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National
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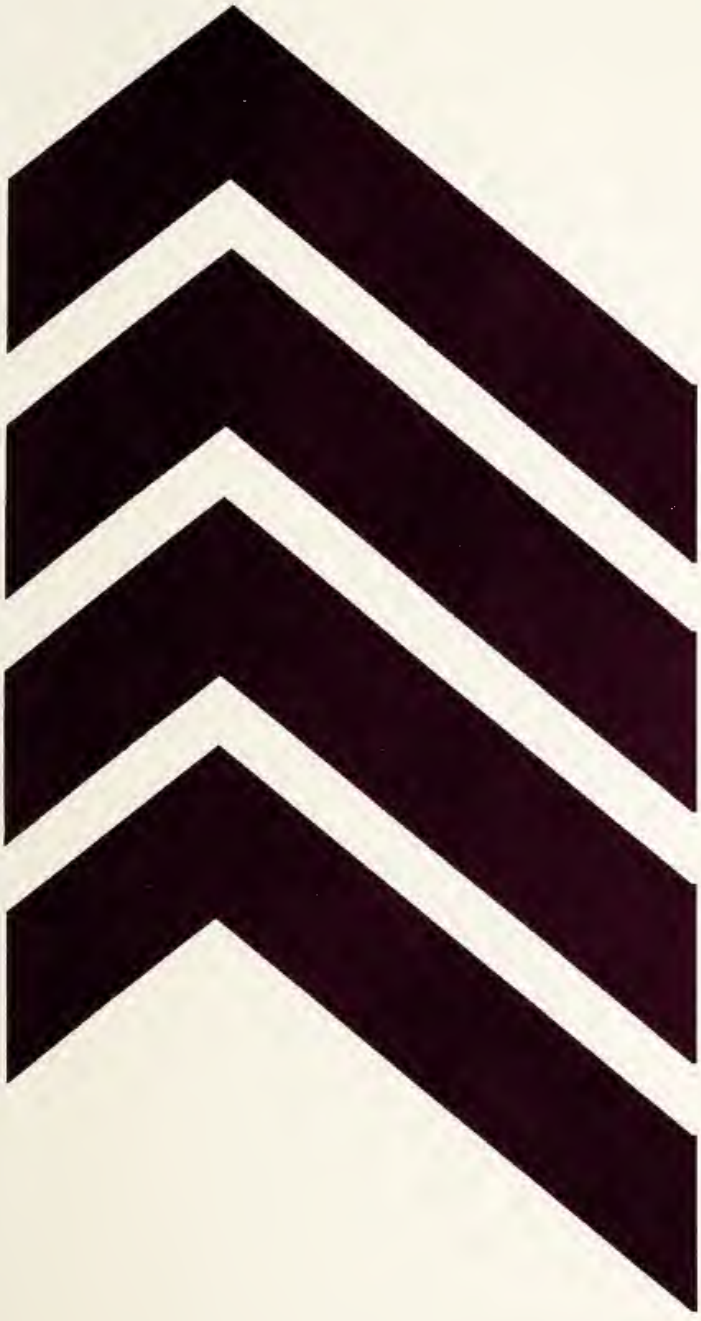
Laboratory
Accreditation
Program



Construction Materials Testing

Paul R. Martin

NIST HANDBOOK 150-5

U.S. Department of Commerce
Technology Administration
National Institute of Standards
and Technology

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- Computer Security
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- Advanced Systems

Computing and Applied Mathematics Laboratory
- Applied and Computational Mathematics[2]
- Statistical Engineering[2]
- Scientific Computing Environments[2]
- Computer Services[2]
- Computer Systems and Communications[2]
- Information Systems

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[1]At Boulder, CO 80303.
[2]Some elements at Boulder, CO 80303.

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National Voluntary Laboratory Accreditation Program

Construction Materials Testing

Paul R. Martin

September 1994

U.S. Department of Commerce
Ronald H. Brown, Secretary

Technology Administration
Mary L. Good, Under Secretary for Technology

National Institute of Standards and Technology
Arati Prabhakar, Director

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PREFACE

NIST Handbook 150-5 presents the technical requirements of the National Voluntary Laboratory Accreditation Program (NVLAP) for Construction Materials Testing (formerly called the Construction Testing Services program). It is intended for information and use by staff of accredited laboratories, those laboratories seeking accreditation, other laboratory accreditation systems, users of laboratory services, and others needing information on the requirements for accreditation.

This publication supplements NIST Handbook 150, *NVLAP Procedures and General Requirements*, which contains Part 285 of Title 15 of the U.S. Code of Federal Regulations (CFR) plus all general NVLAP procedures, criteria, and policies. The criteria in NIST Handbook 150 encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987). Handbook 150-5 contains information that is specific to the Construction Materials Testing program and does not duplicate information contained in the Procedures and General Requirements. The numbering of the sections of this handbook is patterned after Handbook 150; for example, Section 285.3 of Handbook 150 presents the description and goal of NVLAP, whereas Section 285.3 of Handbook 150-5 presents the description of the Construction Materials Testing program. Where there is no material specific to the field of accreditation, the section number is omitted.

Any questions or comments on this handbook should be submitted to the National Institute of Standards and Technology/NVLAP, Building 411, Room A162, Gaithersburg, MD 20899; phone (301) 975-4016; FAX (301) 926-2884.

ACKNOWLEDGMENTS

The author acknowledges the contributions of the NVLAP staff in preparing the operational information and accreditation requirements contained in this handbook. Recognition is also given to the writers and developers of the original Construction Testing Services program handbook.

Special thanks are extended to Vanda White who edited the handbook for publication.

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SUMMARY

Any laboratory (including commercial, manufacturer, university, or federal, state, or local government laboratory) that performs the test methods that comprise the Construction Materials Testing program may apply for NVLAP accreditation. Accreditation will be granted to a laboratory that satisfactorily fulfills the conditions for accreditation defined in the NVLAP Procedures: Title 15, Part 285 of the Code of Federal Regulations (see NIST Handbook 150). These conditions include satisfactory performance in selected proficiency testing as required, and fulfilling the on-site assessment requirements, including resolution of identified deficiencies. The names of NVLAP-accredited laboratories are published in the NVLAP annual directory and other media to which information is regularly provided.

Laboratory accreditation for construction materials testing was established in response to a request from the private sector. The NVLAP program satisfies the requirements for accreditation and evaluation specified by the ASTM Standard Practices E329, C1077, D3666, and D3740.

Testing services covered: Admixtures, Aggregates, Cement, Concrete, Geotextiles, Road and Paving Materials, Soil and Rock, and Steel Materials.

Period of accreditation: One year, renewable annually.

On-site assessment: Visit by a technical expert(s) to determine compliance with the NVLAP criteria before initial accreditation and every two years thereafter. Additional monitoring visits as required.

Assessors: Technical experts with experience in the appropriate field of testing.

Proficiency Testing: The services of outside proficiency testing programs are utilized for Asphalt Materials (Road and Paving), Cement, Concrete, and Soil. A laboratory seeking accrediation for concrete testing must start a within-laboratory proficiency test based on the coefficients of variation of companion concrete cylinders.

Granting Accreditation: Based upon satisfactory on-site assessment and resolution of deficiencies, proficiency testing, and technical evaluation of applicable laboratory information.

Fees: Payments are required as listed on the NVLAP fee schedule, including the administrative/technical support fee, on-site assessment fee, proficiency testing fee, and test method fee.

Sec. 285.1 Purpose

The purpose of this handbook is to set out procedures and technical requirements for NVLAP accreditation of construction materials testing laboratories. It complements and supplements the NVLAP programmatic procedures and general requirements found in NIST Handbook 150. The interpretive comments and additional requirements contained in this handbook make the general NVLAP criteria specifically applicable to the Construction Materials Testing program. The quality system requirements are designed to comply with the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002.

Sec. 285.2 Organization of procedures

(a) The handbook is organized to cross-reference with NIST Handbook 150, *NVLAP Procedures and General Requirements*.

(b) In addition, the handbook contains six appendices:

(1) Appendix A provides examples of a Certificate of Accreditation and a Scope of Accreditation for the Construction Materials Testing program;

(2) Appendix B provides the General Operations Checklist, which NVLAP assessors use during an on-site technical assessment to evaluate a laboratory's ability to conduct testing in general;

(3) Appendix C provides the Specific Operations Checklist, which NVLAP assessors use during an on-site technical assessment of a laboratory that tests construction materials;

(4) Appendix D contains Calibration Requirements;

(5) Appendix E contains a description of the Within-Laboratory Proficiency Testing Program; and

(6) Appendix F contains the Test Method Selection List.

Sec. 285.3 Description of Construction Materials Testing accreditation program

Accreditation is available for selected test methods in the areas of admixtures, aggregates, cement, concrete, geotextiles, road and paving materials, soil and rock, and steel materials. This accreditation program is designed to satisfy the requirements of contractors, state and local governments, and federal agencies specifying accreditation for construction materials testing laboratories.

The test methods for which a laboratory may seek accreditation are listed in Appendix F. Other test methods may be added to the program upon request, if they are found to be appropriate by NVLAP.

Accreditation is available from NVLAP for ASTM Standard Practices, including C1077, E329, D3740 and D3666. These standard practices contain specific requirements for a laboratory quality system and for the evaluation of laboratories. The NVLAP requirements for a quality system meet and exceed the specifications of these ASTM standards; however, these ASTM standards (except D3740) specify that the laboratory operate under the technical direction of a professional engineer (P.E.). For more information about the specific requirements of these standard practices, please refer to Sec. 285.33(d)(2), *Personnel*, and Sec. 285.33(h)(2), *Calibration and test methods*.

Sec. 285.4 References

The following documents are referenced or cited in this handbook:

(a) ISO/IEC Guide 25, *General Requirements for the Competence of Calibration and Testing Laboratories*; available from:

American National Standards Institute
11 West 42 Street, 13th Floor
New York, NY 10036

Order Phone: (212) 642-4900
Order FAX: (212) 302-1286.

(b) ISO 9002, *Quality Systems—Model for Quality Assurance in Production and Installation*; available from American National Standards Institute (see ordering information under (a)).

(c) NIST Handbook 150, *NVLAP Procedures and General Requirements*; available from:

NIST/NVLAP
Building 411, Room A162
Gaithersburg, MD 20899

Phone: (301) 975-4016
FAX: (301) 926-2884.

Sec. 285.5 Definitions

Construction materials: Materials or products such as concrete, cement, aggregates, mortar, asphalt, soil, rock, geosynthetics, road and paving materials, and steel used for construction purposes.

Critical element: A compilation of summary statements of the key provisions of a standard test method that guides individual assessors in applying a common objective assessment of a laboratory's ability to conduct tests.

Quality assurance: All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

Quality control: The operational techniques and activities that are used to fulfill requirements for quality.

Sec. 285.6 NVLAP documentation

Checklists contain definitive questions about all aspects of the NVLAP criteria for accreditation. NVLAP programs incorporate two types of checklists: (a) a General Operations Checklist and (b) a Specific Operations Checklist. In the former case, the questions are applicable to evaluating a laboratory's ability to conduct testing in general. They address factors such as the laboratory's organization, management, and quality system in addition to its testing competency. In the latter case, the checklist questions are specific to the test method(s) in the given program, and focus on the testing requirements including the assessor's observations of test demonstrations.

