


## 4.2.3 Condition of Maintenance.

The EMP shall include elements that consider current condition of maintenance of electrical equipment and systems as well as the potential safety and operational risks to maintenance and operational personnel. (New Annex S in NFPA-70E)

**What EXACTLY does it mean to consider the condition of maintenance?**

S.2 Assess the Risk (Eliminate is Priority)
S.3 Visual Inspection (Licensed Technicians)
S.4 Periodic Testing and Inspection (Basic, Premium, Prime)
S.5 Permanently Installed Monitoring (Exitherm)
S.6 Predictive Techniques (Technologies)
S.7 Maintenance History.
S.8 Standard for Electrical Equipment Maintenance (NFPA-70B)




# Risk Assessments and Condition of Maintenance.

- 2024 NFPA-70E requires our risk assessment take into consideration the condition of maintenance.
- Are we doing all that is required for compliance?
- Particularly with overcurrent devices as it pertains to arc flash energies
- Which devices and what tests should we be considering?

15.1.1

This chapter identifies electrical maintenance requirements for the following circuit breakers and their enclosures:

(1) Molded-case circuit breakers (MCCBs) rated less than or equal to 1000 V ac.
(2) Insulated-case circuit breakers (ICCBs) rated less than or equal to 1000 V ac.
(3) Low-voltage power circuit breakers (LVPCBs) rated less than or equal to 1000 V ac.
(4) Medium-voltage power circuit breakers (MVPCBs) rated greater than 1000 V ac to less than or equal to 69 kV ac.

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## 8.3.1 Category 1 — Online Standard Test

Online standard tests shall include testing procedures performed while the
electrical equipment or device is connected to the source of supply.

## 8.3.2 Category 1A — Online Enhanced Test

Online enhanced tests shall include certain testing procedures performed while the electrical equipment or device is connected to the source of supply and that are not typically performed in normal electrical maintenance activities and that provide additional diagnostic information. (See A. 8.3.)

# NFPA 70B

## 8.3.3 Category 2 — Offline Standard Test

Offline standard tests shall include testing procedures performed while the
electrical equipment or device is disconnected from the source of supply or is
connected to an external test voltage source of supply.

## 8.3.4 Category 2A — Offline Enhanced Test

Offline enhanced tests shall include certain testing procedures performed while the electrical equipment or device is disconnected from the source of supply or is connected to an external test voltage source of supply and that are not typically performed in normal electrical maintenance activities and that provide additional diagnostic


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# Some excerpts for overcurrent devices

12

## 15.3.2 Cleaning.

## 15.3.2

Electrical equipment surfaces, enclosures, and insulating materials shall be kept in a clean and contaminant-free state.

## 15.3.2.2

If contamination such as dust, dirt, soot, grease, or moisture is found, cleaning shall
be performed in accordance with Table 15.3.2.2.

## 15.3.3 Lubrication.

Moving and sliding surfaces shall be lubricated in accordance with Table 15.3.3.


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**Some excerpts for overcurrent devices**

# 15.3.4 Mechanical Servicing.

Circuit breakers shall be mechanically serviced in accordance with Table 15.3.4.

Table 15.3.4 MCCB, ICCB, and LVPCB Mechanical Servicing

| No. | Task | MCCB Test Type* | ICCB Test Type* | LVPCB Test Type* | Notes |
|---|---|---|---|---|---|
| 1 | Check all accessible electrical hardware connections for correct torque | 2 | 2 | 2 | See Chapter 7. |
| 2 | Operate the circuit breaker three times | 2 | 2 | 2 | |
| 3 | Verify operation and alignment of mechanical safety interlocks, where applicable | 2 | 2 | 2 | |
| 4 | Verify correct operation of shutter assemblies on draw-out circuit breakers | 2 | 2 | 2 | |
| 5 | Measure and record trip bar force | NA | 2A | 2A | |

**NA: Not applicable.**
***Types specified in accordance with Section 8.3, as follows: Type 1 = online standard test; Type 1A = online enhanced test; Type 2 = offline standard test; Type 2A = offline enhanced test.**


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**Some excerpts for overcurrent devices**

# 15.3.5* Electrical Testing.- (THE BIG ONE TO ME)

Circuit breakers shall be electrically tested in accordance with Table 15.3.5.

