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NVLAP Electromagnetic Compatibility and Telecommunications

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Contents

Foreword

The NIST Handbook 150 publication series sets forth the procedures, requirements, and guidance for the accreditation of testing and calibration laboratories by the National Voluntary Laboratory Accreditation Program (NVLAP). The series is comprised of the following publications:

- NIST Handbook 150, *NVLAP Procedures and General Requirements*, which contains the general procedures and requirements under which NVLAP operates as an unbiased third-party accreditation body;

- NIST Handbook 150-xx program-specific handbooks, which supplement NIST Handbook 150 by providing additional requirements, guidance, and interpretive information applicable to specific NVLAP laboratory accreditation programs (LAPs).

The program-specific handbooks are not stand-alone documents, but rather are companion documents to NIST Handbook 150. They tailor the general criteria found in NIST Handbook 150 to the specific tests, calibrations, or types of tests or calibrations covered by a LAP.

NIST Handbook 150-11, *NVLAP Electromagnetic Compatibility and Telecommunications*, presents the technical requirements and guidance for the accreditation of laboratories under the NVLAP Electromagnetic Compatibility and Telecommunications (ECT) LAP. The 2013 edition of NIST Handbook 150-11 supersedes and replaces all previous editions.

The handbook was revised with the participation of technical experts in the field of electromagnetic compatibility and telecommunications testing and was approved by NVLAP. The following main changes have been made to this handbook:

- content that was determined to be redundant with NIST Handbook 150 has been removed;
- clarifying text has been added to certain technical requirements to reduce ambiguity and improve understanding;
- identification of the minimum level and frequency of participation in proficiency testing activity required has been included, as well as the review of the participation and performance during the assessment and accreditation decision process;
- editorial revisions have been made to improve readability and consistency with other NVLAP publications, as well as minor technical revisions such as updating references and definitions.

Annex A (informative) provides a list of major ECT standards-issuing bodies, acronyms commonly cited, and the national economies for which the standards have been issued.

This handbook is also available on the NVLAP website, <http://www.nist.gov/nvlap>.

Questions or comments concerning this handbook should be submitted to NVLAP, National Institute of Standards and Technology, 100 Bureau Drive, Stop 2140, Gaithersburg, MD, 20899-2140; phone: 301-975-4016; fax: 301-926-2884; e-mail: nvlap@nist.gov.

Introduction

General

All electrical devices are potential sources of electromagnetic energy and are potentially affected by electromagnetic energy emitted from other electrical devices in their vicinity. These emissions may interfere with the performance and safe operation of a device. In fact, an electrical device is classified as either a non-intentional radiator, generating emissions as a by-product of normal operation (for example, a television or personal computer), or as an intentional radiator (for example, a citizens band radio or cell phone).

Electromagnetic Compatibility (EMC) is the ability of a device, product, or system to operate properly in its intended electromagnetic environment without degradation and without being a source of electromagnetic interference (EMI). As more sophisticated and sensitive electronic devices enter the marketplace, electromagnetic compatibility becomes more and more important.

In order to achieve EMC, governments set limits, and device manufacturers, including device purchasers, set requirements for the design, production, and operation of electronic systems that are electromagnetically compatible with their environments.

Types of requirements

In the United States, the U.S. Federal Communications Commission (FCC) sets requirements for various commercial and consumer electronic devices and systems. Commonly cited standards outside the United States include International Electrotechnical Commission (IEC) and Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference) (CISPR) standards.

With the global nature of trade, the devices manufactured must meet the EMC requirements of the economies in which they are sold. Governments, buyers, and manufacturers often cite international EMC voluntary standards. To meet this need NVLAP tracks and accredits to a list of test method requirements in the ECT LAP.

Some categories of standards have evolved from older application categories, including telephony and radio communications. As early as 1977, the International Organization for Standardization (ISO) began to develop its Open Systems Interconnection Basic Reference Model as an abstract description for communications and computer network protocol design, including physical standards, protocol standards, and interoperability standards. Also included are “harms to the network” test methods for wired telecommunications. Network Equipment Building System (NEBS) standards apply to the broad array of devices intended for the central office (CO) environment and procurements by Local Exchange Carriers (LECs), Competitive Access Providers (CAPs), Competitive Local Exchange Carriers (CLECs), Internet Service Providers (ISPs), and Access Service Providers (ASPs).