(a) The NVLAP General Operations Checklist is contained in Appendix B, along with comment sheets used by the assessor in conjunction with this checklist. The questions in the General Operations Checklist follow and are numbered to correspond to the requirements in NIST Handbook 150. The comment sheets are primarily used to explain deficiencies noted on the checklist. The assessor may also use the sheets to make comments on aspects of the laboratory's performance other than deficiencies.

(b) An example of the type of Specific Operations Checklist currently used by the Construction Materials Testing program is contained in Appendix C. Note that it is formatted as **test method review sheets**; i.e., lists of specific test methods for which the laboratory is seeking accreditation. Test method review sheets are used in conjunction with critical elements to evaluate a laboratory's ability to conduct construction materials testing.

Sec. 285.22 Assessing and evaluating a laboratory

(a) **On-Site Assessment**

(1) The NVLAP assessor will request the quality manual and/or procedures in advance of the on-site assessment to reduce time at the laboratory. The laboratory should be prepared for conducting test demonstrations, have equipment in good working order, and be ready for examination according to the requirements identified in this handbook, NIST Handbook 150, and the laboratory's quality manual. The assessor will need time and work space to complete assessment documentation during the time at the laboratory.

(2) An assessor performs the following activities during a typical on-site assessment:

(i) Conducts an entry briefing with the laboratory manager 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 briefing.

(ii) Reviews laboratory quality manual and records, including the following:

- sample identification and tracking procedures and copies of completed test reports;

- records of periodic internal audits and use of quality control procedures and participation in interlaboratory comparisons or other similar programs; and

- personnel records, including résumés and job descriptions of key personnel and

competency evaluations for all staff members who routinely perform the procedures for which accreditation is sought.

At least one laboratory staff member must be available to answer questions; however, the assessor may wish to review the documents alone. The assessor does not usually ask to take any laboratory documents out of the laboratory, and documents previously supplied will be returned.

(iii) Physically examines equipment and facilities, determines whether appropriate environmental conditions are maintained, and observes the demonstration of testing procedures by appropriate personnel assigned to conduct the tests, and discusses them with the personnel to assure their understanding of the procedures. The demonstrations must include sample test material(s), preparation of devices, establishment of test conditions and the setup/use of major equipment. The assessor may select and trace the history of one or more samples from receipt to final issuance of the test reports.

(iv) Completes an On-Site Assessment Report, which contains the minimum requirements prescribed in NIST Handbook 150, Sec. 285.22(b)(2), as well as copies of the completed checklists. At the exit briefing, the first page of the report is signed by the assessor and the laboratory's Authorized Representative to acknowledge the discussion but does not necessarily indicate agreement; appeals may be made through NVLAP. All observations made by the NVLAP assessor are held in the strictest confidence.

(3) NVLAP technical assessors are provided with "critical elements" in addition to the checklists described in 285.6, *NVLAP documentation,* to help assure the completeness, objectivity, and uniformity of the on-site assessment. There are over 80 test methods currently in the Construction Materials Testing accreditation program. The most frequently used methods are included in the critical elements handbook which is provided to the NVLAP assessors only. ***The critical elements handbook is a NVLAP internal document and is not for distribution.***

The critical elements include: test setup, test equipment and apparatus, test procedures, and special considerations.

(b) **Proficiency Testing**

(1) Within-Laboratory Proficiency Testing Program

Laboratories testing concrete must conduct a *within-laboratory proficiency testing program.* This program is designed to be a laboratory quality assurance tool. It requires calculating the coefficients of variation for field concrete cylinders made by the personnel of the laboratory (not made by contractor personnel) during regular business operations. This program must be implemented by a laboratory within 90 days after application for accreditation. The procedures for conducting a within-laboratory proficiency test is explained in more detail in Appendix E.. The data tables developed from this program should not be sent to NVLAP; they will be reviewed by the assessor during the on-site assessment.

(2) Interlaboratory Proficiency Testing Programs

All laboratories are required to participate in programs for the analysis of material reference samples. Participation in these proficiency testing programs will vary from year-to-year, depending on the laboratory's scope of accreditation. Instructions for participating in proficiency testing will be provided as required. Proficiency testing results are sent directly to NVLAP from the proficiency testing organization. Each laboratory must complete and return to NVLAP the proficiency testing data release form, which is provided by NVLAP.

The proficiency testing results for each laboratory will be monitored. The laboratory's accreditation may be suspended if the proficiency testing results indicate continued poor performance for two consecutive rounds of proficiency samples.

Sec. 285.23 Granting and renewing accreditation

Laboratories granted NVLAP accreditation are provided with two documents: a Certificate of Accreditation and a Scope of Accreditation. Samples of these accreditation documents for the Construction Materials Testing program are shown in Appendix A.

Sec. 285.33 Criteria for accreditation

(b) Organization and management

(1) As stated in Sec. 285.5 of NIST Handbook 150, *Definitions*: "NVLAP previously differentiated between *main facilities* and *sub-facilities*. This distinction is no longer recognized. (Exception: As long as there is no break in accreditation, any laboratory previously accredited as a sub-facility may request to be 'grandfathered' in its accreditation renewal under the former classification as a sub-facility, including the unique conditions associated with that classification.)"

A NVLAP accreditation does extend to temporary site facilities if they are due to be in operation for a short period of time and the laboratory has sufficient quality assurance procedures in place for the temporary facility. During an on-site assessment, an assessor may randomly select temporary sites to visit. Mobile facilities present special circumstances and will be assessed with particular regard to the equipment contained and the special problems involved with maintaining environmental and calibration conditions.

(2) Main laboratory facilities and sub-facilities are defined as follows:

(i) A *main laboratory facility* permanently maintains staff, equipment, procedures, documentation, and facilities necessary to perform the tests for which it seeks accreditation; implements all quality assurance procedures; and maintains and retains all records, and issues test reports.

(ii) A *sub-facility* is physically separate from, but considered an extension of, the main facility. Although it may have all staff, equipment, procedures, and documentation necessary to perform the requisite tests, it receives technical direction and quality management from the main facility. A sub-facility shall maintain staff, equipment, procedures, documentation, and facilities necessary to perform the tests for which it seeks accreditation.

(3) NVLAP will renew the accreditation of a sub-facility (in addition to the main facility) if:

(i) the laboratory was accredited as a sub-facility prior to October 1, 1993;

(ii) the laboratory main facility meets all NVLAP accreditation criteria;

(iii) the laboratory main facility satisfactorily documents and maintains quality assurance procedures addressing the applicable sub-facility; and

(iv) the sub-facility complies with all applicable NVLAP criteria.

(4) NVLAP requires that sub-facilities undergo on-site assessments.

(c) Quality system, audit and review

(1) A *quality system* is defined as the organizational structure, responsibilities, procedures, processes and resources for implementing quality management. Quality systems are developed by the laboratory for specific testing services by tailoring the generic guidelines for a quality system. The NVLAP requirements for a quality system are contained in the NIST Handbook 150, *NVLAP Procedures and General Requirements*, and Part 285 of Title 15 of the U.S. Code of Federal Regulations.

The quality system includes the following major components: the organization and management, including a corporate quality policy; technical and quality managers, personnel training and quality audits; the facilities and equipment used in performing the specific testing functions; the calibration of test equipment, reference materials, and measurement traceability to the national standards; the laboratory operating procedures for performing the test method/process and maintaining quality control; and the records and test reports.

The laboratory must have a method for identifying items that have been received by the laboratory for testing. This identification can be used for verification of the test report and tracking the progress of the test item from receipt until the test report is sent to the client.

The quality system requirements are designed to promote laboratory practices which ensure technical integrity of the analyses and adherence to quality assurance. This information will be reviewed by NVLAP assessors during on-site assessments.

(2) Under its quality system, the laboratory shall develop and implement procedures covering all the technical requirements of this handbook. Periodic reviews of the quality system by the laboratory shall reflect adherence to NVLAP requirements and the laboratory's quality objectives. These reviews should reflect positive aspects of the quality system as well as deficiencies.

(3) The most recent editions of the documents listed in Sec. 285.4 *References* should be available as references in maintaining the quality system. There should, also, be available in the laboratory general reference texts on statistics and quality assurance.

(4) The *quality manual* is generally one manual that documents and describes the quality system. It contains references to other supporting documents such as calibration records, equipment inventory and status records, operating procedures for performing the specific test, proficiency testing, quality control functions and statistical methods for controlling the quality of the laboratory function.

The documentation must be readily accessible to all staff members and must be in a format and style which can be easily understood by all staff members.

(5) In a construction materials testing laboratory, the functions and activities may be quite diverse. The functions may be separated into different technical areas such as soils testing, concrete testing and asphalt testing, with each area under the supervision of a different person or department. This may result in different procedures and sets of documents for each testing area. All the documents related to a NVLAP accreditation should be under a central document control procedure. The assessor will review the procedures and documentation which support each area for which accreditation is requested.

(d) Personnel

(1) The laboratory shall maintain records on each staff member, including a résumé, assigned duties, laboratory procedures for which they are qualified, training, quality assurance activities, and proficiency testing information.

(2) The laboratory **technical director** shall be a person with appropriate education and experience in a related field. **If the standard practice(s) for which the laboratory desires accreditation specifies that the laboratory operate under the technical direction of a professional engineer (P.E.), the laboratory must have a P.E. in order to be accredited by NVLAP for that practice.** If a regulatory authority requires a P.E., the laboratory may not use the NVLAP accreditation as a substitute for the P.E. requirement. The laboratory must meet the requirement for a P.E. to the satisfaction of the regulatory authority independent of the NVLAP accreditation.

ASTM C1077 and E329 both specify supervising technicians with more than three years of experience. ASTM D3740 specifies that supervising technicians have 5 years of experience.

(3) The laboratory shall have a detailed documented description of its training program for new and current staff members. Each new staff member must be trained for assigned duties and existing staff members must be retrained when procedures are changed or they are assigned new responsibilities. Each staff member must receive training for assigned duties either through on-the-job training, formal classroom sessions or through certification programs recognized by NVLAP, such as those conducted by the American Concrete Institute (ACI) or the National Institute for Certification of Engineering Technicians (NICET).

(4) In addition to training, the competency of each staff member shall be evaluated by the laboratory either through observation of performance, oral or written examination for

each test method the staff member is authorized to conduct, or other suitable means. The evaluation shall be conducted at least annually by the immediate supervisor or a designee appointed by the laboratory director. A record of the staff member's review must be placed in the personnel file, dated and signed by the supervisor and the employee.

For those staff members who are certified by a recognized organization, the supervisor must still conduct a competency evaluation at least annually and maintain a record of the results.

(5) Reference documents, texts and current scientific and industry periodicals should be made available to all technical personnel to keep their knowledge up to date. An ongoing process of training and professional development is essential to the improvement of technical expertise.

(6) The laboratory shall be organized so that staff members are not subjected to undue pressure or inducement that might influence their judgment or results of their work.

(7) Employees shall be aware of the extent of their area of responsibility. This information should be available in the required job descriptions found in the quality documentation and individual files.

(f) Equipment and reference materials

All facilities and equipment used for performing the applicable tests must conform with the requirements of the standard test methods. If by modification the equipment is different from that called for by the test method, the laboratory must provide evidence (e.g., comparative test results, round-robins, analytical or mathematical proof) that use of the modified equipment results in test data which are equivalent to what would be obtained by the test equipment specified in the test method.

