

NIST HANDBOOK 150-11
2007 Edition

National
Voluntary
Laboratory
Accreditation
Program

ELECTROMAGNETIC
COMPATIBILITY AND
TELECOMMUNICATIONS
PROGRAM

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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 2007 edition incorporates changes resulting from the release of the newest editions of ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, and NIST Handbook 150, as well as editorial improvements. The 2007 edition of NIST Handbook 150-11 supersedes and replaces the 1995 edition, *Electromagnetic Compatibility and Telecommunications FCC Methods*, and the 1994 draft of the program handbook, *Electromagnetic Compatibility MIL-STD-462*.

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 with respect to the previous edition:

- all references to applicable international guides and standards have been updated;
- on-site assessment checklists and the test method selection list are no longer included in order that they may be provided as separate documents, which may be updated at different intervals than the handbook;
- the body of the handbook has been restructured to conform with internationally accepted rules for the structure and drafting of standards, where appropriate, to promote ease of use and understanding.

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

This handbook is also available on the NVLAP web site (<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 emitters of electromagnetic radiation and are potentially affected by electromagnetic radiation 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, most electrical devices are required to meet specific limits for electromagnetic emissions, but not immunity to emissions. The U.S. Federal Communications Commission (FCC) sets requirements for commercial and consumer electronic devices and systems. Many nations set requirements for a device's immunity to electromagnetic emissions as well as limits for device emissions. The most 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, devices manufactured in one place must meet the EMC requirements of multiple locations in which they are sold. Governments, buyers and manufacturers often cite international EMC voluntary standards. Even so, NVLAP currently tracks and accredits to more than 900 separate test method requirements in the ECT LAP. Part of the reason for the large number of standards in this field is because of the many ways to categorize electrical and electronic devices for EMC.

Some categories 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 are closely related, such as environmental and product safety, including human exposure limits (maximum permissible exposure [MPE] and specific absorption rate [SAR]), 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. 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 and CISPR 22.

Other test methods used to demonstrate compliance with specific national standards for electromagnetic compatibility are also covered. These standards include Australia and New Zealand Standard (AS/NZS) 3548, Australian Communications Authority (ACA) Technical Specifications (TSs), Chinese National Standard (CNS) 13438, and Canadian Compliance Specification (CS) 03. (CS 03 is the Canadian regulatory requirements to FCC part 68.) In addition, by virtue of a memorandum of understanding between NVLAP and the Voluntary Control Council for Interference (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.

Because of the constant updates and modifications to international, national, and regional requirements, users of this handbook should check frequently with the issuing bodies for changes and additions to requirements and regulations. Please check the NVLAP web site or contact the ECT Program Manager 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 most 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 specifies the technical requirements and provides guidance for the accreditation of laboratories under the NVLAP Electromagnetic Compatibility and Telecommunications Laboratory Accreditation Program (ECT Program). It supplements the NVLAP procedures and general requirements found in NIST Handbook 150, by tailoring the general criteria found in NIST Handbook 150 to the specific tests and types of tests covered by the ECT Program.

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 Program.

1.1.3 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 Program.

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, CISPR and other test method standards that have been and may be added to the program.

The program includes 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 encompasses various test methods that are part of the FCC regulatory requirements associated with radio frequency (RF) safety including specific absorption rate (SAR) and maximum permissible exposure (MPE).

The NVLAP ECT test method standards are in the process of being grouped into one or more of the following categories:

- Electromagnetic emissions;
- Electromagnetic immunity;
- Electromagnetic compatibility (both emissions and immunity);

- Environmental simulation;
- Harms to the public telecommunications network;
- Radio conformance;
- Performance;
- Interoperability;
- RF safety;
- Product safety under normal and/or faulty use.

Laboratories may seek accreditation in ECT 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.

- a) 47 U.S. Code of Federal Regulations (CFR) Telecommunication, Parts 0 through 101
- b) MIL-STD 461, Department of Defense Interface Standard, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
- c) MIL-STD 462, Department of Defense, Measurement of Electromagnetic Interference Characteristics of Subsystems and Equipment
- d) ANSI C63 Electromagnetic Compatibility Standards; for OATS site attenuation measurements, ANSI C63.4:2003 applies.
- e) IEC 61000 Electromagnetic compatibility (EMC)
- f) CISPR 22, Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
- g) For terms and definitions 1.5.1 through 1.5.4 below:

BIPM/IEC/IFCC/ISO/IUPAC/IUPAP/OIML, *International Vocabulary of Basic and General Terms in Metrology* (VIM), Draft 3rd Edition, Final 2007-05-18, BIPM Joint Committee for Guides in Metrology (JCGM)/WG 2 Document N341.