**Table 15.3.5 MCCB, ICCB, and LVPCB Electrical Tests**

| No. | Task | MCCB† 250 Amperes and Less Frame Test Type* | MCCB† Over 250 Amperes Frame Test Type* | ICCB Test Type* | LVPCB Test Type* | |
|---|---|---|---|---|---|---|
| 1 | Perform infrared thermography | 1 | 1 | 1 | 1 | |
| 2 | Measure contact resistance of each switching pole | 2A | 2 | 2 | 2 | |
| 3 | Perform insulation-resistance tests, phase-to-phase and phase-to-ground with crcuit breaker closed and across each open pole | 2A | 2 | 2 | 2 | |
| 4 | Operate circuit breaker auxiliary and control devices such as local and remote-control switches, shunt trips coils, close coils, motors, auxiliary switches, and under-voltage coils | 2 | 2 | 2 | 2 | |
| 5 | Verify the calibration of all functions of the trip unit by means of the manufacturer's specified test set for circuit breakers equipped with electronic trip units | 2A | 2 | 2 | 2 | |
| 6 | Perform inverse time trip test at 300% of rated continuous current of thermal magnetic circuit | 2A | 2 | NA | NA | |


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**Some excerpts for overcurrent devices**

# 15.3.5* Electrical Testing.- (THE BIG ONE TO ME)

Circuit breakers shall be electrically tested in accordance with Table 15.3.5.

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | Perform inverse time trip test at 300% of rated continuous current of electronic trip circuit breakers | 2A | 2A | 2A | 2A | |
| 8 | Perform the instantaneous overcurrent trip test for thermal-magnetic circuit breakers by "run-up" or "pulse" method | 2A | 2 | NA | 2 | |
| 9 | Perform the instantaneous overcurrent trip test for electronic trip breakers by "run-up" or "pulse" method | 2A | 2A | 2A | 2A | |
| 10 | Perform rated hold-in test | 2A | 2A | 2A | 2A | |
| 11 | Test current-limiter resistance | 2 | 2 | 2 | 2 | |
| 12 | Check status of rating plug battery | 2 | 2 | 2 | 2 | |
| 13 | Perform millivolt drop test | 2A | 2A | 2A | 2A | |
| 14 | Test arc reduction technology in accordance with the manufacturer's instructions | 2 | 2 | 2 | 2 | |

**NA: Not applicable.**
***Types specified in accordance with Section 8.3, as follows: Type 1 = online standard test; Type 1A = online enhanced test; Type 2 = offline standard test; Type 2A = offline enhanced test.**
**†The rating of adjustable-trip circuit breakers shall be the maximum setting possible.**


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# What does this mean for us?

## Reviewing the basics:

- Guides – Informational from advisors with “pointers” on how to’s
- **Recommended Practice – Explanatory information with best practice suggestions**

  **(where we were pre-2023)**
- **Standards – Mandated, enforceable procedures necessary to meet codes**

  **(where we are NOW moving forward)**
- **Codes – Industry based “laws” enacted by authorities.**

# Areas of Emphasis


## The roadmap to reliability and reduced costs

- Electrical equipment maintenance requirements and procedures.
- Documented, ongoing maintenance program.
- Concise records containing tests, results, repairs, and replacements and verifications.
- Training and continuing education of personnel responsible for maintenance tasks.
- Safety considerations to reduce and eliminate electrical hazards.
- Continuous improvement.


# CHAPTER 7

# Fundamental Tests

## Chapter 7 Fundamental Tests

N

N 7.1 **Fundamental Tests.** The fundamental test procedures described in this chapter shall be used where required elsewhere in this standard.

N 7.2 **Bolted Bus Connections, Conductor Terminations, and Conductor Connectors.**

N 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.

N 7.2.1.1 **Infrared Thermographic Inspection of Electrical Connections.** Infrared thermographic inspection of electrical connections and terminations shall be performed in accordance with Section 7.4.

N 7.2.1.2 **Thermal Sensors.** Permanently mounted thermal sensors shall be permitted to monitor the temperature of electrical connections and terminations. N

N 7.2.1.3 **Contact Resistance Test.**

N 7.2.1.3.1 A calibrated tester shall be used to obtain contact resistance test values.

N 7.2.1.3.2 Where contact resistance tests are used, the resistance values shall not exceed the maximum values published by the manufacturer.

N 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.

