Approved American National Standard

ANSI

ANSI/NETA MTS-2019

STANDARD FOR

MAINTENANCE TESTING SPECIFICATIONS

FOR ELECTRICAL POWER EQUIPMENT & SYSTEMS

NETA®

AMERICAN NATIONAL STANDARD

STANDARD FOR MAINTENANCE TESTING SPECIFICATIONS

for Electrical Power Equipment and Systems

Secretariat
NETA (InterNational Electrical Testing Association)

Approved by
American National Standards Institute

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American National Standard

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FOREWORD

(This Foreword is not part of American National Standard ANSI/NETA MTS-2019)

The InterNational Electrical Testing Association (NETA) was formed in 1972 to establish uniform testing procedures for electrical equipment and apparatus. NETA has been an Accredited Standards Developer for the American National Standards Institute since 1996. NETA's scope of standards activity is different from that of IEEE, NECA, NEMA, and UL. In matters of testing electrical equipment and systems NETA continues to reference other standards developers' documents where applicable. NETA's review and updating of presently published standards takes into account both national and international standards. NETA's standards may be used internationally as well as in the United States. NETA firmly endorses a global standardization. IEC standards as well as American consensus standards are taken into consideration by NETA's ballot pools and reviewing committees.

The first NETA *Maintenance Testing Specifications for Electrical Power Equipment and Systems* was published in 1975. Since 1989, revised editions of the *Maintenance Testing Specifications* have been published in 1993, 1997, and 2001.

In 2005, this document was approved for the first time as an American National Standard. It was published as a revised American National Standard in 2011 and in 2015. The 2019 *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems* is the most current revision of this document, and was approved as a revised American National Standard on February 4, 2019.

The ANSI/NETA *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems* was developed for use by those responsible for the continued operation of existing electrical systems and equipment to guide them in specifying and performing the necessary tests to ensure that these systems and apparatus perform satisfactorily, minimizing downtime, and maximizing life expectancy. This document aids in ensuring safe, reliable operation of existing electrical power systems and equipment. Maintenance testing and understanding the condition of maintenance can identify potential problem areas before they become safety concerns or major problems requiring expensive and time-consuming solutions.

PREFACE

(This Preface is not part of American National Standard ANSI/NETA MTS-2019)

It is recognized by the Association that the needs for maintenance testing of commercial, industrial, governmental, and other electrical power systems vary widely. Many criteria are used in determining what equipment is to be tested and to what extent.

To help the user better understand and navigate more efficiently through this document, we offer the following information:

Notation of Changes
Material included in this edition of the document but not part of the previous edition is marked with a black vertical line to the left of the insertion of text, deletion of text, or alteration of text.

Document Structure
The document is divided into thirteen separate and defined sections:

Section	Description
Section 1	General Scope
Section 2	Applicable References
Section 3	Qualifications of Testing Organization and Personnel
Section 4	Division of Responsibility
Section 5	General
Section 6	Power System Studies
Section 7	Inspection and Test Procedures
Section 8	System Function Test
Section 9	Thermographic Survey
Section 10	Electromagnetic Field Survey
Section 11	Online Partial-Discharge Survey for Switchgear
Tables	Reference Tables
Appendices	Informational Documents

Section 7 Structure
Section 7 is the main body of the document with specific information on what to do relative to the inspection and maintenance testing of electrical power equipment and systems. It is not intended that this document explain how to test specific pieces of equipment or systems.

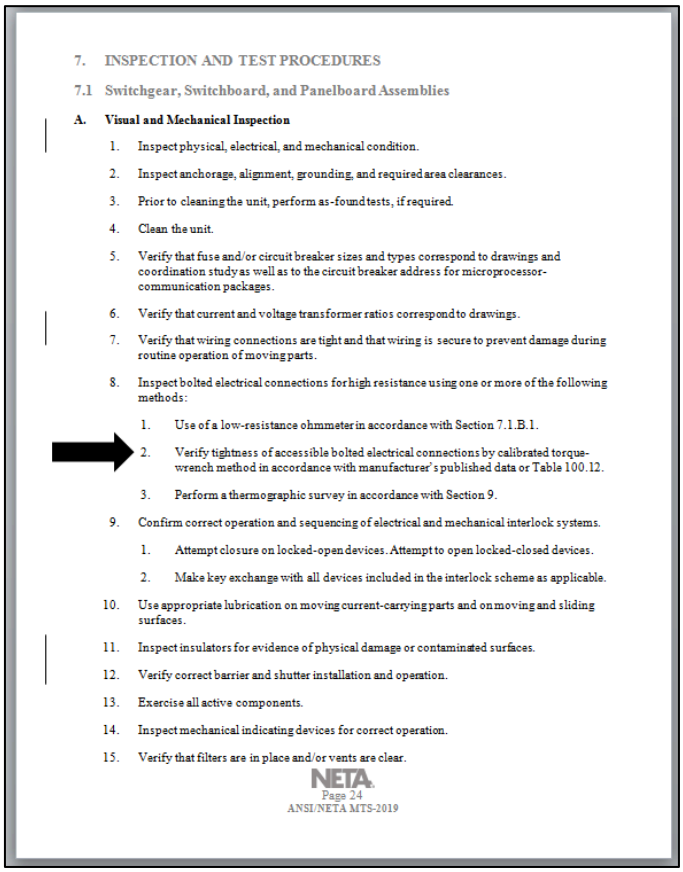
Sequence of Tests and Inspections
The tests and inspections specified in this document are not necessarily presented in chronological order and may be performed in a difference sequence.