The laboratory workspace and any environmentally controlled spaces (e.g., storage tanks, moist rooms) will be checked for proper conditions, including monitoring devices.

(g) Measurement traceability and calibration

(1) All equipment used in performing accredited test methods must be calibrated according to the following order of priority:

- as specified in the test method;
- in accordance with the manufacturer's recommendation; or
- at least once per year.

A list of apparatuses requiring calibration and the calibration intervals is contained in Appendix D. Calibrations (verifications) may be performed by the laboratory or by an external calibration service. Calibrations of load measuring devices must be traceable to NIST; for foreign laboratories, calibrations should be traceable to the appropriate national standards authority.

(2) Calibration certificates and records must be retained and made available for an assessor's inspection during the on-site visit. The calibration certificate should indicate uncertainty or accuracy limits, and traceability of reference standards. If calibration is performed by the laboratory, the metrology standards used and the environmental conditions must be documented. Certificates are required for calibrations performed by outside services; they are not required for all testing equipment.

The records for each calibration and test shall contain sufficient information to permit their repetition. The records shall include the identity of personnel involved in sampling, preparation, calibration or testing.

(h) Calibration and test methods

(1) The NVLAP accreditation is based on the evaluation of a laboratory's technical qualifications and competence for conducting specific test methods in construction materials or products in accordance with standard test methods, such as ASTM methods. In order to maintain the quality of the results of these standard tests, a laboratory must have written instructions for the laboratory personnel to follow when conducting the tests. These procedures should address any information not specifically contained in the standard method and any deviations used by the laboratory. These procedures should also include equipment

operation, calibration checks, and quality control checks. The laboratory may use the specific standard test method procedure when determined suitable by a NVLAP assessor.

(2) ASTM C1077 requires that the laboratory be able to perform a set of required test methods for concrete and aggregate testing. These test methods include C172, C143, C138, C173 or C231, C31, C39, C136, C117, C127, C128, C40.

(3) The laboratory shall have in-house the latest published version of all of the test methods for which accreditation has been requested. In addition, the laboratory shall have copies of any applicable referenced standards, practices, or procedures, such as:

ASTM C511	Standard Specification for Moist Cabinets and Rooms;
ASTM E4	Load Verification of Testing Machines;
ASTM E11	Standard Specification for Wire Cloth Sieves;
ASTM D75	Standard Practice for Sampling Aggregates;
ASTM D420	Investigating and Sampling Soil and Rock;
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete.

(j) Records

(1) Test reports should be retained for at least three years. Supporting test records and data should also be retained in order to verify or reconstruct the test report if necessary. It is recommended that the test reports be maintained in excess of 3 years on microfilm or microfiche or computer data disks.

(2) Records covering the following items are required and will be reviewed during the on-site visit either in total or by selected sampling:

(i) staff training dates and results;

(ii) staff competency review dates and results;

(iii) equipment calibration and maintenance;

(iv) test data and reports;

(v) specimen control; and

(vi) within-laboratory testing data.

(3) Concrete field testing reports and laboratory records must include the following items for each set of companion concrete cylinders tested:

(i) concrete supplier;

(ii) concrete mix;

(iii) description of field curing facility;

(iv) field curing temperature;

(v) field curing time;

(vi) method of moisture loss prevention;

(vii) ambient temperature and weather conditions on job site;

(viii) slump;

(ix) unit weight of concrete;

(x) concrete cylinder diameter measurements per ASTM C39;

(xi) air content;

(xii) name of person making cylinder;

(xiii) name of person breaking cylinder;

(xiv) ultimate compressive strength;

(xv) structure sample taken from;

(xvi) location in structure where sample was taken;

(xvii) project name; and

(xviii) client name.

APPENDIX A

SAMPLE ACCREDITATION DOCUMENTS

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

ISO/IEC GUIDE 25:1990
ISO/IEC GUIDE 58:1993
ISO 9002:1994

Certificate of Accreditation

DEPARTMENT OF COMMERCE ★ UNITED STATES OF AMERICA ★

LABORATORY NAME
ANYTOWN, USA

is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. Accreditation is awarded for specific services, listed on the Scope of Accreditation for:

CONSTRUCTION MATERIALS TESTING

January 1, 19--
Effective until

Albert D. Nolan
For the National Institute of Standards and Technology

NVLAP LAB CODE: 0000

National Institute of Standards and Technology

NVLAP®

National Voluntary Laboratory Accreditation Program

ISO/IEC GUIDE 25:1990
ISO/IEC GUIDE 58:1993
ISO 9002:1994

Scope of Accreditation

CONSTRUCTION MATERIALS TESTING **NVLAP LAB CODE 0000**

LABORATORY, INC.
1 Main Street, Anytown, USA 00000
John Doe Phone: 301-555-1212

NVLAP Code	*Designation*	*Short Title*
CONCRETE		
02/A01	ASTM C39	Compressive Strength of Cylindrical Specimens
02/A40	ASTM C78	Flexural Strength of Concrete - Simple Beam with Third Point Loading
AGGREGATES		
02/A08	ASTM C123	Lightweight Pieces in Aggregate
CEMENT		
02/A17	ASTM C109	Compressive Strength of Hydraulic Cement
SOIL AND ROCK		
02/L08	ASTM D1557	Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18-Inch Drop
STANDARD PRACTICES		
02/A39	ASTM C1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

January 1, 19--

Effective until

For the National Institute of Standards and Technology

APPENDIX B

GENERAL OPERATIONS CHECKLIST

NVLAP LAB CODE: [ ]

GENERAL OPERATIONS CHECKLIST

Instructions to the Assessor: This checklist addresses general accreditation criteria prescribed in applicable sections of NIST Handbook 150, *NVLAP Procedures and General Requirements*.

This checklist follows and is numbered to correspond to the *NVLAP Procedures and General Requirements*, Subsection 285.33. The numbers in square brackets identify related checklist items. A small black triangle appears in the left-hand margin of selected lines of text throughout this checklist; the marked text applies only to the Calibration Laboratory Accreditation Program (LAP).

Place an "X" beside each checklist item which represents a deficiency. Place a "C" beside each item on which you are commenting for other reasons. Record the item number and your written deficiency explanations and/or comments in this list or on the attached comment sheets. Place a check beside all other items you observed or verified at the laboratory.

SEC. 285.33 CRITERIA FOR ACCREDITATION

(b) ***Organization and management***

(1) The laboratory shall be:

_____ (i) legally identifiable;

Legal name of laboratory ownership: _____

(ii) organized and shall operate in such a way that its permanent, temporary and mobile facilities meet the NVLAP requirements [see also (b)(2)(i), (c)(2)(ii)];

_____ (iii) properly identified on the NVLAP Application.

(2) The laboratory shall:

_____ (i) have managerial staff with the authority and resources needed to discharge their duties [see also (b)(1)(ii), (c)(2)(ii)];

_____ (ii) have policies to ensure that its personnel are free from any commercial, financial and other pressures which might adversely affect the quality of their work;

_____ (iii) be organized in such a way that confidence in its independence of judgment and integrity is maintained at all times;

_____ (iv) specify and document the responsibility, authority and interrelation of all personnel who manage, perform or verify work affecting the quality of calibrations and tests;

_____ (v) provide supervision by persons familiar with the calibration or test methods and procedures, the objective of the calibration or test, and the assessment of the results. The ratio of supervisory to non-supervisory personnel shall be such as to ensure adequate supervision;

_____ (vi) have a technical manager (however named) who has overall responsibility for the technical operations;

Name of person: _____

_____ (vii) have a quality manager (however named) who has responsibility for the quality system and its implementation. The quality manager shall have direct access to the highest level of management at which decisions are taken on laboratory policy or resources, and to the technical manager. In some laboratories, the quality manager may also be the technical manager or deputy technical manager;

Name of person: _____

_____ (viii) nominate deputy(ies) in case of absence of the technical or quality manager;

Name(s): _____

_____ (ix) have documented policy and procedures to ensure the protection of clients' confidential information and proprietary rights [see also (c)(2)(xviii)];

_____ (x) where appropriate, participate in interlaboratory comparisons and proficiency testing programs [see also (c)(2)(xiv), (c)(6)(ii), (g)(3)];

_____ (xi) have documented policy and procedures to ensure that its clients are served with impartiality and integrity.

(c) ***Quality system, audit and review***

(1) The laboratory shall:

_____ (i) have an established and maintained quality system appropriate to the type, range and volume of calibration and testing activities it undertakes;

_____ (ii) have the elements of the quality system documented;

_____ (iii) ensure that the quality documentation is available for use by the laboratory personnel;

_____ (iv) define and document its policies and objectives for, and its commitment to, good laboratory practice and quality of calibration or testing services;

_____ (v) have the laboratory management which ensures that these policies and objectives are documented in a quality manual and communicated to, understood, and implemented by all laboratory personnel concerned;

_____ (vi) ensure that the quality manual is maintained current under the responsibility of the quality manager [see also (c)(2)(iv)].

Date of quality manual: _____

Date of latest update: _____

(2) The quality manual, and related quality documentation, shall state the laboratory's policies and operational procedures established in order to meet the NVLAP requirements. The quality manual and related quality documentation shall contain:

_____ (i) a quality policy statement, including objectives and commitments, by top management;

_____ (ii) the organization and management structure of the laboratory, its place in any parent organization and relevant organizational charts;

_____ (iii) the relations between management, technical operations, support services and the quality system;

_____ (iv) procedures for control and maintenance of documentation [see also (c)(1)(vi), (j)(1)];

_____ (v) job descriptions of key staff and reference to the job descriptions of other staff;

_____ (vi) identification of the laboratory's approved signatories (list here or in the comments section): _____

_____

_____ (vii) the laboratory's procedures for achieving traceability of measurements;

_____ (viii) the laboratory's scope of calibrations and/or tests;

_____ (ix) written procedures for ensuring that the laboratory reviews all new work to ensure that it has the appropriate facilities and resources before commencing such work;

_____ (x) reference to the calibration, verification and/or test procedures used;

_____ (xi) procedures for handling calibration and test items;

_____ (xii) reference to the major equipment and reference measurement standards used;

_____ (xiii) reference to procedures for calibration, verification and maintenance of equipment;

_____ (xiv) reference to verification practices including interlaboratory comparisons, proficiency testing programs, use of reference materials and internal quality control schemes [see also (b)(2)(x), (c)(6)(ii), (g)(3)];

(xv) procedures to be followed for feedback and corrective action whenever:

_____ a) testing discrepancies are detected, or

_____ b) departures from documented policies and procedures occur;

_____ (xvi) the laboratory management policies for departures from documented policies and procedures or from standard specifications;

_____ (xvii) procedures for dealing with complaints [see also (n)];

_____ (xviii) procedures for protecting confidentiality and proprietary rights [see also (b)(2)(ix)];

_____ (xix) procedures for audit and review;

_____ (xx) a description of the laboratory's policy regarding the use of the NVLAP logo;

▸ _____ (xxi) a statement of the laboratory's policy for establishing and changing
▸ calibration intervals for equipment it controls; and

▸ _____ (xxii) a statement of the laboratory's policy concerning the technique(s) to be used
▸ for determining measurement uncertainty and calibration/verification
▸ adequacy.

