



## Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction<sup>1</sup>

This standard is issued under the fixed designation E 329; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope

1.1 This specification defines the minimum requirements for inspection agency personnel or testing agency laboratory personnel, or both, and the minimum technical requirements for equipment and procedures utilized in the testing and inspection of materials used in construction.

1.2 Criteria is provided for evaluating the capability of agency to properly perform designated tests on construction materials, and establishes essential characteristics pertaining to the organization, personnel, facilities, and quality systems of the agency. This practice may be supplemented by more specific criteria and requirements for particular projects.

1.3 This specification can be used as a basis to evaluate an agency and is intended for use in qualifying and/or accrediting agencies, public or private, engaged in the testing and inspection of construction materials. These materials include concrete, steel, soil, masonry and bituminous materials.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- A 880 Practice for Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys<sup>2</sup>
- C 1077 Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation<sup>3</sup>
- C 1093 Practice for Accreditation of Testing Agencies for Unit Masonry<sup>4</sup>
- D 3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials<sup>5</sup>
- D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock

- as Used in Engineering Design and Construction<sup>6</sup>
- E 4 Practices for Force Verification of Testing Machines<sup>7</sup>
- E 543 Practice for Agencies Performing Nondestructive Testing<sup>8</sup>
- E 548 Guide for General Criteria Used for Evaluating Laboratory Competence<sup>9</sup>
- E 994 Guide for Calibration and Testing Laboratory Accreditation Systems General Requirements for Operation and Recognition<sup>9</sup>

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *agency*—the organization/body, or part thereof, authorized by the project sponsor or his duly authorized representative to inspect or test construction materials as required by the project specifications.

3.1.1.1 *inspection agency*—an agency or testing laboratory that makes visual observations and field measurements of construction materials. It may collect and submit samples, identified with respective portions of the construction, for laboratory evaluation. The inspection agency/body and testing agency may be one organization or separate organizations.

3.1.1.2 *testing agency*—an agency or testing laboratory that measures, examines, tests, or otherwise determines the characteristics or performance of materials and products.

3.1.2 *bituminous material and mixes, n—as used in construction*, all types of asphalts and tars for pavements.

3.1.2.1 *Discussion*—Bituminous mixes are bituminous stabilized soil, base course, binder, leveling, surface course, and mastic mixes. Bituminous mixes may contain either tar or asphalt binder material which, in some cases, may be further modified with other additive materials to produce special properties.

3.1.3 *concrete, n—as used in construction*, all portland cement concrete used in construction, particularly reinforced concrete.

3.1.4 *contract*—the contractual agreement between the agency and the project sponsor.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee E36 on Conformity Assessment and is the direct responsibility of Subcommittee E36.70 on Construction and Building Testing/Inspection Agencies.

Current edition approved Nov. 10, 2001. Published January 2002. Originally published as E 329 – 67 T. Last previous edition E 329 – 00b.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 01.03.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.05.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 04.03.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 04.08.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 03.03.

<sup>9</sup> *Annual Book of ASTM Standards*, Vol 14.02.



3.1.5 *documentation, n*—unless otherwise specified, the term documentation, and related terms such as the verb “document,” refer herein to written documentation.

3.1.5.1 *Discussion*—Documentation other than written documentation, such as video or audio recordings, shall be used, where appropriate, in addition to written documentation, if possible.

3.1.6 *engineer, n*—the term “engineer,” when used in combination with the terms “registered,” “licensed,” or “professional” are to be considered interchangeable for the purposes of clarification.

3.1.6.1 *Discussion*—Geographical areas differ in the title, but the definition and intent are the same.

3.1.7 *inspection, n*—examination of a product, product design, service, process or plant, and determination of conformity with specific or, on the basis of professional judgment, general requirements, the results of which may be used to support certification.

3.1.7.1 *Discussion*—Inspection of processes includes personnel, facilities, technology and methodology.