1.5 Terms and definitions

For the purposes of this handbook, the terms and definitions given in NIST Handbook 150 and the following 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 See verification.

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 test method review summary sheets and checklists to ensure that each laboratory receives an assessment comparable to that received by others. Checklists assist assessors in documenting the assessment to certain specific test methods and to the NVLAP requirements found in NIST Handbook 150 and this handbook. Checklists and test method review summary sheets form part of the On-Site Assessment Report (see NIST Handbook 150). The current versions of these forms are available on the NVLAP web site <<http://www.nist.gov/nvlap>>.

1.6.2 NIST Handbook 150 Checklist

All NVLAP programs use the NIST Handbook 150 Checklist (formerly called the General Operations 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. The checklist contains guidance expressed at a more detailed level than found in this handbook. Other checklists (such as the FCC Parts 2, 15, and 18 Checklist) may apply and are available on the NVLAP web site.

1.6.4 Test Method Review Summary {if applicable}

Because of the very large number of relevant standards and test methods in the ECT LAP, the assessor uses Test Method Review Summary sheets, along with applicable checklists, to review the laboratory's ability to perform the ECT test methods. The review 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 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 program additions and changes. Current Lab Bulletins are posted on the program-specific handbooks page of the NVLAP web site.

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

3.1.1 This clause discusses the assessment and accreditation process for laboratories in the ECT LAP.

3.1.2 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.

3.1.3 The assessment process consists of a NVLAP review of the application and laboratory management system documentation and an on-site assessment visit.

3.1.4 For an initial accreditation, NVLAP management may consider a pre-assessment on-site visit to better define the laboratory's requested scope of accreditation. In such cases, the pre-assessment costs will be charged to the laboratory in addition to the On-Site Assessment Fee.

3.2 Management system review

3.2.1 Prior to applying to NVLAP for accreditation, a laboratory shall have a fully implemented management system. A copy of the latest quality manual and relevant associated documents shall be sent to NVLAP with the application forms.

3.2.2 The laboratory shall create a cross-reference document allowing the laboratory and 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 shall 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.

3.2.3 Prior to the on-site assessment, the assigned assessor will review all relevant management system documentation for conformity with 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. The laboratory shall provide requested test method(s), operator instructions and/or test procedures to the assessor.

3.3 On-site assessment

3.3.1 General information

3.3.1.1 The purpose of the on-site assessment is to determine whether the laboratory is following its documented management system and to assess the capability and competence of the laboratory's delivery of its testing services.

3.3.1.2 The on-site assessment will take place at the laboratory site. Prior to the visit, the NVLAP assessor will provide a preliminary agenda, which may change due to findings observed during the on-site assessment. Efforts will be made to minimize disruption to the normal working routines during the assessment. The assessor will need time and workspace to complete assessment documentation during his/her time at the laboratory site.

3.3.1.3 The laboratory shall make available all supporting technical information in a format that is conducive to a detailed review. If relevant documentation is in a language other than English, all relevant documentation shall be provided to NVLAP and its assessors in English, prior to the assessment. The assessor may request additional information to clarify issues regarding nonconformities or to delve more deeply into any technical issues.

3.3.2 Typical on-site assessment

3.3.2.1 Opening meeting

The NVLAP assessor will meet with laboratory management, supervisory personnel, and other appropriate staff members to explain the purpose of the on-site assessment and to discuss the schedule for the assessment activities. Information provided by the laboratory on its application form may be discussed during this meeting. At the discretion of the laboratory manager, other staff may attend the briefing.

3.3.2.2 Staff interviews

The NVLAP assessor will ask the laboratory manager to assist in arranging times for individual interviews with laboratory staff members. The assessor will interview staff members filling key positions (e.g., Laboratory Manager, Technical Director, Quality Manager, Authorized Representative, Approved Signatories) and staff members who have an effect on the outcome of the testing, including staff who conduct the testing. The assessor does not need to talk to all staff members; however, the assessor will

select staff members representing all aspects of the laboratory. These interviews are conducted to determine if the staff members are properly trained, assigned, and supervised, and are technically competent for the tasks assigned to them.