_____ (3) The laboratory shall arrange for audits of its activities at appropriate intervals to verify that its operations continue to comply with the requirements of the quality system. Such audits shall be carried out by trained and qualified staff who are, wherever possible, independent of the activity to be audited. Where the audit findings cast doubt on the correctness or validity of the laboratory's calibration or test results, the laboratory shall take immediate corrective action and shall immediately notify, in writing, any client whose work may have been affected.

The audits shall be objective and be conducted internally or on contract. The audits shall include both general criteria (documents, records and policies) and technical compliance (test methods and practices and calibration procedures).

_____ (4) The quality system adopted to satisfy the NVLAP requirements shall be reviewed at least once a year by the management to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements.

_____ (5) All audit and review findings and any corrective actions that arise from them shall be documented. The person responsible for quality shall ensure that these actions are discharged within the agreed timescale.

(6) In addition to periodic audits the laboratory shall ensure the quality of results provided to clients by implementing checks. These checks shall be reviewed and shall include, as appropriate, but not be limited to:

_____ (i) internal quality control plans, such as control charts and other available statistical techniques;

NOTE: Measurement assurance techniques are acceptable means to control the measurement process and consistently produce the highest quality measurements.

_____ (ii) participation in proficiency testing or other interlaboratory comparisons [see also (b)(2)(x), (c)(2)(xiv), (g)(3)];

_____ (iii) regular use of certified reference materials and/or in-house quality control using secondary reference materials;

_____ (iv) replicate testings using the same or different methods;

_____ (v) retesting of retained items;

_____ (vi) correlation of results for different characteristics of an item.

(d) ***Personnel*** [see also (c)(2)(v)]

_____ (1) The testing laboratory shall have sufficient personnel, having the necessary education, training, technical knowledge and experience for their assigned functions.

_____ (2) The testing laboratory shall ensure that the training of its personnel is kept up-to-date.

_____ (3) Records on the relevant qualifications, training, skills and experience of the technical personnel shall be maintained by the laboratory.

(e) ***Accommodation (facilities) and environment*** [see also (i)(3)]

_____ (1) Laboratory accommodation, calibration and test areas, energy sources, lighting, heating and ventilation shall be such as to facilitate proper performance of calibrations or tests.

NOTE: Laboratory design will be, to the maximum extent practical, in accordance with the guidelines found in the NCSL Recommended Practice #7, *Laboratory Design*, July 25, 1993.

_____ (2) The environment in which these activities are undertaken shall not invalidate the results or adversely affect the required accuracy of measurement. Particular care shall be taken when such activities are undertaken at sites other than the permanent laboratory premises.

NOTE: It is expected that environments which do not meet generally accepted norms, such as those found in NCSL Recommended Practice #7, yet which exhibit the stability required to apply necessary correction factors, will be specified by the laboratory for the purpose of assessment of compliance with its own procedures to achieve its stated uncertainties.

_____ (3) The laboratory shall provide facilities for the effective monitoring, control and recording of environmental conditions as appropriate. Due attention shall be paid, for example, to biological sterility, dust, electromagnetic interference, humidity, voltage, temperature, and sound and vibration levels, as appropriate to the calibrations or tests concerned.

_____ (4) There shall be effective separation between neighboring areas when the activities therein are incompatible.

_____ (5) Access to and use of all areas affecting the quality of these activities shall be defined and controlled.

_____ (6) Adequate measures shall be taken to ensure good housekeeping in the laboratory.

NOTE: While it is the laboratory's responsibility to comply with relevant health and safety requirements, this is outside the scope of this assessment.

(f) *Equipment and reference materials*

(1) The laboratory shall:

_____ (i) be furnished with all items of equipment (including hardware, software, and reference materials) required for the correct performance of calibrations and tests;

_____ (ii) in those cases where the laboratory needs to use equipment outside its permanent control, including rented, leased and client-owned equipment, ensure that the relevant NVLAP requirements are met.

_____ (2) All equipment shall be properly maintained. Maintenance procedures shall be documented. Any item of the equipment which has been subjected to overloading or mishandling, or which gives suspect results, or has been shown by verification or otherwise to be defective, shall be taken out of service, clearly identified and wherever possible stored at a specified place until it has been repaired and shown by calibration, verification or test to perform satisfactorily. The laboratory shall examine the effect of this defect on previous calibrations or tests.

_____ (3) Each item of equipment including reference materials shall, when appropriate, be labelled, marked or otherwise identified to indicate its calibration status.

_____ (4) Records shall be maintained of each item of equipment and all reference materials significant to the calibrations or tests performed. The records shall include:

_____ (i) the name of the item of equipment, software or reference material;

_____ (ii) the manufacturer's name, type identification, and serial number or other unique identification;

_____ (iii) date received and date placed in service;

NOTE: For initial accreditation, the date received and the date placed in service are not considered mandatory requirements for inclusion in laboratory records, although this is encouraged as good laboratory practice.

_____ (iv) current location, where appropriate;

_____ (v) condition when received (e.g., new, used, reconditioned);

_____ (vi) copy of the manufacturer's instructions, where available;

_____ (vii) dates and results of calibrations and/or verifications and date of next calibration and/or verification;

_____ (viii) details of maintenance carried out to date and planned for the future;

_____ (ix) history of any damage, malfunction, modification or repair;

► _____ (x) measured value observed for each parameter found to be out of tolerance
► during calibration/verification.

(g) ***Measurement traceability and calibration***

_____ (1) All measuring and testing equipment having an effect on the accuracy or validity of calibrations or tests shall be calibrated and/or verified before being put into service. The laboratory shall have an established program for the calibration and verification of its measuring and test equipment. The program will ensure the recall or removal from service of any standard or equipment which has exceeded its calibration interval or is otherwise judged to be unreliable.

_____ (2) The overall program of calibration and/or verification and validation of equipment shall be designed and operated so as to ensure that, wherever applicable, measurements made by the laboratory are traceable to national standards of measurement where available. Calibration certificates shall, wherever applicable, indicate the traceability to national standards of measurement and shall provide the measurement results and associated uncertainty of measurement and/or a statement of compliance with an identified metrological specification.

NOTE: Traceability to national standards includes traceability to standards maintained or defined at national laboratories in foreign countries where applicable. In these cases, traceability is achieved via international standards. This includes intrinsic standards of measurement where available.

Where applicable, the methodology of the *Guide to the expression of uncertainty in measurement*: 1993, shall be used as the basis for expression of uncertainty of the measurement. NIST Technical Note 1297; January 1993, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, is a practical application document written around the *Guide to the expression of uncertainty in measurement*. Where detailed procedures are not used to quantify and combine uncertainties (i.e., use of test accuracy ratio concepts), the sources of uncertainty shall be tabulated and demonstrated to be acceptable for the measurement undertaken.

NOTE: A significant number of intrinsic standards, such as the Josephson Array Voltage Standard and the Iodine-Stabilized Helium-Neon Laser Length Standard, have been developed and are now being used by many national standards laboratories and some industrial laboratories. These standards are based on well-characterized laws of physics, fundamental constants of nature, or invariant properties of materials, and make ideal stable, precise, and accurate measurement standards if properly designed, characterized, operated, monitored and maintained. Where intrinsic standards are used, the laboratory should demonstrate by measurement assurance techniques, interlaboratory comparisons, or other suitable means, that its intrinsic standard measurement results are correlated with those of national or international standards.

_____ (3) Where traceability to national standards of measurement is not applicable, the laboratory shall provide satisfactory evidence of correlation of results, for example by participation in a suitable program of interlaboratory comparisons or proficiency testing [see also (b)(2)(x), (c)(2)(xiv), (c)(6)(ii)].

NOTE: Traceability requirements may also be satisfied by:

(i) internationally accepted standards in the field concerned;

(ii) suitable reference materials;

(iii) ratio or reciprocity measurements; or

(iv) mutual consent standards which are clearly specified and mutually agreed upon by all parties concerned.

_____ (4) Reference standards of measurement held by the laboratory shall be used for calibration only and for no other purpose, unless it can be demonstrated that their performance as reference standards has not been invalidated.

_____ (5) Reference standards of measurement shall be calibrated by a body that can provide traceability to a national standard of measurement. There shall be a program of calibration and verification for reference standards.

_____ (6) Where relevant, reference standards and measuring and testing equipment shall be subjected to in-service checks between calibrations and verifications.

_____ (7) Reference materials shall, where possible, be traceable to national or international standards of measurement, or to national or international standard reference materials.

(h) ***Calibration and test methods***

_____ (1) The laboratory shall have documented instructions on the use and operation of all relevant equipment, on the handling and preparation of items and for calibration and/or testing, where the absence of such instructions could jeopardize the calibrations or tests. All instructions, standards, manuals and reference data relevant to the work of the laboratory shall be maintained up-to-date and be readily available to the staff.

_____ (2) The laboratory shall use appropriate methods and procedures for all calibrations and tests and related activities within its responsibility (including sampling, handling, transport and storage, preparation of items, estimation of uncertainty of measurement and analysis of calibration and/or test data). They shall be consistent with the accuracy required, and with any standard specifications relevant to the calibrations or tests concerned.

NOTES:

(i) Calibration procedures shall contain the required range and tolerance or uncertainty of each item or unit parameter being calibrated or verified. In addition, the procedures shall contain the generic description of the measurement standards and equipment needed with the required parameter, range, tolerances or uncertainties, and specifications for performing the measurement of the calibration or verification, and/or representative types (manufacturer, model, option) that are capable of meeting the generic description for the measurement standards. The procedures shall be consistent with the accuracy required, and with any standard specifications relevant to the calibrations/verifications concerned.

(ii) The laboratory shall ensure that the calibration uncertainties are sufficiently small so that the adequacy of the measurement is not affected. Well-defined and documented measurement assurance techniques or uncertainty analyses may be used to verify the adequacy of a measurement process. If such techniques are not used, then the collective uncertainty of the measurement standards shall not exceed 25% of the acceptable tolerance (e.g., manufacturer's specification) for each characteristic of the measuring and test equipment being calibrated or verified.

_____ (3) Where methods are not specified, the laboratory shall, wherever possible, select methods that have been published in international or national standards, those published by reputable technical organizations or in relevant scientific texts or journals.

_____ (4) Where it is necessary to employ methods that have not been established as standard, these shall be subject to agreement with the client, be fully documented and validated, and be available to the client and other recipients of the relevant reports [see also (k)(2)(x)].

_____ (5) Where sampling is carried out as part of the test method, the laboratory shall use documented procedures and appropriate statistical techniques to select samples [see also (k)(2)(ix)].

_____ (6) Calculations and data transfers shall be subject to appropriate checks.

(7) Where computers or automated equipment are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of calibration or test data, the laboratory shall have written procedures which ensure that:

_____ (i) the NVLAP requirements are complied with;

_____ (ii) computer software, computers or automated equipment is documented and adequate for use;

_____ (iii) procedures are established and implemented for protecting the integrity of data; such procedures shall include, but not be limited to, integrity of data entry or capture, data storage, data transmission and data processing;

_____ (iv) computer and automated equipment is maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain the integrity of calibration and test data [see also (f)(1)];

_____ (v) it establishes and implements appropriate procedures for the maintenance of security of data including the prevention of unauthorized access to, and the unauthorized amendment of, computer records.

_____ (8) Documented procedures shall exist for the purchase, reception and storage of consumable materials used for the technical operations of the laboratory [see also (m)(2)].

