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3. Qualifications of Testing Organization and Personnel
   3.1 Testing Organization
   3.2 Testing Personnel
4. Division of Responsibility
   4.1 The Owner’s Representative
   4.2 The Testing Organization
5. General
   5.1 Safety and Precautions
   5.2 Suitability of Test Equipment
   5.3 Test Instrument Calibration
   5.4 Test Report

The purchaser is required to include the above sections with any section(s) of 7.

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FOREWORD

(This Foreword is not part of American National Standard ANSI/NETA ATS-2013)

The InterNational Electrical Testing Association (NETA) was formed in 1972 to establish uniform testing procedures for electrical equipment and apparatus. NETA developed specifications for the acceptance of new electrical apparatus prior to energization and for the maintenance of existing apparatus to determine its suitability to remain in service. The first NETA Acceptance Testing Specifications for Electrical Power Equipment and Systems was produced in 1972. Upon completion of this project, the NETA Technical Committee began work on a maintenance document, and Maintenance Testing Specifications for Electrical Power Equipment and Systems was published in 1975.

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 the 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 Section Panels and reviewing committees.

The NETA Acceptance TestingSpecifications was developed for use by those responsible for assessing the suitability for initial energization of electrical power equipment and systems and to specify field tests and inspections that ensure these systems and apparatus perform satisfactorily, minimizing downtime and maximizing life expectancy.

Since 1972, several revisions of the Acceptance Testing Specifications have been published; in 1989 the NETA Technical Committee, with approval of the Board of Directors, set a four-year review and revision schedule. Unless it involves a significant safety or urgent technical issue, each comment and suggestion for change is held until the appropriate review period. Each edition includes new and completely revised sections. The document uses the standard numbering system of ANSI and IEEE. Since 1989, revised editions of the Acceptance Testing Specifications have been published in 1991, 1995, 1999, 2003, 2007, and 2009.


Suggestions for improvement of this standard are welcome. They should be sent to the InterNational Electrical Testing Association, 3050 Old Centre Avenue, Suite 102, Portage, MI 49024.
PREFACE

It is recognized by the Association that the needs for acceptance 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 2009 edition is marked with a black vertical line to the left of the insertion of text, deletion of text, or alteration of text.

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

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

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

1. Visual and Mechanical Inspection
2. Electrical Tests
3. Test Values
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 3.1 Test Values – Visual and Mechanical. For example, Section 7.1 Switchgear and Switchboard Assemblies, item 7.1.1.8.2 calls for verifying tightness of connections using a calibrated torque wrench method. Under the Test Values – Visual and Mechanical Section 7.1.3.1.2, the expected results for that particular task are listed within Section 3.1, with reference back to the original task description on item 7.1.1.8.2.
Results of Electrical Tests
Each electrical test has a corresponding expected result, and the test and the result have identical numbers. 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 7.15.1.2.2 (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

**Visual and Mechanical Inspection**

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect equipment physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding.
4. Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging.
5. 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 7.15.1.2.
   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 thermographic survey in accordance with Section 9.
6. Perform special tests such as air-gap spacing and machine alignment.
7. Manually rotate the rotor and check for problems with the bearings or shaft.
8. Rotate the shaft and measure and record the shaft extension runout.
9. Verify the application of appropriate lubrication and lubrication systems.
10. Verify that resistance temperature detector (RTD) circuits conform to drawings.

**Electrical Tests – AC Induction**

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, in accordance with Section 7.15.1.1.
   1. Machines larger than 200 horsepower (150 kilowatts):
      - Test duration shall be ten minutes. Calculate polarization index.
   2. Machines 200 horsepower (150 kilowatts) and less:
      - Test duration shall be one minute. Calculate dielectric-absorption ratio for 60/30 second periods.
   3. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
   4. Investigate phase-to-phase stator resistance values that deviate by more than five percent.
   5. Power-factor or dissipation-factor values shall be compared to manufacturer’s published data. In the absence of manufacturer’s published data, these values will be compared with previous values of similar machines.
   6. Tip-up values shall indicate no significant increase in power factor.

* Optional
Optional Tests

The purpose of these specifications is to assure that all tested electrical equipment and systems supplied by either contractor or owner are operational and within applicable standards and manufacturer’s published tolerances and that equipment and systems are installed in accordance with design specifications.

Certain tests are assigned an optional classification. The following considerations are used in determining the use of the optional classification:

1. Does another listed test provide similar information?
2. How does the cost of the test compare to the cost of other tests providing similar information?
3. How commonplace is the test procedure? Is it new technology?

Manufacturer’s Instruction Manuals

It is important to follow the recommendations contained in the manufacturer’s published data. Many of the details of a complete and effective testing procedure can be obtained from this source.