3.3.2.3 Records review

The NVLAP assessor will review laboratory documentation, including the management system, quality manual, 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. The assessor will review the laboratory's own detailed instructions to perform ECT testing according to the standard test procedures for which it seeks accreditation, the range of test items and conditions it can test, and the descriptions of the maintenance and calibration of its specific equipment. Also subject to review are:

- item identification and tracking procedures and copies of completed test reports;
- records of internal audits and use of quality control procedures and participation in interlaboratory comparisons or other similar programs;
- personnel records, including résumés and job descriptions of key personnel and competency evaluations for all staff members who routinely perform the test method for which accreditation is sought.

Laboratory staff shall be available to answer questions; however, the assessor may wish to review the documents and records alone. The assessor usually does not ask to remove any laboratory documents or records from the laboratory premises.

NVLAP assessors do not need access to employee information that may be considered sensitive or private such as salary, medical information, or performance reviews for work done outside the scope of the laboratory's accreditation. However, this information is often stored together with technical information that an assessor will need to check (e.g., job descriptions, résumés, and technical performance reviews). In these cases, the assessor will work with the laboratory to ensure the review is performed without violating individual privacy. At the discretion of the laboratory, a member of its human resources department may be present during the review of personnel information.

3.3.2.4 Internal audit and management review

The NVLAP assessor will review and discuss with the laboratory staff the laboratory's internal audit and management review activities, which are separate and distinct activities. The discussion will include all aspects of those activities including the management system procedures, the audit findings, the root cause determination, the actions taken to resolve problems identified, the actions taken to prevent recurrence, and the results of the management review.

3.3.2.5 Equipment and software

The NVLAP assessor will examine and determine the suitability of all equipment and facilities required to perform the standard test methods for which the laboratory is accredited (or is seeking accreditation). The appropriate environmental conditions required for testing will be assessed. The assessor will review test data, as well as examine hardware and software for function and appropriateness.

3.3.2.6 Demonstrations

The demonstrations requested may be selective or all-inclusive. The NVLAP assessor will observe the demonstration of testing procedures by technical personnel assigned to conduct the tests, and will discuss the tests with the technical personnel to assure their understanding of the procedures. The demonstrations will include preparation of test items, establishment of test conditions, and the setup/use of major equipment. The assessor uses the Test Method Review Summary and the ECT Program-Specific Checklist in reviewing and summarizing the laboratory's ability to conduct the test methods. For program-specific information about demonstrations, see 3.3.3 and 3.3.4.

3.3.2.7 Proficiency testing

The NVLAP assessor will discuss all aspects of proficiency testing results with appropriate staff. Test methodology and records documenting the laboratory's execution of the testing will be reviewed and discussed. Any unusual trends or outlying results will be discussed.

NVLAP reserves the right to provide a test item as a proficiency test sample. The assessor may request testing or a demonstration using this or another test item.

3.3.2.8 On-site assessment report

The assessor will complete an On-Site Assessment Report, which summarizes the findings and clearly lists all nonconformities and comments (positive or negative). This report normally consists of the On-Site Assessment Summary, the On-Site Assessment Narrative Summary, the NIST Handbook 150 Checklist, the ECT Program-Specific Checklist, and the Test Method Review Summary. The first page of the report shall be signed by the assessor and the laboratory's Authorized Representative or designee to acknowledge the discussion, but this does not necessarily indicate agreement by the laboratory. A copy of the report is given to the laboratory representative for retention and the assessor sends the original to NVLAP. All observations made by the NVLAP assessor are held in the strictest confidence.

3.3.2.9 Closing meeting

The NVLAP assessor will conduct a closing meeting with the laboratory manager, supervisory personnel, and other appropriate staff members to discuss the findings. During the visit the assessor will have categorized all problems identified as nonconformities and comments. They will be discussed at the closing meeting and resolutions may be mutually agreed upon. The assessor will specifically note items that have been corrected during the on-site assessment along with any recommendations for other action(s). The process for resolving nonconformities identified during the on-site is documented in NIST Handbook 150. Disagreements between the laboratory and an assessor may be referred to NVLAP for resolution.