(i) ***Handling of calibration and test items***

_____ (1) The laboratory shall have a documented system for uniquely identifying the items to be calibrated or tested, to ensure that there can be no confusion regarding the identity of such items at any time [see also (k)(2)(v)].

_____ (2) Upon receipt, the condition of the calibration or test item, including any abnormalities or departures from standard condition as prescribed in the relevant calibration or test method, shall be recorded. Where there is any doubt as to the item's suitability for calibration or test, where the item does not conform to the description provided, or where the calibration or test required is not fully specified, the laboratory shall consult the client for further instruction before proceeding. The laboratory shall establish whether the item has received all necessary preparation, or whether the client requires preparation to be undertaken or arranged by the laboratory.

_____ (3) The laboratory shall have documented procedures and appropriate facilities to avoid deterioration or damage to the calibration or test item, during storage, handling, preparation, and calibration or test; any relevant instructions provided with the item shall be followed. Where items have to be stored or conditioned under specific environmental conditions, these conditions shall be maintained, monitored and recorded where necessary. Where a calibration or test item or portion of an item is to be held secure (for example, for reasons of record, safety or value, or to enable check calibrations or tests to be performed later), the laboratory shall have storage and security arrangements that protect the condition and integrity of the secured items or portions concerned [see also (e)].

_____ (4) The laboratory shall have documented procedures for the receipt, retention or safe disposal of calibration or test items, including all provisions necessary to protect the integrity of the laboratory.

_____ (5) Tamper-resistant seals shall be affixed to operator-accessible controls or adjustments on measurement standards or measuring and test equipment which, if moved, will invalidate the calibration. The laboratory's calibration system shall provide instructions for the use of such seals and for the disposition of equipment with damaged or broken seals.

NOTE: Tamper-resistant seals are sometimes affixed to equipment to prevent unauthorized access to areas where adjustments or critical components are located.

(j) ***Records***

_____ (1) The laboratory shall maintain a record system to suit its particular circumstances and comply with any applicable regulations. It shall retain on record all original observations, calculations and derived data, calibration records and a copy of the calibration certificate, test certificate or test report for an appropriate period. The records for each calibration and test shall contain sufficient information to permit their repetition. The records shall include the identity of personnel involved in sampling, preparation, calibration or testing [see also (c)(2)(iv)].

▸ **EXCEPTION:** The retention of all original observations, calculations, and
▸ derived data in the calibration record system is not a mandatory requirement
▸ for calibration laboratories, although it is encouraged as good laboratory
▸ practice.

_____ (2) All records (including those listed in (f)(4) pertaining to calibration and test equipment), certificates and reports shall be safely stored, held secure and in confidence to the client [see also (b)(2)(ix), (c)(2)(xviii)].

NOTE: The period of retention shall be specified in the quality manual.

Record retention time specified: _____

(k) ***Certificates and reports***

_____ (1) The results of each calibration, test, or series of calibrations or tests carried out by the laboratory shall be reported accurately, clearly, unambiguously and objectively, in accordance with any instructions in the calibration or test methods. The results should normally be reported in a calibration certificate, test report or test certificate and should include all the information necessary for the interpretation of the calibration or test results and all information required by the method used [see also (k)(4)(i)].

▸ **NOTE:** It is recognized that the results of each calibration do not always
▸ result in the production of a calibration certificate or report. Whenever a
▸ certificate or report is produced, the above requirements shall be met.

(2) Each certificate or report shall include at least the following information:

_____ (i) a title, e.g., "Calibration Certificate," "Test Report" or "Test Certificate";

_____ (ii) name and address of laboratory, and location where the calibration or test was carried out if different from the address of the laboratory;

_____ (iii) unique identification of the certificate or report (such as serial number) and of each page, and the total number of pages;

_____ (iv) name and address of client, where appropriate;

_____ (v) description and unambiguous identification of the item calibrated or tested [see also (i)(1)];

_____ (vi) characterization and condition of the calibration or test item;

_____ (vii) date of receipt of calibration or test item and date(s) of performance of calibration or test, where appropriate;

▸ **EXCEPTION:** Although it is encouraged as good laboratory practice, the
▸ requirement for inclusion of the date received is not mandatory for
▸ calibration laboratories.

_____ (viii) identification of the calibration or test method used, or unambiguous description of any non-standard method used;

_____ (ix) reference to sampling procedure, where relevant [see also (h)(5)];

_____ (x) any deviations from, additions to or exclusions from the calibration or test method, and any other information relevant to a specific calibration or test, such as environmental conditions [see also (c)(2)(xv), (h)(4)];

_____ (xi) measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified;

_____ (xii) a statement of the estimated uncertainty of the calibration or test result, where relevant;

_____ (xiii) a signature and title, or an equivalent identification of the person(s) accepting responsibility for the content of the certificate or report (however produced), and date of issue [see also (c)(2)(vi)];

_____ (xiv) where relevant, a statement to the effect that the results relate only to the items calibrated or tested;

_____ (xv) a statement that the certificate or report shall not be reproduced except in full, without the written approval of the laboratory;

_____ (xvi) a statement that the report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government;

_____ (xvii) the signature of an approved signatory for all test and calibration reports endorsed with the NVLAP logo;

▸ _____ (xviii) special limitations of use; and

▸ _____ (xix) traceability statement.

_____ (3) Where the certificate or report contains results of calibrations or tests performed by subcontractors, these results shall be clearly identified [see also (l)].

_____ (4) Particular care and attention shall be paid to the arrangement of the certificate or report, especially with regard to presentation of the calibration or test data and ease of assimilation by the reader. The format shall be carefully and specifically designed for each type of calibration or test carried out, but the headings shall be standardized as far as possible [see also (k)(1)].

_____ (5) Material amendments to a calibration certificate, test report or test certificate after issue shall be made only in the form of a further document, or data transfer including the statement "Supplement to Calibration Certificate (or Test Report or Test Certificate), serial number ... (or as otherwise identified)," or equivalent form of wording. Such amendments shall meet all the relevant requirements of item (j).

_____ (6) The laboratory shall notify clients promptly, in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any calibration certificate, test report, or test certificate or amendment to a report or certificate.

NOTE: Such notification shall quantify the magnitude of error created in the calibration results. The laboratory shall notify customers promptly, in writing, of any customer's measuring and test equipment found significantly out of tolerance during the calibration/verification process. Measurement data shall be reported so that appropriate action can be taken.

_____ (7) The laboratory shall ensure that, where clients require transmission of calibration or test results by telephone, telex, facsimile or other electronic or electromagnetic means, staff will follow documented procedures that ensure that the NVLAP requirements are met and that confidentiality is preserved.

_____ (8) Whenever a laboratory accredited by NVLAP issues a calibration or test report which contains data covered by the accreditation and also data not covered by the accreditation, it must clearly identify in its records, and in the report to the client, specifically which calibration or test method(s), or portion of a calibration or test method(s), was not covered by the accreditation. The laboratory must also inform the client, before the fact, when calibrations or tests requested are not covered by the accreditation.

NVLAP policy regarding calibration and test reports issued by an accredited laboratory, which reference the laboratory's accredited status, requires that any calibration or test report containing data from calibrations or tests which are not covered by the accreditation include:

_____ (i) a statement at the beginning of the report prominently indicating, "This report contains data which are not covered by the NVLAP accreditation"; and

_____ (ii) a clear indication of which data are not covered by the accreditation.

The laboratory must not misrepresent its accreditation. When a client requires or requests accredited services and any of the requested services are not covered by the accreditation, the client must be so advised.

(l) ***Subcontracting of calibration or testing*** [see also (k)(3)]

_____ (1) Where a laboratory subcontracts any part of the calibration or testing, this work shall be placed with a laboratory complying with these requirements. The laboratory shall ensure and be able to demonstrate that its subcontractor is competent to perform the activities in question and complies with the same criteria of competence as the laboratory in respect of the work being subcontracted. The laboratory shall advise the client in writing of its intention to subcontract any portion of the testing to another party.

_____ (2) The laboratory shall record and retain details of its investigation of the competence and compliance of its subcontractors and maintain a register of all subcontracting.

_____ (3) A NVLAP-accredited laboratory intending to subcontract testing or calibration work that will be performed and reported as meeting NVLAP procedures and criteria must:

_____ (i) have in its quality manual a subcontracting policy compatible with the NVLAP policy, with a description of the procedures for administering and implementing those actions to demonstrate the conformance and consistency of the subcontracted laboratory to perform according to NVLAP procedures;

_____ (ii) place the subcontracted work with a laboratory that maintains accreditation established by NVLAP shown by a current NVLAP Lab Code, or provide and maintain current records that demonstrate that the subcontracted laboratory is competent to perform the test(s) or calibration(s) and that it operates in a manner consistent with and in conformance to NVLAP criteria for accreditation;

_____ (iii) clearly identify in its records, and in the report to the client, exactly which data were obtained by the NVLAP-accredited laboratory and which data were obtained by the subcontractor, NVLAP-accredited or not;

_____ (iv) inform its client, before the fact, that it intends to subcontract for completion of all or a portion of the client's work; and

_____ (v) include at the beginning of the report the name, address, and contact person of the subcontracted laboratory(ies), and one of the following statements, as appropriate:

if NVLAP-accredited

"This report contains data which were produced by a subcontracted laboratory **ACCREDITED (NVLAP LAB CODE)** for the calibration or test methods performed"

if not NVLAP-accredited

"This report contains data which were produced by a subcontracted laboratory **NOT ACCREDITED** for the calibration or test methods performed."

The requirements of this section do not supersede any regulation, law, contract specification, or other related conditions which require NVLAP accreditation.

(m) ***Outside support services and supplies***

_____ (1) Where the laboratory procures outside services and supplies in support of calibrations or tests, the laboratory shall use only those outside support services and supplies that are of adequate quality to sustain confidence in the laboratory's calibrations or tests.

_____ (2) Where no independent assurance of the quality of outside support services or supplies is available, the laboratory shall have procedures to ensure that purchased equipment, materials and services comply with specified requirements. The laboratory should, wherever possible, ensure that purchased equipment and consumable materials are not used until they have been inspected, calibrated or otherwise verified as complying with any standard specifications relevant to the calibrations or tests concerned [see also (h)(8)].

_____ (3) The laboratory shall maintain records of all suppliers from whom it obtains support services or supplies required for calibrations or tests.

(n) ***Complaints*** [see also (c)(2)(xvii)]

_____ (1) The laboratory shall have documented policy and procedures for the resolution of complaints received from clients or other parties about the laboratory's activities. A record shall be maintained of all complaints and of the actions taken by the laboratory.

_____ (2) Where a complaint, or any other circumstance, raises doubt concerning the laboratory's compliance with the laboratory's policies or procedures, or with the NVLAP requirements or otherwise concerning the quality of the laboratory's calibrations or tests, the laboratory shall ensure that those areas of activity and responsibility involved are promptly audited in accordance with item (c)(3).

(o) ***Measuring and test equipment (M & TE)***

NOTE: This section applies to the control of measuring and test equipment (M & TE) used to assure that supplies and services comply with prescribed customer requirements. It is based in large part on the requirements found in government audit standards such as MIL-STD 45662A, and is found in Part II of the ANSI/NCSL Z540-1-1994 (Draft) standard.