Summary

The guidance of an experienced testing professional should be sought when making decisions concerning the extent of testing. It is necessary to make an informed judgment for each particular system regarding how extensive a procedure is justified. The approach taken in these specifications is to present a comprehensive series of tests applicable to most industrial and larger commercial systems. In smaller systems, some of the tests can be deleted. In other cases, a number of the tests indicated as optional should be performed.

Likewise, guidance of an experienced testing professional should also be sought when making decisions concerning the results of test data and their significance to the overall analysis of the device or system under test. Careful consideration of all aspects of test and calibration data, including manufacturer’s published data and recommendations, must be included in the overall assessment of the device or system under test.

The Association encourages comment from users of this document. Please contact the NETA office or your local NETA Accredited Company.
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1. GENERAL SCOPE

1. These specifications cover the suggested field tests and inspections that are available to assess the suitability for initial energization and final acceptance of electrical power equipment and systems.

2. The purpose of these specifications is to assure that tested electrical equipment and systems are operational, are within applicable standards and manufacturer's tolerances, and are installed in accordance with design specifications.

3. The work specified in these specifications may involve hazardous voltages, materials, operations, and equipment. These specifications do not purport to address all of the safety issues associated with their use. It is the responsibility of the user to review all applicable regulatory limitations prior to the use of these specifications.
2. APPLICABLE REFERENCES

2.1 Codes, Standards, and Specifications

All inspections and field tests shall be in accordance with the latest edition of the following codes, standards, and specifications except as provided otherwise herein.

1. American National Standards Institute – ANSI

2. ASTM International - ASTM

- ASTM D92: Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- ASTM D664: Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D924: Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids
- ASTM D971: Standard Test Method for Interfacial Tension of Oil against Water by the Ring Method
- ASTM D974: Standard Test Method for Acid and Base Number by Color-Indicator Titration
- ASTM D1298: Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
2. APPLICABLE REFERENCES

2.1 Codes, Standards, and Specifications (continued)

ASTM D2029  Standard Test Methods for Water Vapor Content of Electrical Insulating Gases by Measurement of Dew Point

ASTM D2129  Standard Test Method for Color of Clear Electrical Insulating Liquids (Platinum-Cobalt Scale)

ASTM D2284  Standard Test Method of Acidity of Sulfur Hexafluoride

ASTM D2285  Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin against Water by the Drop-Weight Method

ASTM D2477  Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Insulating Gases at Commercial Power Frequencies


ASTM D2759  Standard Practice for Sampling Gas from a Transformer under Positive Pressure


ASTM D3612  Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography

ASTM D3613  Standard Practice for Sampling Electrical Insulating Oils for Gas Analysis and Determination of Water Content

3. Association of Edison Illuminating Companies - AEIC

4. Canadian Standards Association - CSA

5. Electrical Apparatus Service Association - EASA

  ANSI/EASA AR100  Recommended Practice for the Repair of Rotating Electrical Apparatus
2. APPLICABLE REFERENCES

2.1 Codes, Standards, and Specifications (continued)

6. Institute of Electrical and Electronic Engineers - IEEE

- ANSI/IEEE C2  
  National Electrical Safety Code

- ANSI/IEEE C37  
  Guides and Standards for Circuit Breakers, Switchgear, Relays, Substations, and Fuses

- ANSI/IEEE C57  
  Distribution, Power, and Regulating Transformers

- ANSI/IEEE C62  
  Surge Protection

- ANSI/IEEE C93.1  
  Requirements for Power-Line Carrier Coupling Capacitors and Coupling Capacitor Voltage Transformers (CCVT)

- ANSI/IEEE 43  
  IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery

- ANSI/IEEE 48  
  IEEE Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV

- IEEE 81  

- ANSI/IEEE 81.2  
  IEEE Guide for Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems

- ANSI/IEEE 95  
  IEEE Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage

- IEEE 100  
  The Authoritative Dictionary of IEEE Standards Terms

- IEEE 141  
  IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants (IEEE Red Book)

- ANSI/IEEE 142  
  IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)

- ANSI/IEEE 241  
  IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)

- ANSI/IEEE 242  
  IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book)
2. APPLICABLE REFERENCES

2.1 Codes, Standards, and Specifications (continued)

- ANSI/IEEE 450: IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
- ANSI/IEEE 519: IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- IEEE 644: Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines
- ANSI/IEEE 739: IEEE Recommended Practice for Energy Management in Commercial and Industrial Facilities (Bronze Book)
- IEEE 1015: IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems (Blue Book)
- IEEE 1100: IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book)
2. APPLICABLE REFERENCES