3.3.3 Specific requirements for ECT on-site assessments

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

3.3.3.2 The laboratory shall have appropriate OATS measurement description reports and OATS attenuation data available. The assessor will review OATS measurement description reports and OATS

attenuation data. Unless the OATS meets the description of a standard site, the site attenuation measurements shall be performed using the volumetric techniques described in ANSI C63.4:2003.

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.

3.3.3.4 Both automatic and manual systems will be evaluated in detail by the assessor as applicable.

3.3.4 Demonstrations

3.3.4.1 Assessor safety

Some test methods may be harmful to staff and/or assessors if appropriate safety measures are not employed. The purpose of the assessment is not to do an Occupational Safety and Health Administration (OSHA) workplace safety assessment; however, the assessors or observers will not knowingly expose themselves or others to a hazardous or inappropriate test method environment. All appropriate personnel safety measures shall be taken. These measures include:

- observing any warnings and precautions contained in user manuals;
- following all appropriate OSHA workplace statutory mandates.

Examples of potentially hazardous test methods or situations include:

- inappropriate implementation of techniques required by the technical standard;
- applying surges to products without associated personal protective equipment such as eye protection or physical barriers;
- exposing observers to the radiated electromagnetic fields associated with radio frequency immunity test methods (if demonstrating in an OATS environment);
- employing field strengths that expose observers to magnitudes that exceed the MPE requirements specified by the FCC in CFR 47, Part 2, 1091;
- faulty implementation of “ground isolation” requirements.

The assessor will not observe potentially hazardous test methods without appropriate measures taken to protect all observers and staff from harm. Standards associated with these test methods will be removed from the scope of accreditation if appropriate protective measures have not been 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 OATS validation as part of demonstration

As part of the demonstration of measurement, an OATS or an alternative site, shall be validated at three frequencies of measure in both horizontal and vertical polarization.

3.3.4.4 Requested demonstrations to be minimally disruptive

The assessor will attempt to minimize disruption to the normal working routine; however, the laboratory shall demonstrate the appropriate test methods in the scope of accreditation. NVLAP may not accredit to test methods that are not demonstrated unless other suitable means of demonstrating competency in this area are found acceptable.

3.3.4.5 Assessor transportation

The laboratory shall ensure transportation to OATS or alternative site for the assessor.

3.3.4.6 Demonstrations for multiple OATS

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 in the same manner. Usually one site will be examined; however, at the discretion of the assessor, more than one site may be examined.

3.3.4.7 OATS validation reports

Validation reports for all OATS and/or alternative sites shall be available that include all the requirements stated in 47 CFR Part 2.948.

3.3.5 Nonconformity resolution

3.3.5.1 The laboratory shall resolve or formulate a plan to resolve all nonconformities and provide a response to NVLAP within 30 days from the date of the on-site assessment. For the case of an initial application, all non-conformities must be resolved before accreditation is granted (i.e., plans are not acceptable).

3.3.5.2 The laboratory shall review all comments for potential improvements in their electromagnetic compatibility testing program.

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 create a cross-reference document allowing the laboratory and 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 requirement can be satisfied in a number of ways. One way is to number and organize the management system documentation to be the same as the NIST Handbook 150 Checklist.

4.2.3 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.

4.2.4 If a customer, for whatever reason (e.g., regulatory requirement), requires accreditation to a version of a test method that is not the latest published version, then the laboratory shall document that requirement and shall have readily available the required version of the test method.

4.2.5 When a test method references another test method, guide, practice, or specification, the laboratory shall have readily available the referenced documents, where relevant.

4.2.6 In addition to the information specified in NIST Handbook 150, the management system documentation shall include:

- a) testing facilities and scope of relevant services offered;
- b) policy and procedures for use of subcontractors, if applicable;
- c) procedures for receipt, identification, and tracking of test items;
- d) procedures by which the laboratory describes the test items and the criteria, if any, for determining if the item is acceptable for testing;
- e) procedures and actions concerning damaged or altered test items;
- f) procedures for maintenance and calibration of the equipment used in conducting the tests;
- g) descriptions of the procedures, practices, and equipment that the laboratory uses in conducting tests;
- h) if the laboratory participates in any laboratory comparisons, procedures for interlaboratory comparison and the laboratory's participation in proficiency testing, a summary of the results, and a description of any corrective actions taken because of the results;
- i) the personnel training and competency evaluations, which demonstrate that the test procedures are being followed correctly.