3.1.8 *masonry, n*—as used in construction, masonry units, brick, mortar and grout used in construction.

3.1.8.1 *Discussion*—The masonry construction may be load bearing or non-load bearing.

3.1.9 *nondestructive testing, n*—procedures for testing products as used in construction.

3.1.9.1 *Discussion*—Nondestructive testing includes all test methods that do not impair the serviceability of the material, part, or assembly under test. Nondestructive tests are specific. They usually reveal only the specific kinds of defects and conditions for whose detection they were designed. Consequently, they must be selected in accordance with the specific materials, the specific conditions to be detected, and the specific job to be done.

3.1.10 *owner, n*—the owner’s officer, the engineer, or the architect responsible for the work, or his duly recognized or authorized representative.

3.1.11 *project sponsor, n*—the organization that retains the agency, and normally, the owner of record when the project is complete.

3.1.12 *qualified accreditation authority, n*—an organization recognized throughout the country, with the capability to assess and monitor the professional and technical activities of an inspection or testing agency, or both.

3.1.13 *soil, n*—as used in construction, subgrade, subbase, base, select fill and other similar types of granular and non-granular soils used in construction regardless of whether it is considered as a structural element in the project or general fill not supporting structural elements.

3.1.14 *steel, n*—as used in construction, structural steel plates and shapes used wholly or in part for structures including reinforcing steel used in concrete.

3.1.14.1 *Discussion*—It is not intended to include steels used in conjunction with mechanical, electrical, heating or air-conditioning equipment except for the supporting structures.

3.1.15 *technician, n*—an employee of the inspection and

testing agency assigned to perform the actual operations of inspection or testing.

#### 4. Reference Material

4.1 Appropriate references, relevant to the construction being inspected, including project plans and specifications, shall be readily available to the technicians or inspectors at all times. The following are particularly essential:

4.1.1 Applicable parts of *Annual Book of ASTM Standards*,

4.1.2 *Applicable Parts of AISC Manual of Steel Construction*,

4.1.3 *Applicable Parts of ASME Boiler and Pressure Vessel Code*,

4.1.4 Applicable building codes,

4.1.5 AWS D1.1 Structural Welding Code, Steel,

4.1.6 AWS B1.11 Guide for the Visual Inspection of Welds,

4.1.7 AWS D1.5 Bridge Welding Code,

4.1.8 AWS D1.4 Structural Welding Code—Reinforcing, and

4.1.9 Steel Joist Institute (SJI) Recommended Code of Standard Practice for Steel Joists and Joist Girders.

#### 5. Significance and Use

5.1 The testing and inspection of construction materials is an important element in obtaining quality construction. A testing and inspection agency must be selected with care after a comprehensive evaluation of its competency to perform the work properly.

5.2 This standard provides basic minimum criteria for use in evaluating the qualifications of technically oriented testing or inspection agencies, or both. The criteria may be supplemented by more specific criteria and requirements for particular classes of testing or types of inspection agencies. An individual user can also use it to judge the competency of an agency. The existence of a formal accrediting authority such as a federal, state, or independent agency is not necessary for the use of this practice, but the practice can be used as a basis for accreditation, if desired.

5.3 The intent of this standard is to provide a consensus system standardized basis for requirements for a technically oriented testing or inspection agency, with respect to the agency’s capability to objectively and competently provide the specific services needed by the user without prejudice.

5.4 Typically, evaluating an agency involves the following three essential sequential phases:

5.4.1 Submittal of basic information in accordance with the criteria of this practice to the evaluator by an agency desiring to be qualified to this standard,

5.4.2 Evaluation of the agency-submitted information, and

5.4.3 On-site verification of the agency-submitted information by the user or a qualified national authority.

#### 6. Organization and Management

6.1 The agency shall be legally identifiable. It shall be organized and shall operate in such a way that its permanent, temporary, and mobile facilities meet the requirements of this standard.