Some EMC requirements are based on the intended usage environment of the product, often more extreme than normal business and other public applications. For example, U.S. Military Standards (MIL-STD) 461/462 impose requirements for devices used in various ground, flight, and naval environments. Radio Technical Commission for Aeronautics, now RTCA, Inc., (RTCA) DO-160 test methods apply to devices dedicated to aeronautical environments.

Some standards that are not directly EMC standards, such as energy efficiency, product safety, and RF exposure, are also included in the ECT LAP.

History of the NVLAP ECT Program

The NVLAP ECT Program for FCC test methods was established in October 1985 in response to a request from five private-sector testing laboratories. The purpose of the program was to formally recognize laboratories found competent to perform testing in accordance with Title 47 of the U.S. Code of Federal Regulations (CFR) Part 15-Radio Frequency Devices and 47 CFR Part 68-Connection of Terminal Equipment to the Telephone Network. The program was expanded in 1988 in response to a request from the Naval Air Systems Command (NAVAIR) for the establishment and maintenance of adequate technical resources for MIL-STD-462 Acceptance Testing as part of the NAVAIR Search for Excellence program. The purpose of that part of the program is to assess and accredit laboratories that produce reliable test data for the U.S. military.

Present status of the NVLAP ECT Program

At the time of publication, this handbook covers test methods used to demonstrate compliance with FCC requirements given in 47 CFR, Telecommunication, Parts 0 through 101, the test methods in MIL-STD 461/462, the ANSI C63 standards, and the international standards IEC 61000-4-x series and CISPR product standards line (e.g., CISPR 11 and CISPR 22).

Other test methods used to demonstrate compliance with specific national standards for electromagnetic compatibility are also covered. These standards include, but are not limited to, Australia and New Zealand (AS/NZS) standards, Australian Communications and Media Authority (ACMA) Technical Specifications (TSs), Chinese National Standards (CNS), and Canadian Compliance Specifications (CS) 03. In addition, by virtue of a memorandum of understanding between NVLAP and the VCCI Council (VCCI) of Japan, NVLAP provides ISO/IEC 17025 accreditation of any electromagnetic compatibility-testing laboratory to the Normative Annex 1 Technical Requirements of Regulations (VCCI V-3) for voluntary control measures of VCCI.

Due to periodic updates and modifications to international, national, and regional requirements, users of this handbook should check frequently with the issuing bodies of the applicable standards and requirements for changes and additions. Please check the NVLAP website or contact the ECT Program Management on questions about specific standards for which accreditation is available or may be made available. Informative Annex A provides the names and acronyms of the common EMC standards organizations and, where applicable, the national economies for which the standards have been issued.

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1 General information

1.1 Scope of handbook

1.1.1 NIST Handbook 150-11 identifies the program-specific requirements and provides guidance for the accreditation of laboratories under the NVLAP Electromagnetic Compatibility and Telecommunications Laboratory Accreditation Program (ECT LAP). It supplements the NVLAP procedures and general requirements found in NIST Handbook 150, *NVLAP Procedures and General Requirements*, by tailoring the general criteria found in NIST Handbook 150 to the specific tests and types of tests covered by the ECT LAP.

1.1.2 NIST Handbook 150, this handbook, and their respective checklists (see 1.6) constitute the collective body of requirements that must be met by a laboratory seeking NVLAP accreditation for the ECT LAP.

1.1.3 This handbook does not contain the general requirements for accreditation. The general requirements are included in NIST Handbook 150. This handbook is intended for information and use by accredited ECT laboratories, assessors conducting on-site assessments, laboratories seeking accreditation, other laboratory accreditation systems, users of laboratory services, and others needing information on the requirements for accreditation under the ECT LAP.