(1) General requirements for M & TE

_____ (i) The supplier shall establish and document a system to control the calibration/verification of M & TE.

_____ (ii) M & TE used to determine compliance with customer technical specifications shall be calibrated or verified in accordance with sections 285.33(b) through (n).

_____ (iii) The supplier shall have a program to recall for calibration or verification, or remove from service, M & TE that has exceeded its calibration interval, has broken calibration seals, or is suspected to be malfunctioning because of mishandling, misuse, or unusual results.

_____ (iv) All operations performed by the supplier in compliance with these requirements shall be subject to customer verification at unscheduled intervals.

_____ (v) The supplier shall carry out, or arrange to have carried out, periodic quality auditing of the calibration and verification system in order to ensure its continuing effective implementation and compliance with these requirements.

- Based on the results of the audits and any other relevant factors, such as customer feedback, the supplier shall review and modify the system as necessary.

- Plans and procedures for the audits shall be documented. The conduct of the audit and any subsequent corrective action shall also be documented.

(2) Detailed requirements for M & TE

_____ (i) Calibration system description: The supplier shall provide and maintain a written description of the calibration/verification system covering M & TE and measurement standards. The description shall be sufficient to satisfy each requirement of section 285.33(o) and any deviations shall be submitted with supporting documentation to the customer for approval.

_____ (ii) Adequacy of measurement standards: Measurement standards used by the supplier for calibrating M & TE and other measurement standards shall comply with the requirements of items (f)(1), (g)(1), and (h)(2).

_____ (iii) Environmental conditions: M & TE shall be used in an environment controlled to the extent necessary to ensure valid results. Due consideration shall be given to temperature, humidity, lighting, vibration, dust control, cleanliness, electromagnetic interference and any other factors affecting the results of measurements. Where pertinent, these factors shall be monitored and recorded and, when appropriate, correcting compensations shall be applied to measurement results.

_____ (iv) Intervals of calibration and verification: M & TE requiring calibration shall be calibrated or verified at periodic intervals established and maintained to assure acceptable reliability, where reliability is defined as the probability that M & TE will remain in-tolerance throughout the interval. Intervals shall be established for all M & TE requiring calibration unless the equipment is regularly monitored through the use of check standards in a documented measurement assurance process. Check standards must closely represent the item parameters normally tested in the process and the check standard must be verified periodically. Where intervals are used to ensure reliability, the interval setting system must be systematically applied and shall have stated reliability goals and a method of verifying that the goals are being attained. Intervals may be based on usage or time since last calibration or verification. All exemptions from periodic calibration or verification shall be documented. The recall system may provide for the temporary extension of the calibration due date for limited periods of time under specified conditions that do not unreasonably impair the satisfaction of the customer's requirements.

_____ (v) Calibration procedures: Procedures used to calibrate/verify the supplier's M & TE shall comply with the requirements of items (h)(1) and (h)(2).

_____ (vi) Out-of-tolerance conditions: If any M & TE is found to be significantly out of tolerance during the calibration/verification process, the supplier's system shall provide for notification to the user and to the supplier's quality element, if appropriate, of the out-of-tolerance condition with the associated measurement data so that appropriate action can be taken.

_____ (vii) Adequacy of calibration system: The supplier shall establish and maintain documented procedures to evaluate the adequacy of the calibration system and to ensure compliance with these requirements.

_____ (viii) Calibration sources: M & TE requiring calibration shall be calibrated or verified by laboratories that comply with sections 285.33(b) through (n).

_____ (ix) Records: These requirements shall be supported by records documenting that established schedules and procedures are followed to maintain the adequacy of all M & TE. The records for M & TE requiring calibration shall include an individual record of calibration or verification, or other means of control, providing a description or identification of the item, calibration interval, date calibrated, identification of the calibration source, calibration results (data and/or condition status) and calibration action taken (adjusted, repaired, new value assigned, derated, etc.).

_____ (x) Calibration status: M & TE shall be labeled to indicate calibration or verification status. The label shall identify specific date calibrated (day, month, year, Julian date, or equivalent) and the specific calibration due date or usage equivalent. Items not calibrated to their full capability or which have other limitations of use, shall be labeled or otherwise identified as to the limitations. When it is impractical to apply a label directly to an item, the label may be affixed to the instrument container or some other suitable means may be used to reflect calibration status. Tamper-resistant seals are affixed to operator accessible controls or adjustments which if moved will invalidate the calibration. The quality system shall provide instructions for the disposition of equipment with broken tamper-resistant seals.

_____ (xi) Control of subcontractor calibration: The supplier is responsible for assuring that the subcontractor's calibration system conforms to section 285.33 (l) to the degree necessary to assure compliance with contractual requirements. NVLAP accreditation of the subcontractor's laboratory can serve as the basis for compliance with this requirement.

_____ (xii) Storage and handling: M & TE shall be handled, stored, and transported in a manner which shall not adversely affect the calibration or condition of the equipment.

NVLAP LAB CODE: [ ]

GENERAL OPERATIONS CHECKLIST - COMMENTS AND DEFICIENCIES

Instructions to the Assessor: Use this sheet to document comments and deficiencies. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and deficiencies with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

Item No.	*Comments and/or Deficiencies*

NVLAP LAB CODE: [ ]

GENERAL OPERATIONS CHECKLIST - COMMENTS AND DEFICIENCIES

Instructions to the Assessor: Use this sheet to document comments and deficiencies. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and deficiencies with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

Item No.	*Comments and/or Deficiencies*

APPENDIX C

SPECIFIC OPERATIONS CHECKLIST

This program uses **test method review sheets** in conjunction with critical elements to evaluate a laboratory's ability to conduct construction materials testing. Test method review sheets list the specific test methods for which the laboratory is seeking accreditation.

An example is included in this appendix.

NVLAP LAB CODE: [ ]

CONSTRUCTION MATERIALS TESTING
TEST METHOD REVIEW SHEETS

INSTRUCTIONS: Each one of the test methods listed has been selected by the laboratory to be included in its scope of accreditation. Please review these test methods and indicate if the review and/or demonstration of the test method was satisfactory or deficient. Also, include such deficiencies as calibration requirements, test equipment and apparatus, environmental conditions, and test report deficiencies. In the space provided write satisfactory or explain the deficiency.

CONCRETE

	NVLAP Code	*Test Method Designation*	*Short Title*
☐	02/G01	ASTM C31	Making and Curing Test Specimens
☐		ASTM C172	Sampling Freshly Mixed Concrete
☐		ASTM C143	Slump of Portland Cement Concrete
☐		ASTM C138	Unit Weight, Yield and Air Content
☐		ASTM C231	Air Content-Pressure Method

	NVLAP Code	Test Method Designation	Short Title
☐		ASTM C173	Air Content-Volumetric Method
☐	02/A01	ASTM C39	Compressive Strength of Cylindrical Specimens
☐	02/A02	ASTM C617	Capping Cylindrical Specimens
☐	02/A41	ASTM C192	Making and Curing Concrete Specimens in the Laboratory (requires C173, C231, C138, C143, C136, C127, C128, C566, C1064, C29, C40, C117)
☐	02/A43	ASTM C1064	Temperature of Freshly Mixed Portland Cement Concrete

AGGREGATES

	NVLAP Code	*Test Method Designation*	*Short Title*
☐	02/A03	ASTM C29	Unit Weight and Voids in Aggregates
☐	02/A04	ASTM C40	Organic Impurities in Fine Aggregate
☐	02/A06	ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate
☐	02/A07	ASTM C117	Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
☐	02/A09	ASTM C127	Specific Gravity and Absorption of Coarse Aggregate

	NVLAP Code	Test Method Designation	Short Title
☐	02/A10	ASTM C128	Specific Gravity and Absorption of Fine Aggregate
☐	02/A11	ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate in the Los Angeles Machine
☐	02/A46	ASTM C535	Resistance to Degradation of Large-Size Coarse Aggregate in the Los Angeles Machine
☐	02/A12	ASTM C136	Sieve Analysis of Fine and Coarse Aggregates

SOIL AND ROCK

	NVLAP Code	*Test Method Designation*	*Short Title*
☐	02/L02	ASTM D422	Particle Size Analysis of Soils
☐	02/L04	ASTM D698	Moisture Density Relations of Soils and Soil-aggregate Mixtures Using 5.5-lb Rammer and 12-inch Drop
☐	02/L05	ASTM D854	Specific Gravity of Soils
☐	02/L06	ASTM D1140	Amount of Material in Soils Finer Than the #200 Sieve

NVLAP LAB CODE:

	NVLAP Code	Test Method Designation	Short Title
☐	02/L07	ASTM D1556	Density of Soil by the Sand Cone Method
☐	02/L08	ASTM D1557	Moisture Density Relations of Soils and Soil-aggregate Mixtures Using 10-lb Rammer and 18-inch Drop
☐	02/L11	ASTM D2166	Unconfined Compressive Strength of Cohesive Soil
☐	02/L13	ASTM D2216	Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
☐	02/L23	ASTM D2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

	NVLAP Code	Test Method Designation	Short Title
☐	02/L25	ASTM D3017	Moisture Content of Soil-Aggregate in Place by Nuclear Method (Shallow Depth)
☐	02/L20	ASTM D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

APPENDIX D

CALIBRATION REQUIREMENTS

CALIBRATION REQUIREMENTS

APPARATUS	CALIBRATION OR VERIFICATION FREQUENCY
Concrete	
Compression testing machine(s)*	12 months
Bearing blocks	6 months
Temperature reading device(s) used in laboratory moist curing facility	12 months
Temperature reading device(s) used in field curing facility	12 months
Unit weight scale(s)*	12 months
Pressure air meter apparatus (C231)	3 months
Volumetric air apparatus (C173)	36 months
Molds (single use) (representative sample)	on receipt
Molds (reusable)	12 months
Slump cone(s)	12 months
Unit weight measure	12 months
Tamping rods	12 months
Capping apparatus including plates	6 months
Capping material	3 months
Flexural strength test bearing blocks and hand-operated loading devices (C78)*	12 months
Planeness of capped cylinders	checked daily
Cement	
Testing machine(s) (C109)*	12 months
Scales (C109)	12 months
Weights (reference) (C114)*	5 years
Balance (C114)*	12 months
Microammeter (C115)	12 months
Autoclave pressure gage (C151)	12 months
Comparator (C157, C140)	12 months
Weighing device (C185)	12 months
Reference Thermometer (C180)*	12 months
Vicat apparatus (C191, C451)	12 months
Air permeability apparatus (C204)	12 months
Gillmore needles (C266)	12 months
Pressure gage (C430)	12 months
Sieves (according to E11)	12 months

* Traceable calibration documentation is required.