6.2 The agency shall:

6.2.1 Have managerial staff with the authority and resources

needed to discharge their duties.

6.2.2 Have arrangements to ensure that its personnel are free from any commercial, financial, and other pressures that might adversely affect the quality of their work.

6.2.3 Be organized in such a way that confidence in its independence of judgment and integrity is maintained at all times.

6.2.4 Specify and document the responsibility, authority, qualifications, and interrelation of all personnel who manage, perform, or verify work affecting the quality of inspections or tests, or both.

6.2.5 Provide supervision by persons qualified to perform the inspections and tests and to implement relevant procedures. They should also be qualified to evaluate the objective of the inspections or tests and the results. The ratio of supervisory to non-supervisory personnel shall be such as to ensure adequate supervision.

6.2.6 Have a technical manager (however named) who has overall responsibility for the technical operations.

6.2.7 Have a quality manager (however named) who has the 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 made on agency policy or resources, and to the technical manager. In some agencies, the quality manager may also be the technical manager or deputy technical manager.

6.2.8 Nominate deputies in case of absence of the technical or quality manager.

6.2.9 Where relevant, have documented policy and procedures to ensure the protection of clients' confidential information and proprietary rights.

6.2.10 Where appropriate, as determined by the agency's quality manual, participate in interlaboratory comparisons and proficiency testing programs.

## 7. Personnel

7.1 The agency shall have sufficient personnel having the necessary education, training, technical knowledge, certification as appropriate, and experience for their assigned functions.

7.1.1 The agency shall ensure that the training of its personnel is kept up-to-date.

7.1.2 Records of relevant certification, qualifications, training, skills, and experience of the technical personnel shall be maintained by the agency.

7.2 The following personnel requirements must be satisfied by the agency when services are being provided for construction:

7.2.1 The testing and inspection services of the agency, that provides the quality control or quality assurance program, or both, as related to construction practices or materials, or both, shall be under the direction of a person charged with engineering managerial responsibility. The person shall be a licensed professional/registered engineer and a full-time employee of that agency. The person shall have at least five years engineering experience in testing and inspection of construction materials. The organization may consist of one or more separate facilities providing inspection or testing services or both. A licensed professional/registered engineer may have engineer-

ing managerial responsibility for one or more facilities within the organization.

7.2.1.1 When a producer's or manufacturer's laboratory only serves as a quality control laboratory and does not produce tests for acceptance, payment, or the official record, the requirement for a registered professional engineer is waived. However, the laboratory function of the organization shall be supervised by a quality control manager. The quality control manager shall have at least five years experience in testing of that particular construction material, and be a full time employee of the organization. The quality control manager will have the authority to make changes in production to ensure that quality material is produced. He may serve as the quality control manager for several materials production facilities. The quality control manager shall have the certifications appropriate to the testing of the materials supervised.

7.2.2 A laboratory supervisor shall have at least five years experience performing tests on relevant construction materials. This person shall be able to demonstrate either by oral or written examination, or both, their ability to perform the tests normally required in the manner stipulated under ASTM or other governing test procedures and shall be capable of evaluating the test results in terms of specification compliance. Certification by ACI (American Concrete Institute) Laboratory Testing Technician, Grade II or NICET (National Institute for Certification of Engineering Technicians) Level III or higher, or certification by other qualified national, regional or state authorities as appropriate to the work, is required.

7.2.3 A field supervisor shall have at least five years inspection experience in the type of work being supervised. This person shall be able to demonstrate, either by oral or written examination, or both, their ability to perform correctly the required duties and shall be capable of evaluating the inspection or test results in terms of specification compliance. Certification by ACI (Concrete Construction Inspector or Concrete Transportation Construction Inspector), BOCA/ICBO Reinforced Concrete Special Inspector, NICET (Level III or higher), ASNT (Level II or III), AWS (CWI), or certification by other qualified national, regional or state authorities as appropriate to the work, is required.