4.3 Document control

The master list that identifies the current revision status and distribution of documents shall include all national and/or international standards on the 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. At least one project record will be examined by the assessor. The record will include the request, the

quotation, the proposal, and the review of the contract along with receipt of the equipment under test (EUT).

4.5 Subcontracting of tests and calibrations

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 (CSP). The technical requirements of the calibration need to be specified by the laboratory 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.

For example, for Line Impedance Stabilization Network used for FCC-conducted emissions measurements, the technical requirements of the calibrations are contained in ANSI C63.4:2003, Annex F; and, traceability needs to be established for attenuation, impedance, and frequency.

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 and/or calibration work

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

NOTE Laboratories are expected to provide data within the expected band of measurement uncertainty established by the laboratory. If data falls outside the expected measurement uncertainty, then this data is “nonconforming work.” Written notification should be provided to each client who has been affected. Even if the outcome of the test remains the same (i.e., the conducted emissions data still meets the requirements of the FCC Part 15.207 limit for Class B equipment), the client should still be informed if the data are changed significantly (positively or negatively).

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, the laboratory management system, as well as regulatory, contractual, and testing requirements.

4.14.2 An internal audit of test method competency shall be included as part of the internal audit plan and its execution.

4.14.3 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.

4.14.4 For accredited laboratories, internal audit reports conducted since the previous on-site assessment shall be made available for review.

4.14.5 Internal audits are separate and distinct from management reviews (see 4.15).

4.15 Management reviews

4.15.1 Periodic reviews of the management system shall reflect adherence to NVLAP requirements and the laboratory's quality objectives.

4.15.2 Management reviews shall review all nonconformities and may reflect positive aspects of the management system.

4.15.3 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.

4.15.4 The report of the management review shall be available during the NVLAP on-site assessment.

5 Technical requirements for accreditation

5.1 General

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

5.2 Personnel

5.2.1 An observation and an evaluation of performance shall be conducted at least annually by the immediate supervisor or a designee appointed by the laboratory director. A record of the annual evaluation of each staff member shall be dated and signed by the supervisor and the employee.

5.2.2 Accredited test method competency shall be included as part of the personnel competency evaluations.

5.3 Accommodation and environmental conditions

5.3.1 All appropriate personnel safety precautions and warnings shall be taken.

5.3.2 FCC Part 15-Radio Frequency Devices: A facility layout plan of the laboratory, including a complete description of the laboratory's OATS, and drawings and descriptions of the surrounding area and adjacent structures shall be available, if applicable. If a facility other than an OATS is used, a complete description shall be available along with documentation of equivalence. The laboratory's submission to the FCC Description of Measurement Facilities Program shall be documented.

5.3.3 All parts of OATS shall be operational and available for inspection during the on-site visit. The site attenuation shall be checked per ANSI C63.4 at least once per year 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.

5.3.4 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 and calibration methods and method validation

5.4.1 All appropriate safety precautions and warnings shall be incorporated in test and calibration methods.

5.4.2 Measurement uncertainty (MU) shall be estimated for all test methods within the laboratory's scope of accreditation.

5.4.3 MU is handled in different ways depending on the test method standards that are employed.

- a) If MU can be calculated from Type A and B uncertainties, then the procedure shall follow 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 95 %.
- b) In some instances, the standard provides a MU budget as part of the test method. Examples include European Telecommunications Standards Institute (ETSI) standards concerning radio measurements. Each MU 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, MU budgets and/or other appropriate calculations.
- d) In some instances, the standard provides a tolerance for the test components and/or instrumentation, but not the test method. The tolerance of the instrument should be supported by calibration and computational data or comparison to some other appropriate measurement standard (see NIST Handbook 150, Annex B, B.3.5). At this time, MU calculation or budgets are not required but should be estimated in so far as possible and reasonable.
- e) When the normative standard references neither a MU nor tolerance, the laboratory’s own uncertainties associated with the method, its instrumentation, and comparisons between operators, locations, etc. should be estimated in so far as possible and reasonable.

5.5 Equipment

5.5.1 Shielded enclosure

The laboratory shall specify how it will monitor and record 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 Surge generator

The waveform of the surge generator shall be verified with an oscilloscope at least once per year and photographs of the waveform shall be kept on file.