Aggregates

Balance (C29, C88, C119, C123, C127, C128, C131, C136, C140, C289)*		12 months
Measure (C29)		12 months
Testing machine (C109, C87)*		12 months
Hydrometer (C88, E100, C123)		12 months
Sieves (per E11)		12 months
Spectrophotometer (C289)		12 months

Soil and Rock

Balance (D422, D698, D854, D1556, D2166, D2216, D2217, D2435, D2850, D3080, D4221, D4253, D4254, D4318)*		12 months
Thermometer (D422, D4221)		12 months
Temperature/moist Room (D422, D3080)		12 months
Timing device (D422, D2166, D2850)		12 months
Sieves (per E11)		12 months
Rammer (D698, D1557, D1883)		1000 uses
Drying oven (D698, D1556, D1557, D2166, D2217 D2974,D2435,D3080,D4221,D4253,D4318)		12 months
Pycnometer (D854)		12 months
Loading machine (D1883, D2166)		12 months
Nuclear source (D2922, D3017)	standardized daily when used, calibrated	24 months
Muffle furnace (D2974)		12 months
Gage blocks*		24 months

Road and Paving Materials

Timing device (D5, D2170, D2171)	12 months
Thermometer (D5, D113, D244, D402, D1559, D1856, D2170, D2171, D3142, D3143, D3289)	12 months
Testing machine (D113, D1074, D1560, D1561)*	12 months
Balance/scale (D244, D546, D1074, D1075, D1188, D1559, D1560, D1561, D2172, D3289)*	12 months
Sieve (D244, D546)	12 months
Oven (D244, D546, D1074, D1559, D1560, D1561, D2042, D2172, D2872, D3142)	12 months

Steel Materials

Tensile testing machine per ASTM E4 (A370 Sec. 5-13)*	12 months
Brinnell hardness testing machine per E10 (A370 Sec. 15&16)	12 months
Rockwell hardness testing machine per E18 (A370 Sec. 18)	12 months
Charpy impact machine per E23 (A370 Sec. 18-23)	12 months
Ammeters	3 months
Voltage meters	3 months

* Traceable calibration documentation is required.

APPENDIX E

WITHIN-LABORATORY PROFICIENCY PROGRAM

WITHIN-LABORATORY PROFICIENCY PROGRAM

This program provides a method to monitor the average variation in sets of companion cylinders (the term "set of companion cylinders" refers to a set of two or three cylinders from a single sample of field concrete made by laboratory personnel). The method uses data from individual sets of companion cylinders and specifies a statistical analysis to indicate one-week and five-week patterns in the within-laboratory variation.

This procedure can indicate problems as they occur over a period of time. It is not intended to catch isolated mistakes, but to reveal long-term effects such as out-of-calibration equipment or a technician who may be consistently performing the tests improperly.

By interpreting the results of the analysis, a laboratory should be able to determine when problems occur and take action to remedy them.

DATA SELECTION

The test data selected should be from the laboratory's routine work. The concrete should have a nominal specified compressive strength between 20.7 MPa and 34.5 MPa (3000 and 5000 psi) and a slump exceeding 0.051 m (2 inches). The cylinders should be 0.152 × 0.305 m (6 × 12 inches) and cured for 28 days. If the specimens selected are not within these limits, please note any deviations on Table 1.

To perform the analyses which follow, a laboratory should use data from all the applicable tests which the laboratory performs or, if there is a very large workload, a random selection of not less than 10 tests per week. The selected test data must be recorded for submission to NVLAP. Table 1 shows the required information and gives a suggested format which may be reproduced and used.

Note: 1 psi = 6.895×10^3 Pa
1 MPa = 10^6 Pa

DATA ANALYSIS METHOD

1. Calculate the average strength $\overline{X}_i$ for each set i of companion cylinders as follows:

$$\overline{X}_i = \frac{\sum_1^n X}{n}$$

where X = strength in MPa of the individual cylinders in the i^{th} set tested in a given week

n = number of cylinders (either 2 or 3) in the i^{th} set.

Example: Let the strengths of the cylinders in set i be as follows:

cylinder #1 = 25.9 MPa
cylinder #2 = 27.4 MPa

Then the average strength of the i^{th} set in MPa is computed as follows:

$$\overline{X}_i = (25.9 \text{ MPa} + 27.4 \text{ MPa})/2 = 26.6 \text{ MPa}$$

2. Calculate the range R_i for each set i of companion cylinders. R_i is defined as the difference between the highest and lowest strength values in the i^{th} set.

Example: The range of the set in the previous example is computed as follows:

$$R_i = 27.4 \text{ MPa} - 25.9 \text{ MPa} = 1.5 \text{ MPa}$$

3. Calculate the coefficient of variation V_i (expressed as a percentage) for each set i as follows:

$$V_i = \frac{R_i \cdot d}{\overline{X}_i} \cdot 100$$

where $d = 0.886$ for a set of 2 cylinders*
$d = 0.591$ for a set of 3 cylinders*

* d is derived from table B2 ASTM STP 15-C

Example: The coefficient of variation for the i^{th} set in the above examples is computed as follows:

$$V_i = \frac{1.5 \cdot 0.886}{26.6} \cdot 100 = 5.00\%$$

4. Calculate the average coefficient of variation $\overline{V}$ of all the n sets selected for a given week as follows:

$$\overline{V} = \frac{\sum_{1}^{n} V_i}{n}$$

where n = number of sets selected for the week.

Example: Let the V_i of six (6) sets of cylinders (n = 6 sets/week) be as follows:

$$V_1 = 5.14\%,\ V_2 = 4.27\%,\ V_3 = 3.35\%,\ V_4 = 2.57\%,\ V_5 = 3.98\%,\ V_6 = 2.75\%$$

Then $\overline{V} = (5.14 + 4.27 + 3.35 + 2.57 + 3.98 + 2.75)/6 = 22.06/6 = 3.68\%$ for the week.

5. Calculate the moving average coefficient of variation $\bar{\bar{V}}$ of the weekly averages for the five most recent weeks for which tests were performed:

$$\bar{\bar{V}} = \frac{\sum_{1}^{n} \bar{V}}{n}$$

where $n = 5$.

Note: When calculating $\bar{\bar{V}}$, include only the weeks for which tests were performed; i.e., do not average zeroes into the 5-week moving average.

Example: Let the $\bar{V}$ of five (5) weeks be as follows:

$\bar{V}_1 = 3.68\%$, $\bar{V}_2 = 4.97\%$, $\bar{V}_3 = 8.60\%$, $\bar{V}_4 = 2.90\%$, $\bar{V}_5 = 5.33\%$

Then $\bar{\bar{V}} = (3.68 + 4.97 + 8.60 + 2.90 + 5.33)/5 = 25.48/5 = 5.10\%$.

6. Rate the five-week moving average coefficient of variation $\bar{\bar{V}}$ as follows:

$\bar{\bar{V}}$	*Rating*
less than or equal to 5.0%	Satisfactory (SAT)
greater than 5.0%	Unsatisfactory (UNSAT)

TABULATION

In order to provide a running check on the concrete testing operations, the forms used must be the same as those shown in Tables 1 and 2. If tables are generated by data processing equipment, please use a format as close as possible to the one shown.

Table 1 is a daily record of tests for monitoring individual set within-test variation and is shown on page E-8. Table 2 is a weekly and five-week record of average within-test coefficients of variation and is shown on page E-9. An example of a completed Table 2 is shown below.

National Voluntary Laboratory Accreditation Program
for
Freshly Mixed Field Concrete

WITHIN-LABORATORY PROFICIENCY PROGRAM

Week Ending	Approximate No. of Tests for Week	No. of Tests Sampled for Week	No. of V_i Exceeding 10%	Weekly Average $\bar{V}$	5-Week Average $\bar{\bar{V}}$	Rating (SAT or UNSAT)
3/3	85	10	0	3.68		
3/10	110	10	0	4.97		
3/17	100	10	2	8.60		
3/24	125	10	1	2.90		
3/31	115	10	0	5.33	5.10	UNSAT
4/7	90	10	1	7.00	5.76	UNSAT
4/14	140	10	3	11.00	6.97	UNSAT
4/21	130	10	1	4.20	6.09	UNSAT
4/28	145	10	1	4.50	6.41	UNSAT
5/5	120	10	0	3.05	5.95	UNSAT
5/12	140	10	0	2.00	4.95	SAT
5/19	160	10	0	4.00	3.55	SAT
5/26	180	10	0	3.70	3.45	SAT
6/2	170	10	0	4.31	3.41	SAT

Example: Table for Weekly and Five-Week Record of Average Within-Test Coefficients of Variation

INTERPRETATION

The limits for the values obtained in the analysis are:

V_i - should not exceed 10% more than one time out of 20 sets selected;

$\bar{\bar{V}}$ - should not exceed 5% for any period.

If either of the above limits are exceeded, the laboratory should investigate and take appropriate action to locate and correct the problem. Documentation detailing the investigation and corrective action must be maintained by the laboratory.

SUMMARY OF REQUIREMENTS FOR WITHIN-LABORATORY PROGRAM

A laboratory must:

1. implement a within-laboratory proficiency program within 120 days after the date of application for accreditation;

2. document the corrective actions taken to respond to problems identified by the out-of-tolerance results of the within-test variation table; and

3. maintain the within-test variation tables developed, as shown in Tables 1 and 2, along with a summary of any corrective actions taken, for review by the on-site assessor.

National Voluntary Laboratory Accreditation Program
for
Freshly Mixed Field Concrete

RECORD OF TESTS SELECTED FOR MONITORING
INDIVIDUAL SET WITHIN-TEST VARIATION

Company Name: NVLAP Lab Code:
Supervisor's Name: Date of Submission:

Date Made	Date Tested	Identification	Test Results 1	2	3	Difference R_i	Average $\bar{X}$	V_i

Table 1. NVLAP Record of Tests Selected for Monitoring Individual Set Within-Test Variation

National Voluntary Laboratory Accreditation Program
for
Freshly Mixed Field Concrete

WITHIN-LABORATORY PROFICIENCY PROGRAM

Company Name: NVLAP Lab Code:
Supervisor's Name: Date of Submission:

Week Ending	Approximate No. of Tests for Week	No. of Tests Sampled for Week	No. of V_i Exceeding 10%	Weekly Average $\bar{V}$	5-Week Average $\bar{\bar{V}}$	Rating (SAT or UNSAT)

Table 2: NVLAP Within-Laboratory Proficiency Program

APPENDIX F

TEST METHOD SELECTION LIST

NVLAP LAB CODE: _____

CONSTRUCTION MATERIALS TESTING
TEST METHOD SELECTION LIST

Instructions: Check each test method for which you are requesting accreditation.

NVLAP Code	*Test Method Designation*	*Short Title*
CONCRETE		
_____	02/G01 (only available as a group; select either C231 or C173, or both.)	

Note: You will be charged for only one test method in 02/G01, regardless of how many are selected.