1.2 Organization of handbook

The numbering and titles of the first five clauses of this handbook match those of NIST Handbook 150. The primary subclauses in clauses 4 and 5 (e.g., 4.1, 4.2, etc.) are also numbered and titled to correspond with those of NIST Handbook 150, even when there are no requirements additional to those in NIST Handbook 150.

1.3 Program description

The purpose of the ECT LAP is to accredit testing laboratories found capable and competent to perform EMC conformance testing to FCC, MIL-STD, IEC, EN, CISPR, and other test method standards that have been and may be added to the program.

The program includes standards for the testing of both intentional radiators (i.e., radio transmitters) and unintentional radiators (i.e., digital devices), as well as wireless and wired telecommunications products. The program also includes various test standards for conformance, performance, and/or interoperability. In addition, the program envelops test standards that are part of the FCC regulatory requirements associated with radio frequency (RF) safety.

The NVLAP ECT program includes test method standards for many areas including:

- Electromagnetic emissions;
- Electromagnetic immunity;
- Mil-Stds electromagnetic compatibility (emissions and susceptibility);

- Energy Star;
- Telecommunications;
- Radio conformance;
- Product Safety;
- RF Exposure.

Laboratories may seek accreditation in test methods in any of the areas listed above.

1.4 References

The following references are important for the application of this handbook. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

— NIST Handbook 150, *NVLAP Procedures and General Requirements*

— 47 U.S. Code of Federal Regulations (CFR) Telecommunication, Parts 0 through 101

— ISO 7637-2, *Road vehicles — Electrical disturbances from conduction and coupling — Part 2: Electrical transient conduction along supply lines only*

— ISO/IEC 17043:2010, *Conformity assessment – General requirements for proficiency testing*

— ISO/IEC Guide 98-3:2008, *Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

— ISO/IEC Guide 99:2007, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

1.5 Terms and definitions

For the purposes of this handbook, the terms and definitions given in NIST Handbook 150, the terms and definitions given in the standards, for which the laboratory seeks accreditation, and the following terms, which are contained in ISO/IEC Guide 99 (2007) apply.

1.5.1
calibration
Operation that, under specified conditions, in a first step establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication. A calibration may be expressed by a statement, calibration function, calibration diagram, calibration curve, or calibration table. In some cases it may consist of an additive or multiplicative correction of the indication with associated measurement uncertainty.

1.5.2
uncertainty budget
Statement of a measurement uncertainty, of the components of that measurement uncertainty, and of their calculation and combination.

1.5.3
validation
Verification, where the specified requirements are adequate for the intended use.

1.5.4
verification
Provision of objective evidence that a given item fulfills specified requirements. When applicable, measurement uncertainty should be taken into consideration.

1.6 Program documentation

1.6.1 General

Assessors use NVLAP checklists and test method review summary forms to ensure assessment consistency. Checklists assist assessors in documenting compliance with the NVLAP requirements found in NIST Handbook 150, this handbook, and the specific test methods for which accreditation is requested. Checklists and test method review summary forms are part of the On-Site Assessment Report (see NIST Handbook 150). These documents are available on the NVLAP website, <http://www.nist.gov/nvlap>.

1.6.2 NIST Handbook 150 Checklist

All NVLAP programs use the NIST Handbook 150 Checklist, which contains the requirements published in NIST Handbook 150. The checklist items are numbered to correspond to clauses 4 and 5 and annexes A and B of NIST Handbook 150.

1.6.3 NIST Handbook 150-11 Checklist

The NIST Handbook 150-11 Checklist (also referred to as the ECT Program-Specific Checklist) addresses the requirements specific to electromagnetic compatibility and telecommunications testing given in NIST Handbook 150-11. Other checklists (such as Handbook 150-11A, a checklist for FCC Parts 2, 15, and 18) may apply and are available on the NVLAP website.

1.6.4 Test Method Review Summary

Because of the very large number of relevant standards and test methods in the ECT LAP, the assessor uses Test Method Review Summary forms, along with applicable checklists, to evaluate the laboratory's compliance to the test methods. The evaluation of the test methods by the assessor ranges from observing tests to having laboratory staff describe the test procedures. The assessor notes on the Test Method Review Summary form the depth into which each part of the test method was reviewed (Observed Test, Examined Apparatus, Walked/Talked Through Test, Listened to Description of Procedures).