7.2.4 Inspector or Technician—This person shall have sufficient education and on-the-job training or trade school training to properly perform the test or inspection to which the person is assigned. This person must be able to demonstrate competence for the test or inspection which is being conducted either by oral or written examination, or both. Certification by ACI (American Concrete Institute), BOCA/ICBO Reinforced Concrete Special Inspector, AWS (American Welding Society), ASNT (American Society for Nondestructive Testing), NICET (National Institute for Certification of Engineering Technicians), ICC (International Code Council), ICBO (International Council of Building Officials), BOCA (Building Officials Code Administration), as appropriate for the work being performed, or certification by other qualified national authorities as appropriate to the work; shall be considered as one means of documenting competency. The Inspector or Technician shall work under the direct supervision of personnel meeting the requirements of 7.2.2 or 7.2.3 (see Appendix X1).





## 8. Equipment

8.1 The agency shall furnish all items of equipment, including reference materials, required for the correct performance of inspections and tests. In those cases where the agency needs to use equipment outside its permanent control, it shall ensure that the relevant requirements of this standard are met.

8.2 All equipment shall be properly maintained. Maintenance procedures shall be documented and shall include a schedule for future maintenance.

8.2.1 Any equipment that has been subjected to overloading or mishandling, or that 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.

8.2.1.1 The agency shall examine the effect of this defect on previous inspections or tests.

8.3 Each item of equipment including reference materials shall, when appropriate, be labeled, marked or otherwise identified to indicate its calibration status.

8.4 Records shall be maintained for each item of equipment and all reference materials significant to the inspections or tests performed. The records shall include:

8.4.1 The name of the item of equipment,

8.4.2 The manufacturer's name, type identification, and serial number or other unique identification,

8.4.3 Date received and date placed in service,

8.4.4 Condition when received (for example, new, used, reconditioned, and so forth),

8.4.5 Copy of the manufacturer's instructions, where available, condition when received (for example, new, used, reconditioned, and so forth),

8.4.6 Details of maintenance carried out to date,

8.4.7 Dates and results of calibrations or verifications, or both, and date of next calibration or verification, or both,

8.4.8 History of any damage, malfunction, or repair, and

8.4.9 Current location.

## 9. Quality System, Audit and Review

9.1 The agency shall establish and maintain a quality system appropriate to the type, range, and volume of inspections and testing activities it undertakes. The elements of this system shall be documented. The quality documentation shall be available for use by the agency's personnel.

9.1.1 The agency shall define and document its policies and objectives for, and its commitment to good practice and quality of, inspection or testing services.

9.1.2 The agency management shall ensure that these policies and objectives are documented in a quality manual and communicated to, and understood and implemented by all personnel concerned. The quality manual shall be maintained current under the responsibility of the quality manager.

9.2 The quality manual, and related quality documentation, shall state the agency's policies and operational procedures established in order to meet the requirements of this standard. The quality manual and related quality documentation shall also contain:

9.2.1 A quality policy statement, including objectives and

commitments, by top management,

9.2.2 The organization and management structure of the agency, its place in any parent organization and relevant organizational charts,

9.2.3 The relations between management, technical operations, support services and the quality system,

9.2.4 Procedures for control and maintenance of documentation,

9.2.5 Job descriptions of key staff and reference to the job descriptions of other staff,

9.2.6 Identification of the agency's approved signatories (where this concept is appropriate),

9.2.7 The agency's procedures for achieving traceability of measurements,

9.2.8 The agency's scope of inspections or tests, or both,

9.2.9 Arrangements for the agency to review all new work to ensure that it has the appropriate facilities and resources before commencing such work,

9.2.10 Reference to the test procedures used,

9.2.11 Procedures for handling inspection and test items,

9.2.12 Reference to the equipment and reference measurement standards used,

9.2.13 Reference to procedures for calibration, verification and maintenance of equipment,

9.2.14 Procedures to be followed for feedback and corrective action whenever testing discrepancies are detected, or departures from documented policies and procedures occur,

9.2.15 The agency management arrangements for exceptionally permitting departures from documented policies and procedures or from standard specifications,

9.2.16 Procedures for dealing with complaints,

9.2.17 Procedures for protecting confidentiality and proprietary rights, and

9.2.18 Procedures for audit and review.

9.3 The agency shall arrange for audits or inspections 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 qualified staff who are independent of the activity to be audited.