Expected Test Results
Section 7 consists of sections specific to each particular type of equipment. Within those sections there are, typically, four main bodies of information:

A. Visual and Mechanical Inspection
B. Electrical Tests
C. Test Values – Visual and Mechanical
D. Test Values – Electrical

Results of Visual and Mechanical Inspections

Some, but not all, visual and mechanical inspections have an associated test value or result. Those items with an expected result are referenced under Section C. Test Values – Visual and Mechanical. For example, Section 7.1 Switchgear and Switchboard Assemblies, item 7.1.A.8.2 calls for verifying tightness of connections using a calibrated torque wrench method. Under the Test Values – Visual and Mechanical Section 7.1.C.2, the expected results for that particular task are listed within Section C, with reference back to the original task description on item 7.1.A.8.2.



7. INSPECTION AND TEST PROCEDURES

7.1 Switchgear, Switchboard, and Panelboard Assemblies

A. Visual and Mechanical Inspection

1. Inspect physical, electrical, and mechanical condition.
2. Inspect anchorage, alignment, grounding, and required area clearances.
3. Prior to cleaning the unit, perform as-found tests, if required.
4. Clean the unit.
5. Verify that fuse and/or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker address for microprocessor-communication packages.
6. Verify that current and voltage transformer ratios correspond to drawings.
7. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.
8. Inspect bolted electrical connections for high resistance using one or more of the following methods:
   1. Use of a low-resistance ohmmeter in accordance with Section 7.1.B.1.
   2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.
   3. Perform a thermographic survey in accordance with Section 9.
9. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
   1. Attempt closure on locked-open devices. Attempt to open locked-closed devices.
   2. Make key exchange with all devices included in the interlock scheme as applicable.
10. Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
11. Inspect insulators for evidence of physical damage or contaminated surfaces.
12. Verify correct barrier and shutter installation and operation.
13. Exercise all active components.
14. Inspect mechanical indicating devices for correct operation.
15. Verify that filters are in place and/or vents are clear.

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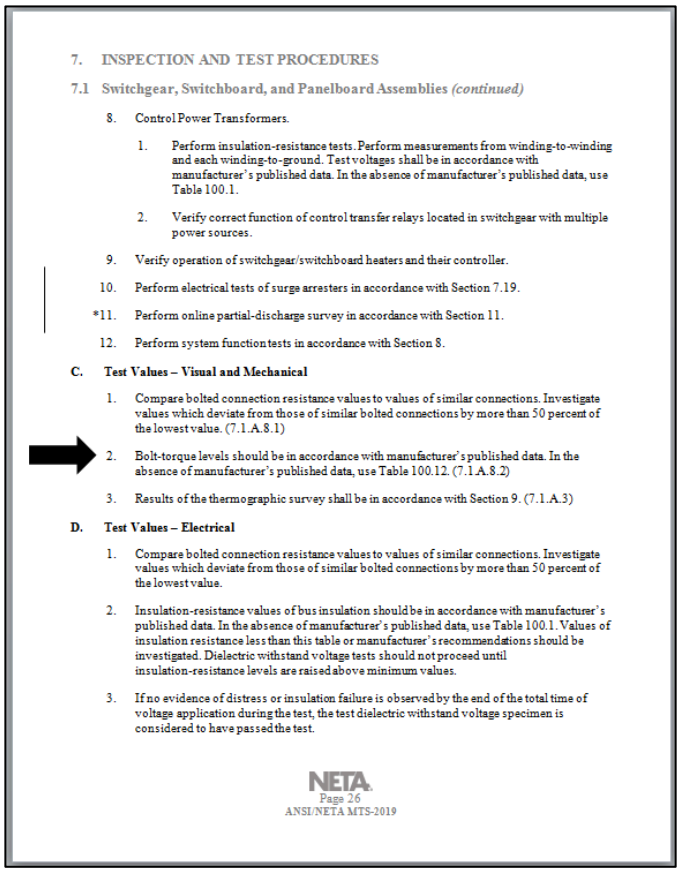