1.6.5 NVLAP Lab Bulletins

NVLAP Lab Bulletins are issued to laboratories and assessors, when needed, to clarify program-specific requirements and to provide information about the most current program additions and changes. Lab

Bulletins providing additions or changes to the current program will supersede the requirements of the current published handbook until such time as the additions or changes are published in a revision of the handbook. Lab Bulletins are posted on the program-specific handbooks page of the NVLAP website.

2 LAP establishment, development and implementation

This clause contains no information additional to that provided in NIST Handbook 150, clause 2.

3 Accreditation process

3.1 General

An overview of the laboratory accreditation process is provided in NIST Handbook 150, clause 3, and includes information pertaining to application for accreditation; on-site assessment; proficiency testing; accreditation decision; granting accreditation; renewal of accreditation; changes to scope of accreditation; monitoring visits; and suspension, denial, revocation, and voluntary termination of accreditation.

3.2 Management system review

3.2.1 Prior to the on-site assessment, the lab is requested to provide a cross-reference document allowing a NVLAP assessor to verify that all requirements of clauses 4 and 5 and annexes A and B of NIST Handbook 150 and the corresponding NIST Handbook 150-11 are addressed in the management system documentation. The cross-reference document should verify that all requirements of this handbook and clauses 4 and 5 and annexes A and B of NIST Handbook 150 are addressed and their locations clearly identified in the management system documentation.

3.2.2 Prior to the on-site assessment, the assigned assessor will review all relevant management system documentation against NVLAP requirements, including the requirements of this handbook and NIST Handbook 150. During this review, the assessor may request additional management system documents and/or records, which will be returned upon request. Because of the very large number of relevant standards in the ECT LAP, relevant test method(s), operator instructions, and/or test procedures may be requested by the assessor for review in advance of the on-site assessment.

3.3 On-site assessment

3.3.1 General information

3.3.1.1 The purpose of the on-site assessment is to determine the laboratory's compliance with NIST Handbook 150, this handbook, and its own management system and to assess the capability and competence of the testing activities for which accreditation is being requested.

3.3.1.2 For laboratories that perform testing at locations other than the primary facility covered under the accreditation, these will be reviewed on a case-by-case basis to determine the extent of on-site review necessary.

3.3.1.3 Prior to the on-site assessment, the NVLAP assessor will provide a preliminary agenda. The laboratory shall be prepared to conduct test demonstrations, have equipment in good working order, and be ready for examination according to the requirements identified in this handbook, NIST Handbook 150, Handbook 150-11A Checklist (if applicable), and the laboratory's management system.

3.3.1.4 The laboratory shall make available all supporting technical information. All relevant documentation shall be provided to NVLAP and its assessors in English.

3.3.1.5 In addition to the checklists, to help assure the completeness, objectivity, and uniformity of the on-site assessment, the assessor uses the NVLAP Test Method Review Summary form to review the capability of the laboratory personnel to perform testing for which accreditation is sought. The test method review ranges from observing tests to having laboratory staff describe the test procedures. The assessor notes the depth to which each part of the test method was reviewed and records the results of the review.

3.3.2 Typical on-site assessment

3.3.2.1 Assessment activities

The NVLAP assessor performs the following activities during a typical on-site assessment:

a) Conducts an opening meeting with the laboratory to explain the purpose of the on-site visit and to discuss the schedule for the day(s). At the discretion of the laboratory manager, other staff may attend the meeting.

b) Reviews laboratory documentation not provided for review prior to the assessment, including the management system, equipment and maintenance records, record-keeping procedures, testing procedures, laboratory test records and reports, personnel competency records, personnel training plans and records, and safeguards for the protection of sensitive and proprietary information.