9.3.1 Where the audit findings cast doubt on the correctness or validity of the agency's inspections or test results, the agency shall take immediate corrective action and shall immediately notify, in writing, any client whose work may have been affected.

9.4 The quality system adopted to satisfy the requirements of this standard 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.

9.5 All audit and review findings, external and internal, 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.

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

9.6.1 Internal quality control schemes using, whenever possible, statistical techniques,

- 9.6.2 Participation in proficiency testing or peer reviews,
- 9.6.3 Regular use of certified reference materials or in-house quality control using secondary reference materials, or both,
- 9.6.4 Replicate inspections or testing using the same or different methods,
- 9.6.5 Re-inspection or re-testing of retained items, and
- 9.6.6 Correlation of results for different characteristics of an item.

## 10. Responsibilities and Duties

10.1 It shall be the responsibility of the agency to ensure that it performs only tests and inspections, or both, for which it is adequately equipped and staffed, and that its employees perform only tests and inspections, or both, for which they are adequately trained.

10.2 The following duties are those usually performed by the agency:

10.2.1 Obtain representative samples of those materials required by project specifications, and authorized by contract, to be tested and evaluated.

10.2.2 When samples are collected by the agency, the agency must ensure that there is proper protection, handling, and storing of the samples to ensure that they remain representative of the material being used at the time of sampling.

10.2.3 When the agency is responsible for collecting samples, the samples must be identified with the respective portions of the work in which the material represented was or will be used.

10.2.4 Perform all testing and inspection operations in accordance with appropriate standards as referenced in the contract.

10.2.5 Call to the attention of the project sponsor any irregularities or deficiencies in the construction materials or processes, or both, as related to construction materials, that the contract specifically states the agency is responsible for inspecting.

10.2.6 Submit promptly to the project sponsor and distribute as specified in the contract formal reports of all tests and inspections which indicate compliance or noncompliance with the specifications. The reports shall be complete and factual, citing the methods used in obtaining samples, the tests performed, the specified values for the measured characteristics, the values obtained, the parts of the structure involved, and similar pertinent data. The agency shall be prepared to substantiate its reports to the extent necessary.

10.3 Unless specifically authorized, the agency does not have the right of rejection.

10.4 The agency shall have its laboratory procedures and equipment inspected at intervals of not more than three years by a qualified national authority as evidence of its competence to perform the required tests.

10.4.1 The agency shall demonstrate evidence of meeting the requirements of Specification E 329 through accreditation in the field of its operations by a recognized qualified accreditation authority. Specification E 994 can be used to evaluate the credentials, qualifications, and operation of the accreditation authority.

NOTE 1—Organizations that offer accreditation services in some or all of the fields covered by Specification E 329 include: The American Association for Laboratory Accreditation (A2LA), The AASHTO Accreditation Program (AAP), Construction Materials Engineering Council (CMEC), The National Voluntary Laboratory Accreditation Program (NVLAP), and the ICBO Evaluation Service.

10.5 The testing agency or inspecting agency, or both, shall supply the qualified accreditation authority with the qualification of its Personnel as listed in Section 7. At a minimum each person shall be re-evaluated internally or externally, at least every three years for each test and/or inspection the person is authorized to perform.

## 11. Inspections and Test Methods

11.1 The agency shall have documented instructions on the use and operations of all relevant equipment, on the handling and preparation of items, and for inspection, calibration, or testing, or a combination thereof, where the absence of such instructions could jeopardize the inspections or tests. All instruction, standards, manuals and reference data relevant to the work of the agency shall be maintained up-to-date and be readily available to the staff and external auditors.