N 7.2.1.4 **Torque Verification.**

N 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 percent of the manufacturer's specified initial


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# Fundamental Test: Infrared Thermography

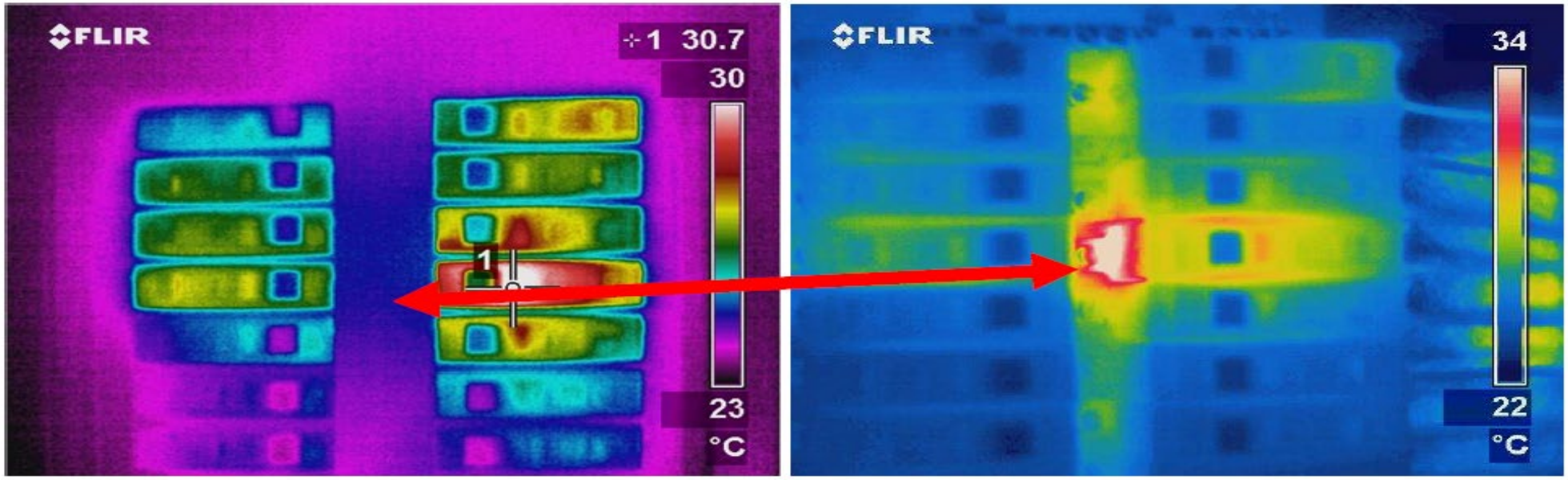
**7.4.1**

Infrared thermography shall be used when required to verify temperature differences (ΔT) of the following:

(1) Similar electrical components under similar loading

(2) Comparison between electrical components and ambient air temperatures


# Fundamental Test: Infrared Thermography




**7.4.2**

All accessible and necessary covers **shall** be removed prior to infrared thermography inspection to provide a clear line of sight to the equipment being scanned




# Maintenance checklist

A safe, reliable electrical infrastructure requires a well-planned electrical maintenance program:

1. Conduct an assessment — PSE / Options Development
2. Identify priorities — Test/Inspect/Repair/Replace
3. Determine maintenance tasks — Basic, Premium Prime
4. Create a schedule — Dispatching


# Maintenance checklist

A safe, reliable electrical infrastructure requires a well-planned electrical maintenance program:

1. Conduct an assessment
2. Identify priorities
3. Determine maintenance tasks
4. Create a schedule
5. Establish procedures ← OEM/70E/70B/NETA
6. Assign responsibility ← Technicians /DES
7. Establish a tracking system ← TEGGPro/CARE


# 9.2 Frequency of Maintenance

**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.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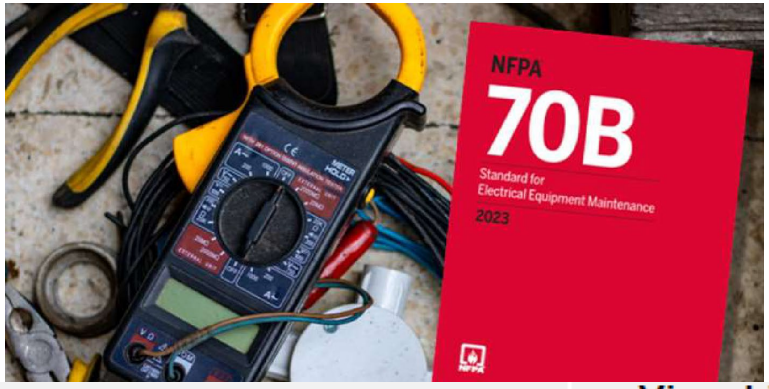
## Table 9.2.2 Maintenance Intervals