   At least one laboratory staff member shall be available to answer questions; however, the assessor may request to review the documents and records alone.

c) Physically examines equipment and facilities, observes the demonstration of selected procedures by the appropriate personnel assigned to conduct the tests, and interviews those personnel. The demonstrations requested may be selective or all-inclusive and shall include the use of sample test devices, preparation of the test device, and establishment of test conditions and the setup/use of major equipment. The assessor will also review the test data and examine the hardware/software for functionality and appropriateness.

d) Completes an On-Site Assessment Report, which contains the NVLAP On-Site Assessment Signature Sheet with Narrative Summary, NIST Handbook 150 Checklist, NIST Handbook 150-11 Checklist, NIST Handbook 150-11A Checklist (if applicable), and the Test Method Review Summary form.

   Comments in the report should be given serious consideration by the laboratory, but no action is mandated and changes are made at the laboratory's discretion. Comments are those areas of concern where a nonconformity may arise; however, no objective evidence is available to support citing a nonconformity. Historically, it has been noted that comments often rise to the level of nonconformities on subsequent assessments. As such, comments noted in the assessment will be

reviewed at the next on-site assessment to ensure that these issues have not risen to the level of nonconformities since the last on-site visit.

e) Conducts a closing meeting with the laboratory to explain the findings of the visit. At the closing meeting, the report shall be signed by the assessor and the laboratory's Authorized Representative to acknowledge the discussion of the outcome of the on-site assessment. The Authorized Representative's signature does not necessarily indicate agreement, and challenges may be made through NVLAP. The process for resolving nonconformities identified during the on-site is documented in NIST Handbook 150.

3.3.2.2 Proficiency testing

NVLAP does not organize a proficiency testing scheme for the ECT program. The laboratory shall assure the quality of tests in accordance with NIST Handbook 150-11, 5.9. The results of the quality assurance monitoring will be reviewed by the assessor during the on-site assessment.

3.3.3 Specific requirements for ECT on-site assessments

3.3.3.1 All laboratory equipment required to perform accredited testing, including equipment that is rented to perform testing, shall be available for assessment and in compliance with testing requirements. The assessor will physically examine equipment and facilities. This includes storage areas, shielded enclosures, open area test sites (OATS), anechoic and semi-anechoic chambers, pre-scan areas, test benches, electronics, test jigs, and antennas, as appropriate.

3.3.3.2 The laboratory shall have normalized site attenuation (NSA) measurement reports for all OATS and semi-anechoic chambers that are used for work under the NVLAP scope of accreditation and make these reports available to the assessor. The assessor will review these NSA measurement reports during the on-site assessment for adequacy and completeness. For test sites used for conducting tests above 1 GHz, the laboratory shall make available for review the results of the Site Voltage Standing Wave Ratio (SVSWR) for each test site.

3.3.3.3 For FCC CFR Part 68-Connection of Terminal Equipment to the Telephone Network, and other similar standards and regulations, an appropriate test artifact shall be used to demonstrate the test equipment.

3.3.4 Demonstrations

3.3.4.1 Assessor safety

The assessor may decline to observe a potentially hazardous test unless appropriate measures are taken.

3.3.4.2 Conducted and radiated emissions measurements

Demonstrations shall include the use of receivers and/or spectrum analyzers in shielded enclosures, pre-scan areas, OATS, and/or fully or semi-anechoic chambers.

3.3.4.3 Test site validation as part of demonstration

3.3.4.3.1 As part of the demonstration of measurement, an OATS or an alternative site, for testing performed below 1 GHz, shall be validated at least at three frequencies of measure in both horizontal and

vertical polarization at a single test distance. This information is recorded in NIST Handbook 150-11A, *ECT: FCC Parts 2, 15 and 18* Checklist.

For laboratories using outside services to perform normalized site attenuation (NSA), the capability to perform NSA shall be available during the on-site assessment.

3.3.4.3.2 For test sites used for conducting tests above 1 GHz, the laboratory shall make available for review the results of the Site Voltage Standing Wave Ratio (SVSWR) for each test site.