2.1 Codes, Standards, and Specifications (continued)

ANSI/IEEE 1106  IEEE Recommended Practice for Maintenance, Testing, and Replacement of Nickel-Cadmium Batteries for Stationary Applications

ANSI/IEEE 1159  IEEE Recommended Practice on Monitoring Electrical Power Quality

ANSI/IEEE 1188  IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications

IEEE 1584  IEEE Guide for Arc-Flash Hazard Calculations

7. Insulated Cable Engineers Association – ICEA

ANSI/ICEA S-93-639/NEMA WC 74  5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

ANSI/ICEA S-94-649  Standard for Concentric Neutral Cables Rated 5,000 - 46,000 Volts

ANSI/ICEA S-97-682  Standard for Utility Shielded Power Cables Rated 5,000 - 46,000 Volts

8. InterNational Electrical Testing Association - NETA

ANSI/NETA ETT  Standard for Certification of Electrical Testing Technicians

ANSI/NETA MTS  Maintenance Testing Specifications for Electrical Power Equipment and Systems

9. National Electrical Manufacturers Association - NEMA

NEMA AB4  Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications

ANSI/NEMA 84.1  Electrical Power Systems and Equipment Voltage Ratings (60 Hz)

NEMA MG1  Motors and Generators


ANSI/NFPA 70  National Electrical Code

ANSI/NFPA 70B  Recommended Practice for Electric Equipment Maintenance

ANSI/NFPA 70E  Standard for Electrical Safety in the Workplace
2. **APPLICABLE REFERENCES**

2.1 **Codes, Standards, and Specifications (continued)**

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11. Occupational Safety and Health Administration - OSHA

12. State and local codes and ordinances

13. Underwriters Laboratories, Inc. - UL
2. **APPLICABLE REFERENCES**

2.2 **Other Publications**

Manufacturer’s instruction manuals for the equipment to be tested.


Megger, *A Stitch in Time...The Complete Guide to Electrical Insulation Testing*


2.3 **Contact Information**

American National Standards Institute – ANSI
25 West 43rd Street 4th Fl.
New York, NY 10036
(212) 642-4900
www.ansi.org

ASTM International – ASTM
100 Barr Harbor Drive
W. Conshohocken, PA 19428
(610) 832-9585
www.astm.org

Association of Edison Illuminating Companies – AEIC
600 N. 18th Street; PO Box 2641
Birmingham, AL 35291
(205) 257-2530
www.aeic.org

Canadian Standards Association – CSA
178 Rexdale Boulevard
Toronto, ON M9W 1R3
(416) 747-4000
www.csa.ca

Electrical Apparatus Service Association – EASA
1331 Baur Boulevard
St. Louis, MO 63132
(314) 993-2220
www.easa.com

Institute of Electrical and Electronic Engineers – IEEE
PO Box 1331
Piscataway, NJ 08855
(732) 981-0060
www.ieee.org
2. APPLICABLE REFERENCES

2.3 Contact Information (continued)

Insulated Cable Engineers Association – ICEA
c/o Global Document Engineers
15 Inverness Way East
Englewood, CO 80112
(303) 397-7956
www.icea.net

International Electrotechnical Commission – IEC
Contact through American National Standards Institute

InterNational Electrical Testing Association – NETA
3050 Old Centre Avenue, Suite 102
Portage, MI 49024
(269) 488-6382 or (888) 300-NETA (6382)
www.netaworld.org

Marcel Dekker, Inc.
PO Box 5005
Monticello, NY 12701
(800) 228-160
www.dekker.com

The McGraw-Hill Companies
P.O. Box 182604
Columbus, OH 43272
Phone: (877) 833-5524
www.mcgraw-hill.com

Megger
4271 Bronze Way
Dallas, TX 75237
(214) 723-2861
www.megger.com

National Electrical Manufacturers Association– NEMA
1300 N. 17th St. Suite 1847
Rosslyn, VA 22209
(703) 841-3200
www.nema.org

National Fire Protection Association – NFPA
1 Battery March Park
PO Box 901
Quincy, MA 02269-9101
(617) 984-7247
www.nfpa.org
2. APPLICABLE REFERENCES

2.3 Contact Information (continued)

Occupational Safety and Health Administration – OSHA
U.S. Department of Labor
Occupational Safety and Health Administration
Office of Public Affairs - Room N3647
200 Constitution Avenue
Washington, D.C.  20210
(202) 693-1999
www.osha.gov

The Okonite Company
102 Hilltop Road
Ramsey, New Jersey 07446
(201) 825-0300 Fax 201-825-3524
www.okonite.com

Underwriters Laboratories, Inc. – UL
333 Pfingsten Road
Northbrook, IL  60062
(847) 272-8800
www.ul.com