### Equipment Condition Assessment

| Condition 1 | Condition 2 | Condition 3 |
|---|---|---|

| Equipment | Cleaning | 60 months | 36 months | 12 months |
|---|---|---|---|---|
| | Servicing | 60 months | 36 months | 12 months |
| Lighting control systems | | | Reserved | |
| | Visual inspection | 12 months | 12 months | 6 months |
| Low-voltage ground-fault protection systems | Cleaning | 60 months | 36 months | 12 months |
| | Lubrication | | Reserved | |
| | Mechanical servicing | 60 months | 36 months | 12 months |
| | Electrical testing | 60 months | 36 months | 12 months |
| | Visual inspection | 12 months | 12 months | 6 months |
| Medium-voltage ground-fault protection systems | Cleaning | 60 months | 36 months | 12 months |
| | Lubrication | | Reserved | |
| | Mechanical servicing | 60 months | 36 months | 12 months |
| | Electrical testing | 60 months | 36 months | 12 months |
| **Medium-voltage power circuit breakers** | **Visual inspection** | **60 months** | **36 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** |
| **Molded-case/insulated-case/low-voltage power circuit breakers** | **Visual inspection** | **60 months** | **36 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 |
| Motor control equipment | Visual inspection | 60 months | 36 months | 12 months |
| | Cleaning | 60 months | 36 months | 12 months |
| | Lubrication | 60 months | 36 months | 12 months |



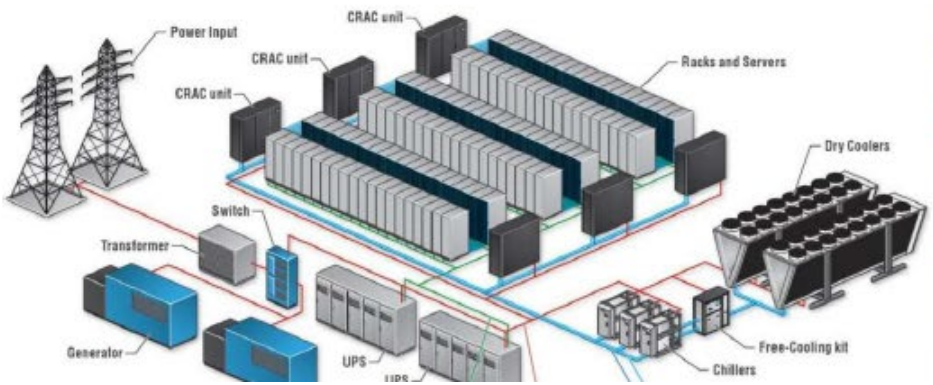

## Table 9.2.2 Maintenance Intervals

| Equipment | Equipment Condition Assessment | Condition 1 | Condition 2 | Condition 3 |
|---|---|---|---|---|
| | Visual inspection | 60 months | 36 months | 12 months |
| | Cleaning | 60 months | 36 months | 12 months |
| | Lubrication | 60 months | 36 months | 12 months |
| | Mechanical inspections | 60 months | 36 months | 12 months |
| | Electrical testing | 60 months | 36 months | 12 months |
| **Power and distribution transformers** | **Visual inspection** | **12 months** | **12 months** | **6 months** |
| | **Cleaning** | **60 months** | **36 months** | **12 months** |
| | **Lubrication** | | **Reserved** | |
| | **Mechanical servicing** | **60 months** | **36 months** | **12 months** |
| | **Electrical testing** | **60 months** | **36 months** | **12 months** |
| | Visual inspection | 60 months | 36 months | 12 months |
| Power cables | Cleaning | 60 months | 36 months | 12 months |
| | Mechanical servicing | Reserved | Reserved | |
| | Electrical testing | 60 months | 36 months | 12 months |
| Power cables | Visual inspection | 36 months | 24 months | 12 months |
| | Cleaning | 36 months | 24 months | 12 months |
| | Lubrication | | Reserved | |
| | Mechanical servicing | 36 months | 24 months | 12 months |
| | **Electrical testing** | **36 months** | **24 months** | **12 months** |
| **Protective relays, solid state and microprocessor** | **Visual inspection** | **60 months** | **36 months** | **12 months** |
| | **Cleaning** | **60 months** | **36 months** | **12 months** |
| | Lubrication | | Reserved | |
| | Mechanical servicing | 60 months | 36 months | 12 months |


| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| **Condition 1** | Condition 2 | Condition 3 |