3.3.4.4 Demonstrations for multiple facilities

If the laboratory maintains more than one OATS and/or alternative site, the assessor will ask questions to determine whether all sites are operated and equipped such that the requirements of NVLAP, applicable regulatory bodies, and the test methods within the laboratory's scope of accreditation are met. Usually one site will be examined; however, at the discretion of the assessor, more than one site may be examined.

3.3.5 Nonconformity resolution

The laboratory shall resolve all nonconformities and provide a response to NVLAP within 30 days from the date of completion of the on-site assessment.

4 Management requirements for accreditation

4.1 Organization

There are no requirements additional to those set forth in NIST Handbook 150.

4.2 Management system

4.2.1 The laboratory shall ensure that the requirements of NIST Handbook 150 are met so that staff are knowledgeable of the electronic or paper-based documentation system and can demonstrate, if authorized, the retrieval of needed documents and/or records.

4.2.2 The laboratory shall have readily available the regulation(s) and the applicable version of the standard(s) for the test methods for which accreditation has been requested.

4.2.3 When a test method references another test method, guide, practice, or specification, which contains the procedure for the testing process, the laboratory shall have readily available the referenced documents.

4.3 Document control

The master list or document control procedure that identifies the current revision status and distribution of documents shall include all national and/or international standards on the requested scope of accreditation (see NIST Handbook 150, 4.3.2.1).

4.4 Review of requests, tenders, and contracts

All requests, tenders, and contracts shall be available for selection and examination by the assessor for the period of time covered between the on-site assessments.

4.5 Subcontracting of tests

There are no requirements additional to those set forth in NIST Handbook 150.

NOTE Subcontracting applies to any of the test methods on the scope of accreditation.

4.6 Purchasing services and supplies

There are no requirements additional to those set forth in NIST Handbook 150.

NOTE Laboratories should pay special attention to the purchasing of calibration services from calibration service providers. The technical requirements of the calibration shall be specified by the laboratory (per NIST Handbook 150, 4.6.3) as well as conformance to the appropriate traceability requirements in Annex B of NIST Handbook 150. Assessors will seek to determine that laboratory calibration records identify the measurement parameters, as well as the traceability chain for each parameter.

4.7 Service to the customer

There are no requirements additional to those set forth in NIST Handbook 150.

4.8 Complaints

There are no requirements additional to those set forth in NIST Handbook 150.

4.9 Control of nonconforming testing work

There are no requirements additional to those set forth in NIST Handbook 150.

4.10 Improvement

There are no requirements additional to those set forth in NIST Handbook 150.

4.11 Corrective action

There are no requirements additional to those set forth in NIST Handbook 150.

4.12 Preventive action

There are no requirements additional to those set forth in NIST Handbook 150.

4.13 Control of records

There are no requirements additional to those set forth in NIST Handbook 150.

4.14 Internal audits

4.14.1 The internal audit shall cover compliance with NVLAP accreditation requirements, the laboratory's management system, as well as regulatory, contractual, and testing requirements.

4.14.2 An applicant laboratory shall conduct at least one complete internal audit prior to the first on-site assessment. The records will be reviewed by the NVLAP assessor before or during the on-site assessment visit.

4.14.3 For accredited laboratories, records of internal audits conducted since the previous on-site assessment shall be made available for review.

4.15 Management reviews

4.15.1 An applicant laboratory shall perform at least one complete management review prior to the first on-site assessment. The records will be reviewed by the NVLAP assessor before or during the on-site assessment visit.

4.15.2 For accredited laboratories, records of management reviews conducted since the previous on-site assessment shall be made available for review.

5 Technical requirements for accreditation

5.1 General

There are no requirements additional to those set forth in NIST Handbook 150.

5.2 Personnel

There are no requirements additional to those set forth in NIST Handbook 150.

5.3 Accommodation and environmental conditions

5.3.1 FCC Part 15-Radio Frequency Devices: If a test site other than an OATS is used, a complete description shall be available along with documentation of equivalence.

5.3.2 All parts of the test site shall be operational and available for inspection during the on-site visit. The site attenuation shall be checked per ANSI C63.4 and complete written records shall be maintained. The site attenuation shall also be checked if significant changes are made in or near the OATS. This information will be reviewed during the on-site assessment visit.