7. INSPECTION AND TEST PROCEDURES

7.1 Switchgear, Switchboard, and Panelboard Assemblies *(continued)*

8. Control Power Transformers.
   1. Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1.
   2. Verify correct function of control transfer relays located in switchgear with multiple power sources.
9. Verify operation of switchgear/switchboard heaters and their controller.
10. Perform electrical tests of surge arresters in accordance with Section 7.19.
*11. Perform online partial-discharge survey in accordance with Section 11.
12. Perform system function tests in accordance with Section 8.

C. Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.1.A.8.1)
2. Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.1.A.8.2)
3. Results of the thermographic survey shall be in accordance with Section 9. (7.1.A.3)

D. Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. Insulation-resistance values of bus insulation should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Dielectric withstand voltage tests should not proceed until insulation-resistance levels are raised above minimum values.
3. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the test, the test dielectric withstand voltage specimen is considered to have passed the test.

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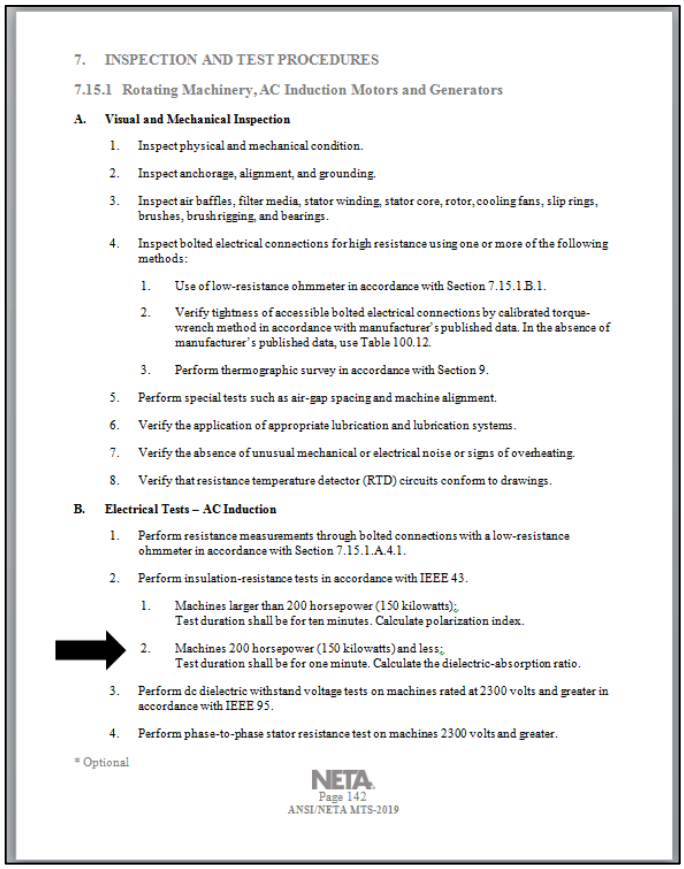
Results of Electrical Tests

Each electrical test has a corresponding expected result, and the test item and the expected result have identical item numbers in their section, that is, if the electrical test is item four, the expected result under the Test Values section is also item four. For example, under Section 7.15.1 Rotating Machinery, AC Induction Motors and Generators, item 7.15.1.B.2 (item 2 within the Electrical Tests section) calls for performing an insulation-resistance test in accordance with IEEE Standard 43. Under the Test Values – Electrical section, the expected results for that particular task are listed in the Test Values section under item 2.



7. INSPECTION AND TEST PROCEDURES

7.15.1 Rotating Machinery, AC Induction Motors and Generators

A. Visual and Mechanical Inspection

1. Inspect physical and mechanical condition.
2. Inspect anchorage, alignment, and grounding.
3. Inspect air baffles, filter media, stator winding, stator core, rotor, cooling fans, slip rings, brushes, brush rigging, and bearings.
4. Inspect bolted electrical connections for high resistance using one or more of the following methods:
   1. Use of low-resistance ohmmeter in accordance with Section 7.15.1.B.1.
   2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12.
   3. Perform thermographic survey in accordance with Section 9.
5. Perform special tests such as air-gap spacing and machine alignment.
6. Verify the application of appropriate lubrication and lubrication systems.
7. Verify the absence of unusual mechanical or electrical noise or signs of overheating.
8. Verify that resistance temperature detector (RTD) circuits conform to drawings.