5.5.4 Software and firmware

Software and/or firmware 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

5.6.1 Antennas, spectrum analyzers, measurement receivers

If a laboratory calibrates its own antennas, spectrum analyzers, and/or measurement receivers, explicit procedures and instructions for those calibrations shall be maintained. Measurement uncertainties associated with these calibrations shall be estimated and reported in the calibration report. Antennas shall be calibrated to a standard (e.g., ANSI C63.5:2005 or SAE ARP-958).

5.6.2 Automated test systems including spectrum analyzer measurements

When automated test equipment or automated test systems are used, appropriate documentation, instructions for use and training are required.

5.6.3 Computer software and firmware

5.6.3.1 Computer software shall be included in the laboratory inventory system.

5.6.3.2 When software or firmware in an automated system is changed by the equipment manufacturer or supplier, whether for maintenance, repair, or upgrade, the laboratory shall verify or validate that the changed software is correct before using it in testing.

5.6.3.3 A staff member shall be responsible for implementing, documenting and verifying changes to software and associated hardware.

5.6.3.4 Documentation shall include initial testing, error detection and resolution, updates, and upgrades.

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 and calibration items

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

5.9 Assuring the quality of test and calibration results

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

5.10 Reporting the results

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

NOTE Certain standards have special reporting requirements (e.g., ANSI C63.4, Section 10 and/or MIL-STD-462).

6 Additional requirements

The Declaration of Conformity (DoC) for the FCC Equipment Authorization (EA) program requires laboratory accreditation and foreign economy/country participation in a Mutual Recognition Agreement (MRA) with the United States. A NVLAP-accredited laboratory shall not provide a test report that uses subcontractor data from a non-MRA member foreign economy as part of the DoC equipment approval process. The most current list of MRAs with the United States is available at <http://ts.nist.gov:80/Standards/Global/mra.cfm>.

NOTE Annex A of NIST Handbook 150 [A.1. i)] requires that any data provided by a subcontractor be clearly identified, and that the report prominently display the statement at the beginning of the report: "This report contains data that were produced under subcontract by Laboratory X." If the subcontracted laboratory is accredited by NVLAP, then its Lab Code should also be stated. If the subcontracted laboratory is accredited by a body other than NVLAP, then the name of the accreditation body and the laboratory's number or other unique identifier should also be stated. Under the FCC EA program's DoC, the subcontracted laboratory shall be accredited.

Annex A (informative)

Information about selected ECT standards

This annex provides information about common ECT standards. The information is sorted by the name of the standards-issuing body (Table 1), the acronym for the standards-issuing body (Table 2), and, if available, the national economy for which the standard has been issued (Table 3).

Table 1. Names of standards-issuing bodies for common ECT standards

Name of standard or standards body	Acronym	National economy
SEMI	SEMI	
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 Authority	ACA	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 Européen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)	CENELEC	European Union
Directorate General of Telecommunications	DGT	Taiwan
Electronic Industries Alliance	EIA	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

Name of standard or standards body	Acronym	National economy
Infocomm Development Authority	IDA	Singapore
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	
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	
Public Land Mobile Network	PLMN	Taiwan
Public Switched Telephone Network	PSTN	Taiwan
Radio Research Laboratory	RRL	Korea
Radio Standards Specification	RSS	Canada
Radio Telecommunications Terminal Equipment	RTTE	Taiwan
RTCA (formerly Radio Technical Commission for Aeronautics)	RTCA	United States
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
Voluntary Control Council for Interference by Information Technology Equipment	VCCI	Japan

Table 2. Acronyms of standards-issuing bodies for common ECT standards

Acronym	Name of standard or standards body	National economy
ACA	Australian Communications Authority	Australia
ACIF	Australian Communications Industry Forum	Australia
ANSI	American National Standards Institute	United States
ARIB	Association of Radio Industries and Businesses	Japan
AS/NZS	Australian Standard/New Zealand Standard	Australia and New Zealand
ASTM	ASTM International (formerly American Standards and Testing Materials)	United States
BETS	Broadcasting Equipment Technical Standards	Canada
BN	British National standard	United Kingdom
BS	British Standard	United Kingdom
BSMI	Bureau of Standards, Metrology and Inspection	Taiwan
CENELEC	Comité Européen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)	European Union
CISPR	Special International Committee on Radio Interference (see also IEC)	
CNS	Chinese National Standards	Taiwan
CSA	Canadian Standards Association	Canada
DGT	Directorate General of Telecommunications	Taiwan
EIA	Electronic Industries Alliance	United States
EN	European Norms (European Standards)	European Union
ETS or ETSI	European Telecommunications Standards Institute	European Union
FCC	Federal Communications Commission	United States
FTA	Federal Transit Administration (formerly the Urban Mass Transportation Administration)	United States
GR	General Requirement (see Network Equipment Building System)	
HKTA	Hong Kong Telecommunications Authority	Hong Kong
ICES	Interference-Causing Equipment Standard	Canada
IDA	Infocomm Development Authority	Singapore
IEC	International Electrotechnical Commission	
IEEE	Institute of Electrical and Electronics Engineers, Inc.	
ISO	International Organization for Standardization	
ITU-T	International Telecommunications Union – Telecommunication Standardization Sector	
KN	Korean Norms	Korea