5.3.3 FCC Part 68-Connection of Terminal Equipment to the Telephone Network: The laboratory shall have a procedure for checking the testing system before each use. This is especially important for automated systems. The laboratory shall have at least one telephone device reserved for use in periodic checks of the test system.

5.4 Test methods and method validation

Measurement uncertainty is addressed in different ways depending on the test method standards that are employed.

a) If measurement uncertainty can be calculated from Type A and B uncertainties, then the procedure shall follow the GUM or NIST Technical Note 1297 (see references in NIST Handbook 150, 1.4). Unless stated by the standard, the coverage factor (*k*) shall be equal to 2 (two) such that the confidence interval is approximately 95 %.

b) In some instances, the standard provides a measurement uncertainty budget as part of the test method. Examples include European Telecommunications Standards Institute (ETSI) standards concerning radio measurements. Each measurement uncertainty budget shall be supported with calibration and computational data applicable to the test method as performed by that laboratory.

c) In some instances, the standard provides a tolerance for the test method (and does not refer to "measurement uncertainty"). Examples include MIL-STD 461E:1999, 4.2.1 (d), which defines a ±3 dB tolerance for the measurement system (and an antenna to receiver tolerance of ±3 dB). The tolerance stated in the standard shall be supported by calibration data, measurement uncertainty budgets and/or other appropriate calculations.

d) In some instances, the standard provides a tolerance for the test components and/or instrumentation, but not for the test method. The tolerance shall be supported by instrument specifications, calibration and computational data, or comparison to some other appropriate measurement standard. At this time, there are no additional requirements beyond those in NIST Handbook 150, 5.4.6.2 - 5.4.6.3.

e) In all other cases, the requirements in NIST Handbook 150, 5.4.6.2 - 5.4.6.3 apply.

5.5 Equipment

5.5.1 Shielded enclosure

The laboratory shall specify how it monitors and records the performance of its shielded enclosure, how often, and what data shall be recorded. For example, any changes made in or near the shielded enclosure should warrant that the enclosure's performance be verified. Requirements for checking associated critical equipment, such as power line filters, and grounding systems shall also be specified and the results documented.

5.5.2 Line impedance stabilization networks

Line impedance stabilization networks (LISN) shall be calibrated for insertion loss and the impedance verified at least once per year.

5.5.3 Equipment that produce transient waveforms

Equipment that produce transient waveforms (i.e., ESD simulators, burst generators, surge generators, automotive transient generators [per ISO 7637-2], and similar equipment) shall be verified with an oscilloscope at least once per year and photographs of the waveform verification shall be kept on file.

NOTE The waveform verification is performed in accordance with NIST Handbook 150, 5.5.10 for intermediate checks. It is not intended to replace the calibration schedule for the instrument.

5.5.4 Software

Software associated with automated test equipment (either stand-alone or computer-controlled) shall be validated before use. This includes validation of any software updates from the original equipment manufacturer (OEM) or other source.

5.6 Measurement traceability

If a laboratory calibrates its own antennas, spectrum analyzers, and/or measurement receivers, procedures and instructions for those calibrations, in accordance with the manufacturer's calibration process and test method requirements, shall be maintained. Measurement uncertainties associated with these calibrations shall be estimated and reported in the calibration documentation. Antennas shall be calibrated to a recognized standard (e.g., ANSI C63.5, SAE ARP-958).

5.7 Sampling

There are no requirements additional to those set forth in NIST Handbook 150.

NOTE The requirements in NIST Handbook 150 for sampling pertain to a laboratory's selecting the sample to be tested. For most ECT test methods, the sample(s) is(are) selected by the laboratory's customer.

5.8 Handling of test items

There are no requirements additional to those set forth in NIST Handbook 150.

5.9 Assuring the quality of test results

5.9.1 The laboratory shall have procedures for the quality control activities performed to assure the validity of the tests. These procedures shall include predefined criteria.