B. Electrical Tests – AC Induction

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter in accordance with Section 7.15.1.A.4.1.
2. Perform insulation-resistance tests in accordance with IEEE 43.
   1. Machines larger than 200 horsepower (150 kilowatts); Test duration shall be for ten minutes. Calculate polarization index.
   2. Machines 200 horsepower (150 kilowatts) and less; Test duration shall be for one minute. Calculate the dielectric-absorption ratio.
3. Perform dc dielectric withstand voltage tests on machines rated at 2300 volts and greater in accordance with IEEE 95.
4. Perform phase-to-phase stator resistance test on machines 2300 volts and greater.

* Optional

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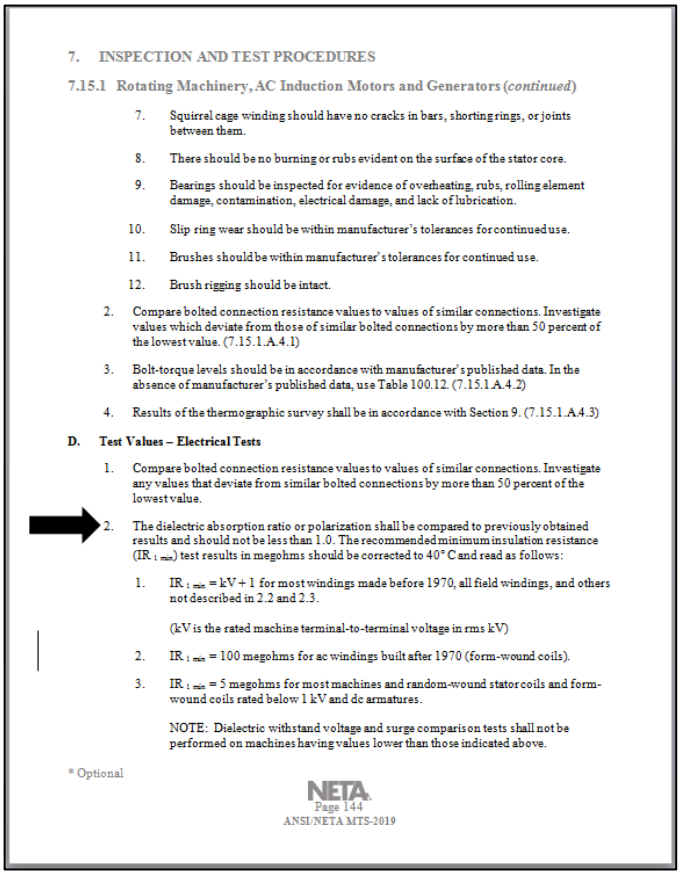

7. INSPECTION AND TEST PROCEDURES

7.15.1 Rotating Machinery, AC Induction Motors and Generators (*continued*)

7. Squirrel cage winding should have no cracks in bars, shorting rings, or joints between them.
8. There should be no burning or rubs evident on the surface of the stator core.
9. Bearings should be inspected for evidence of overheating, rubs, rolling element damage, contamination, electrical damage, and lack of lubrication.
10. Slip ring wear should be within manufacturer's tolerances for continued use.
11. Brushes should be within manufacturer's tolerances for continued use.
12. Brush rigging should be intact.

2. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.15.1.A.4.1)
3. Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.15.1.A.4.2)
4. Results of the thermographic survey shall be in accordance with Section 9. (7.15.1.A.4.3)

D. Test Values – Electrical Tests

1. Compare bolted connection resistance values to values of similar connections. Investigate any values that deviate from similar bolted connections by more than 50 percent of the lowest value.
2. The dielectric absorption ratio or polarization shall be compared to previously obtained results and should not be less than 1.0. The recommended minimum insulation resistance ($IR_{1\ min}$) test results in megohms should be corrected to 40° C and read as follows:
   1. $IR_{1\ min}$ = kV + 1 for most windings made before 1970, all field windings, and others not described in 2.2 and 2.3.

      (kV is the rated machine terminal-to-terminal voltage in rms kV)
   2. $IR_{1\ min}$ = 100 megohms for ac windings built after 1970 (form-wound coils).
   3. $IR_{1\ min}$ = 5 megohms for most machines and random-wound stator coils and form-wound coils rated below 1 kV and dc armatures.

      NOTE: Dielectric withstand voltage and surge comparison tests shall not be performed on machines having values lower than those indicated above.

* Optional

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