Acronym	Name of standard or standards body	National economy
KS	Korean Standards	Korea
MIC	Ministry of Information and Communication	Korea
MIL-STD	Military Standards	United States
NEBS	Network Equipment Building System	
PLMN	Public Land Mobile Network	Taiwan
PSTN	Public Switched Telephone Network	Taiwan
RRL	Radio Research Laboratory	Korea
RSS	Radio Standards Specification	Canada
RTCA	RTCA (formerly Radio Technical Commission for Aeronautics)	United States
RTTE	Radio Telecommunications Terminal Equipment	Taiwan
SAE	Society of Automotive Engineers, Inc.	United States
SEMI	SEMI	
TIA	Telecommunications Industry Association	United States
UL	Underwriters Laboratories, Inc.	United States
UMTA	Urban Mass Transportation Administration (now the Federal Transit Administration)	United States
VCCI	Voluntary Control Council for Interference by Information Technology Equipment	Japan

Table 3. National economies of standards-issuing bodies for common ECT standards

National economy	Acronym	Name of standard or standards body
	SEMI	SEMI
	GR	General Requirement (see Network Equipment Building System)
	IEEE	Institute of Electrical and Electronics Engineers, Inc.
	IEC	International Electrotechnical Commission
	ISO	International Organization for Standardization
	ITU-T	International Telecommunications Union – Telecommunication Standardization Sector
	NEBS	Network Equipment Building System
	CISPR	Special International Committee on Radio Interference (see also IEC)
Australia	ACA	Australian Communications Authority
Australia	ACIF	Australian Communications Industry Forum
Australia and New Zealand	AS/NZS	Australian Standard/New Zealand Standard
Canada	BETS	Broadcasting Equipment Technical Standards
Canada	CSA	Canadian Standards Association
Canada	ICES	Interference-Causing Equipment Standard
Canada	RSS	Radio Standards Specification
European Union	CENELEC	Comité European de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)
European Union	EN	European Norms (European Standards)
European Union	ETS or ETSI	European Telecommunications Standards Institute
Hong Kong	HKTA	Hong Kong Telecommunications Authority
Japan	ARIB	Association of Radio Industries and Businesses
Japan	VCCI	Voluntary Control Council for Interference by Information Technology Equipment
Korea	KN	Korean Norms
Korea	KS	Korean Standards
Korea	MIC	Ministry of Information and Communication
Korea	RRL	Radio Research Laboratory
Singapore	IDA	Infocomm Development Authority
Taiwan	BSMI	Bureau of Standards, Metrology and Inspection
Taiwan	CNS	Chinese National Standards
Taiwan	DGT	Directorate General of Telecommunications

National economy	Acronym	Name of standard or standards body
Taiwan	PLMN	Public Land Mobile Network
Taiwan	PSTN	Public Switched Telephone Network
Taiwan	RTTE	Radio Telecommunications Terminal Equipment
United Kingdom	BN	British National standard
United Kingdom	BS	British Standard
United States	ANSI	American National Standards Institute
United States	ASTM	ASTM International (formerly American Standards and Testing Materials)
United States	EIA	Electronic Industries Alliance
United States	FCC	Federal Communications Commission
United States	FTA	Federal Transit Administration (formerly the Urban Mass Transportation Administration)
United States	MIL-STD	Military Standards
United States	RTCA	RTCA (formerly Radio Technical Commission for Aeronautics)
United States	SAE	Society of Automotive Engineers, Inc.
United States	TIA	Telecommunications Industry Association
United States	UL	Underwriters Laboratories, Inc.
United States	UMTA	Urban Mass Transportation Administration (now the Federal Transit Administration)