NOTE 1 NIST Handbook 150, 5.9.1 identifies a number of monitoring methods that may be utilized to ensure the validity of tests. Laboratories could meet the requirements of section 5.9.1 by participation in proficiency testing or interlaboratory comparisons (ILCs), when available.

NOTE 2 NIST Handbook 150, 5.9.1 requires the resulting data to be recorded in such a way that trends are detectable and, where practicable, statistical techniques be applied to the review of the results.

5.9.2 The laboratory shall have a plan for monitoring the quality control activities performed. These activities are to be planned so that a minimum of one activity per year is performed, ensuring that each ECT category (reference section 1.3) of a laboratory's scope of accreditation is covered within four years.

5.9.3 Laboratories shall participate in proficiency testing when NVLAP announces plans to conduct a proficiency test.

5.9.4 The laboratory shall evaluate the quality monitoring results against the predefined criteria. The laboratory shall follow NIST Handbook 150, 4.9 for the control of nonconforming work, as well as section 4.11 for corrective action (where appropriate), whenever outliers are identified.

5.10 Reporting the results

There are no requirements additional to those set forth in NIST Handbook 150. Test methods, standards, specifies, customers, and regulators may have special reporting requirements.

6 Additional requirements

There are no additional requirements beyond NIST Handbook 150 and its associated normative annexes, and any other normative references cited in this handbook.

Annex A

(informative)

Information about selected ECT standards

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Names, acronyms, and national economies of standards-issuing bodies for common ECT standards

Name of standard or standards body	Acronym	National economy
American National Standards Institute	ANSI	United States
Association of Radio Industries and Businesses	ARIB	Japan
ASTM International (formerly American Standards and Testing Materials)	ASTM	United States
Australian Communications and Media Authority	ACMA	Australia
Australian Communications Industry Forum	ACIF	Australia
Australian Standard/New Zealand Standard	AS/NZS	Australia and New Zealand
British National standard	BN	United Kingdom
British Standard	BS	United Kingdom
Broadcasting Equipment Technical Standards	BETS	Canada
Bureau of Standards, Metrology and Inspection	BSMI	Taiwan
Canadian Standards Association	CSA	Canada
Chinese National Standards	CNS	Taiwan
Comité European de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)	CENELEC	European Union
Directorate General of Telecommunications	DGT	Taiwan
Electronic Industries Alliance	EIA	United States
Environmental Protection Agency Energy Star	EPA Energy Star	United States
European Norms (European Standards)	EN	European Union
European Telecommunications Standards Institute	ETS or ETSI	European Union
Federal Communications Commission	FCC	United States
Federal Transit Administration (formerly the Urban Mass Transportation Administration)	FTA	United States
General Requirement (see Network Equipment Building System)	GR	
Hong Kong Telecommunications Authority	HKTA	Hong Kong
Infocomm Development Authority	IDA	Singapore

Name of standard or standards body	Acronym	National economy
Institute of Electrical and Electronics Engineers, Inc.	IEEE	
Interference-Causing Equipment Standard	ICES	Canada
International Electrotechnical Commission	IEC	
International Organization for Standardization	ISO	
International Telecommunications Union – Telecommunication Standardization Sector	ITU-T	
Korea Communications Commission	KCC	Korea
Korean Norms	KN	Korea
Korean Standards	KS	Korea
Military Standards	MIL-STD	United States
Ministry of Information and Communication	MIC	Korea
Network Equipment Building System	NEBS	United States
Public Land Mobile Network	PLMN	Taiwan
Public Switched Telephone Network	PSTN	Taiwan
Radio Standards Specification	RSS	Canada
Radio Telecommunications Terminal Equipment	RTTE	Taiwan
RTCA (formerly Radio Technical Commission for Aeronautics)	RTCA	United States
SEMI	SEMI	
Society of Automotive Engineers, Inc.	SAE	United States
Special International Committee on Radio Interference (see also IEC)	CISPR	
Telecommunications Industry Association	TIA	United States
Underwriters Laboratories, Inc.	UL	United States
Urban Mass Transportation Administration (now the Federal Transit Administration)	UMTA	United States
VCCI Council	VCCI	Japan