# There are 3 Considerations for Condition Assignments:

- Equipment Physical Condition
- Criticality Condition of the Equipment
- Operating Environment Condition of Equipment





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| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| **Condition 1** | Condition 2 | Condition 3 |

**9.3.1.1**

**Equipment Physical Condition 1** shall be assigned 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 (Electrical Maintenance Program).


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| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| Condition 1 | **Condition 2** | Condition 3 |

## 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 notifications from the continuous monitoring system since the prior assessment.
(4) There are active recommendations from predictive techniques.


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| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| Condition 1 | Condition 2 | **Condition 3** |

**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.


| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| Condition 1 | Condition 2 | Condition 3 |

## 9.3.2* Criticality Condition of Equipment.

**9.3.2.1***

Criticality Condition 1 or Criticality Condition 2 shall be permitted to be assigned where the failure of the equipment or system will not endanger personnel.

**9.3.2.2**

Criticality Condition 3 shall be assigned where the failure of the equipment or system will endanger personnel.

***A.9.3.2.1***

- *The owner can also choose to assign criticality based on the threat to operational continuity.*
- *The criticality assessment should consider personnel exposure to electrical hazards.*
- *Electrical system criticality should be evaluated with consideration of the possible widespread effect of a fault in electrical equipment.*


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| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| Condition 1 | Condition 2 | Condition 3 |

## 9.3.2* Criticality Condition of Equipment. (New Note)

A criticality assessment team should be comprised of personnel who are familiar with the electrical equipment, safety requirements, operational capabilities, potential impact of downtime, required maintenance activities, and business priorities.

The team can include external expertise when needed.

Some examples of the type of personnel to include in a criticality assessment include the following:


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| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| Condition 1 | Condition 2 | Condition 3 |

## 9.3.2* Criticality Condition of Equipment. (New Note con't)

(1) The electrical foreman or superintendent
(2) Production personnel thoroughly familiar with the operation capabilities of the equipment and the effect its loss will have on quality and productivity
(3) The senior maintenance individual who is generally familiar with the maintenance and repair history of the equipment or process
(4) A technical individual knowledgeable in the theoretical fundamentals of the process and its hazards (e.g., in a chemical plant, a chemist; in a mine, a geologist)
(5) A safety engineer or the individual responsible for the overall security of the plant and its personnel against fire and accidents of all kinds


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| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| Condition 1 | Condition 2 | Condition 3 |

## 9.3.2* Criticality Condition of Equipment. (New Note con't)

- The purpose of the review is to identify failure modes and their cause and effect.
- There should be objective criteria consistently used to evaluate all equipment to make a clear determination in establishing whether a system is critical and in having the proper amount of emphasis placed on its maintenance.
- The determination of critical parts should be the responsibility of the electrical foreman or superintendent on the team.


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| Table 9.2.2 Maintenance Intervals | | |
|---|---|---|
| Equipment Condition Assessment | | |
| Condition 1 | Condition 2 | Condition 3 |

## 9.3.3 Operating Environment Condition of Equipment.

**9.3.3.1**
Operating Environment Condition 1 or Operating Environment Condition 2 shall be permitted to be assigned where the equipment is used in an operating environment for which it is rated.

**9.3.3.2**
Operating Environment Condition 3 shall be assigned where the equipment is used in an environment with harsh chemicals, contaminants, or extreme operating conditions for which it is not specifically rated or evaluated..


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# SUMMARY:

- Now a mandatory, compulsory standard, no longer optional (National Standard)
- Enforcement will come (OSHA)
- Always needed attention (Not a one and done)
- Requires advanced skill sets
- Improve employee exposure to hazards
- QUESTIONS??


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**AS PRESIDENT OF EVERYTHING ARC FLASH I WANT TO THANK YOU ALL FOR BEING HERE TODAY, AND I WANT TO THANK MY CLOSE FRIEND AND CONFIDANT, THE VP OF TECHNICAL TRAINING AND SUPPORT FOR ABM FOR HIS EXTRODINARY TALENT,**