_____	ASTM C31	Making and Curing Test Specimens
_____	ASTM C172	Sampling Freshly Mixed Concrete
_____	ASTM C143	Slump of Portland Cement Concrete
_____	ASTM C138	Unit Weight, Yield and Air Content
_____	ASTM C231	Air Content-Pressure Method
_____	ASTM C173	Air Content-Volumetric Method
_____ 02/A01	ASTM C39	Compressive Strength of Cylindrical Specimens
_____ 02/A02	ASTM C617	Capping Cylindrical Specimens
_____ 02/A40	ASTM C78	Flexural Strength of Concrete - Simple Beam with Third Point Loading
_____ 02/A41	ASTM C192	Making and Curing Concrete Specimens in the Laboratory (requires C173, C231, C138, C143, C136, C127, C128, C566, C1064, C29, C40, C117)
_____ 02/A42	ASTM C360	Ball Penetration of Fresh Portland Cement Concrete
_____ 02/A43	ASTM C1064	Temperature of Freshly Mixed Portland Cement Concrete
_____ 02/A45	ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
_____ 02/A47	ASTM C457	Air-Void Content of Hardened Concrete
_____ 02/A48	ASTM C856	Petrographic Examination of Hardened Concrete
AGGREGATES		
_____ 02/A03	ASTM C29	Unit Weight and Voids in Aggregates
_____ 02/A04	ASTM C40	Organic Impurities in Fine Aggregate

_____ 02/A05	ASTM C87	Effect of Organic Impurities in Fine Aggregates on Strength of Mortar
_____ 02/A06	ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate
_____ 02/A07	ASTM C117	Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
_____ 02/A08	ASTM C123	Lightweight Pieces in Aggregate
_____ 02/A09	ASTM C127	Specific Gravity and Absorption of Coarse Aggregate
_____ 02/A10	ASTM C128	Specific Gravity and Absorption of Fine Aggregate
_____ 02/A11	ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate in the Los Angeles Machine
_____ 02/A46	ASTM C535	Resistance to Degradation of Large-Size Coarse Aggregate in the Los Angeles Machine
_____ 02/A12	ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
_____ 02/A13	ASTM C142	Clay Lumps and Friable Particles in Aggregates
_____ 02/A14	ASTM C289	Reactivity of Aggregates (Chemical method)
_____ 02/A44	ASTM C566	Total Moisture Content of Aggregate by Drying
_____ 02/A15	ASTM D75	Practice for Sampling Aggregates
_____ 02/A16	ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate

CEMENT

_____ 02/A17	ASTM C109	Compressive Strength of Hydraulic Cement
_____ 02/A18	ASTM C114	Chemical Analysis of Hydraulic Cement
_____ 02/A19	ASTM C115	Fineness of Portland Cement by the Turbidimeter
_____ 02/A20	ASTM C151	Autoclave Expansion of Portland Cement
_____ 02/A21	ASTM C157	Length Change of Hardened Cement Mortar and Concrete
_____ 02/A22	ASTM C183	Sampling and Acceptance of Hydraulic Cement
_____ 02/A23	ASTM C185	Air Content of Hydraulic Cement Mortar
_____ 02/A24	ASTM C186	Heat of Hydration of Hydraulic Cement
_____ 02/A25	ASTM C188	Density of Hydraulic Cement

_____ 02/A26	ASTM C191	Time of Setting of Hydraulic Cement by Vicat needle
_____ 02/A27	ASTM C204	Fineness of Portland Cement by Air Permeability Apparatus
_____ 02/A28	ASTM C227	Alkali Reactivity of Cement-Aggregate Combinations (Mortar Bar Method)
_____ 02/A29	ASTM C265	Calcium Sulfate in Hydrated Portland Cement Mortar
_____ 02/A30	ASTM C266	Time of Setting of Hydraulic Cement by Gillmore Needles
_____ 02/A31	ASTM C305	Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
_____ 02/A32	ASTM C430	Fineness of Hydraulic Cement by the 45-μm (No.325) Sieve
_____ 02/A33	ASTM C451	Early Stiffening of Portland Cement (Paste Method)
_____ 02/A34	ASTM C452	Potential Expansion of Portland Cement Mortars Exposed to Sulfate

ADMIXTURES

_____ 02/A35	ASTM C233	Testing Air-Entraining Admixtures for Concrete
_____ 02/A36	ASTM C311	Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
_____ 02/A37	ASTM C441	Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali-Aggregate Reactions

GEOTEXTILES

_____ 02/L28	ASTM D4354	Sampling of Geosynthetics for Testing
_____ 02/L33	ASTM D4632	Breaking Load and Elongation
_____ 02/L34	ASTM D3884	Abrasion Resistance
_____ 02/L35	ASTM D4886	Abrasion Resistance (Modified Method)
_____ 02/L36	ASTM D4533	Trapezoid Tearing Strength
_____ 02/L37	ASTM D4884	Seam Strength of Sewn Geotextiles
_____ 02/L38	ASTM D792	Specific Gravity
_____ 02/L39	ASTM D4491	Water Permeability

_____	02/L40	ASTM D4716	Constant Head Hydraulic Transmissivity
_____	02/L41	ASTM D4751	Determining Apparent Opening Size
_____	02/L42	ASTM D1777	Measuring Thickness of Textiles
_____	02/L43	ASTM D4437	Determining the Integrity of Field Seams
_____	02/L44	ASTM D638	Tensile Properties of Plastic
_____	02/L45	ASTM D4595	Tensile Properties by Wide-Width Strip

SOIL AND ROCK

_____	02/L02	ASTM D422	Particle Size Analysis of Soils
_____	02/L03	ASTM D427	Shrinkage Factors of Soils
_____	02/L04	ASTM D698	Moisture Density Relations of Soils and Soil-aggregate Mixtures Using 5.5-lb Rammer and 12-inch Drop
_____	02/L05	ASTM D854	Specific Gravity of Soils
_____	02/L06	ASTM D1140	Amount of Material in Soils Finer Than the #200 Sieve
_____	02/L07	ASTM D1556	Density of Soil by the Sand Cone Method
_____	02/L08	ASTM D1557	Moisture Density Relations of Soils and Soil-aggregate Mixtures Using 10-lb Rammer and 18-inch Drop
_____	02/L09	ASTM D1558	Moisture Content Penetration Resistance Relations of Fine Grained Soils
_____	02/L10	ASTM D1883	Bearing Ratio of Laboratory Compacted Soils
_____	02/L11	ASTM D2166	Unconfined Compr. Strength of Cohesive Soil
_____	02/L31	ASTM D2167	Density of Soil in Place by the Rubber Balloon Method
_____	02/L12	ASTM D2168	Calibration of Laboratory Mechanical Rammer Soil Compactors
_____	02/L13	ASTM D2216	Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
_____	02/L14	ASTM D2217	Wet Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Const.
_____	02/L21	ASTM D2434	Permeability of Granular Soils (Constant Head)

_____	02/L15	ASTM D2435	One-Dimensional Consolidation Properties of Soils
_____	02/L16	ASTM D2487	Classification of Soils for Engr. Purposes
_____	02/L17	ASTM D2488	Description and Identification of Soils (Visual-Manual)
_____	02/L22	ASTM D2850	Unconsolidated, Undrained Strength of Cohesive Soils in Triaxial Compression
_____	02/L23	ASTM D2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
_____	02/L24	ASTM D2974	Moisture, Ash, and Organic Matter of Peat Material
_____	02/L25	ASTM D3017	Moisture Content of Soil-Aggregate in Place by Nuclear Method (Shallow Depth)
_____	02/L18	ASTM D3080	Direct Shear Tests of Soils Under Consolidated Drained Conditions
_____	02/L01	ASTM D4220	Preserving and Transporting Soil Samples
_____	02/L26	ASTM D4221	Dispersive Characteristics of Clay Soil by Double Hydrometer
_____	02/L27	ASTM D4253	Max. Index Density of Soils - Vibratory Table
_____	02/L19	ASTM D4254	Minimum Index Density of Soils and Calculation of Relative Density
_____	02/L20	ASTM D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
_____	02/L46	ASTM D5084	Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
_____	02/L47	ASTM D2844	Resistance *R*-Value and Expansion Pressure of Compacted Soils
_____	02/L29	Corps of Engineers	Manual EM-1110-2-1906, Appendix VII, Permeability of Fine Grained Soils Using a Triaxial Apparatus
_____	02/L30	Corps of Engineers	Manual EM-1110-2-1906, Appendix X, Consolidated Undrained and Consolidated Drained Triaxial Test

ROAD AND PAVING MATERIALS

_____	02/M01	ASTM D5	Penetration of Bituminous Materials
_____	02/M02	ASTM D113	Ductility of Bituminous Materials
_____	02/M03	ASTM D140	Sampling Bituminous Materials
_____	02/M04	ASTM D243	Residue of Specified Penetration

_____	02/M05	ASTM D244	Testing Emulsified Asphalts
_____	02/M06	ASTM D402	Distillation of Cut-Back Asphaltic Products
_____	02/M07	ASTM D546	Sieve Analysis of Mineral Filler
_____	02/M08	ASTM D979	Sampling Bituminous Paving Mixtures
_____	02/M09	ASTM D1074	Compressive Strength of Bituminous Mixtures
_____	02/M10	ASTM D1075	Effect of Water on Cohesion of Compacted mixes
_____	02/M11	ASTM D1188	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
_____	02/M12	ASTM D1559	Resistance to Plastic Flow - Marshall Apparatus
_____	02/M13	ASTM D1560	Resistance to Deformation and Cohesion by Means of Hveem Apparatus
_____	02/M14	ASTM D1561	Preparation of Specimens - California Kneading Compactor
_____	02/M15	ASTM D1856	Recovery of Asphalt by the Abson Method
_____	02/M24	ASTM D2041	Theoretical Maximum Density (Rice Method)
_____	02/M16	ASTM D2042	Solubility of Asphalt Material in Trichlorethylene
_____	02/M17	ASTM D2170	Kinematic Viscosity of Asphalts
_____	02/M18	ASTM D2171	Viscosity of Asphalts by Vacuum Capillary
_____	02/M19	ASTM D2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
_____	02/M25	ASTM D2726	Bulk Density of Cores (SSD)
_____	02/M20	ASTM D2872	Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)
_____	02/M21	ASTM D3142	Specific Gravity or API Gravity of Liquid Asphalts by Hydrometer Method
_____	02/M22	ASTM D3143	Flash Point of Cutback Asphalt with Tag open Cup Apparatus
_____	02/M23	ASTM D3289	Specific Gravity or Density of Semi-Solid and Solid Bituminous Materials by Nickel Crucible

STEEL MATERIALS (Currently excludes fasteners covered by Public Law 101-592)

_____	02/S01	ASTM A370 (Sec. 5-13)/E8	Tension Test - Steel Products
_____	02/S02	ASTM A370 (Sec. 14)/E190	Guided Bend Test for Ductility of Welds - Steel Products
_____	02/S03	ASTM A370 (Sec. 14)/E290	Semi-Guided Bend Test for Ductility - Steel Products
_____	02/S04	ASTM A370 (Sec. 15-16)/E10	Brinnell Hardness - Steel Products
_____	02/S05	ASTM A370 (Sec. 18)/E18	Rockwell Hardness - Steel Products
_____	02/S06	ASTM A370 (Sec. 18-23)/E18	Charpy Impact Testing - Steel Products
_____	02/S07	ASTM E709	Standard Recommended Practice for Magnetic Particle Examination
_____	02/S08	ASTM E165	Standard Recommended Practice for Liquid Penetrant Inspection Method

NVLAP will indicate that a laboratory complies with the following standard practices if: (a) accreditation is granted for all test methods required by the standard practice, and (b) all conditions and requirements stated in the standard practice are complied with. Applicants must be aware that some of these standards require that a professional engineer be in charge of the laboratory, and that performance of a minimum set of test methods is required.

_____	02/A38	ASTM E329	Standard Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction
_____	02/A39	ASTM C1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation (requires ASTM C31, C39, C40, C117, C127, C128, C136, C138, C143, C172, C173)
_____	02/M26	ASTM D3666	Standard Practice for Evaluation of Inspection and Testing Agencies for Bituminous Paving Materials
_____	02/L32	ASTM D3740	Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction.
_____	02/A49	ASTM C1222	Standard Practice for Evaluation of Laboratories Testing Hydraulic Cement

_____ Total number of test methods selected for Construction Materials Testing
(Enter total on Line 5b of the Fee Calculation Worksheet.)

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