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

11.3 Where test methods are not specified, the agency shall, whenever possible, select test methods that have been published as international or national standards, those published by reputable technical organizations or in relevant scientific texts or journals.

11.4 Where it is necessary to employ test methods that have not been established as standards, 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.

11.5 Where sampling is carried out as part of the test method, the agency shall use documented procedures and appropriate statistical techniques to select samples.

11.6 Calculations and data transfers shall be subject to appropriate checks.

11.7 Where computers or automated equipment are used for the capture, processing, manipulation, recording, reporting, storage, or retrieval of inspection or test data, the agency shall ensure that:

11.7.1 All requirements of this standard are complied with,

11.7.2 Computer software is documented and adequate for use,

11.7.3 Procedures are established and implemented for protecting the integrity of data; such procedures shall include, but are not limited to: the integrity of data entry or capture, data storage, data transmission and data processing,

11.7.4 Computer and automated equipment is maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain the integrity of



inspection and test data, and

11.7.5 Appropriate procedures for the maintenance of security of data including the prevention of unauthorized access to, and unauthorized amendment of, computer records are established and implemented.

11.8 Documented procedures shall exist for the purchase, reception and storage of consumable materials used for the technical operations of the agency.

## 12. Records

12.1 The inspection body shall maintain a record system to suit its particular circumstances and to comply with applicable regulations.

12.2 The records shall include sufficient information to permit satisfactory recapitulation of the inspection.

12.3 All records shall be safely stored for a specified period, minimum 3 years, held secure and in confidence to the client, unless otherwise required by law or other governing specifications.

## 13. Report

13.1 The work carried out by the agency shall be covered by a retrievable report or certificate, or both, as appropriate.

13.2 The results of each inspection, test or series of inspections, or tests carried out by the agency shall be reported accurately, clearly, unambiguously and objectively, in accordance with any instructions in the inspection, or test methods. The results shall normally be documented in a referenced inspection report, test report or test certificate, and should reference or include:

13.2.1 A title, for example, "Inspection Report," "Certificate of Compliance," "Test Report" or "Test Certificate,"

13.2.2 Name and address of the agency and location where the inspection or test was carried out,

13.2.3 Unique identification of the certificate or report (such as report number), and of each page and the total number of pages,

13.2.4 Name and address of client, where appropriate,

13.2.5 Description of the characterization and condition, and unambiguous identification of the item inspected or tested,

13.2.6 Date of receipt of inspection request or test item and date of performance of inspection, calibration or test, where appropriate,

13.2.7 Identification of the inspection, or test method used, or unambiguous description of any non-standard test method used,

13.2.8 Reference to sampling procedure, where relevant,

13.2.9 Any deviations from, additions to, or exclusions from, the inspection or test method, any other information relevant to a specific inspection, or test, such as environmental conditions,

13.2.10 Measurements, examinations and derived result, supported by tables, graphs, sketches and photographs, as appropriate, and any failures identified,

13.2.11 A signature and title, or an equivalent identification of the person(s) accepting responsibility for the content of the certificate of report (however produced), and date of issue,

13.2.12 Where relevant, a statement to the effect that the results relate only to the items inspected or tested,

13.2.13 A statement that the certificate or report shall not be reproduced, except in full, without the written approval of the laboratory, and

13.2.14 Reports or certificates, or both, shall be signed or otherwise approved by authorized staff members only.

13.3 Material corrections or additions to a report or certificate, or both, after issue shall be made only in the form of a further document, or data transfer including the statement "Supplement to Inspection Report" (or 'Revised Test Report' or as appropriate), report number (or as otherwise uniquely identified), or equivalent wording. Such amendments or supplements shall meet all the relevant requirements of 13.2 of this standard.

13.4 The agency shall ensure that, where clients require transmission of inspection or test results by telephone, telex, fax or other electronic means, staff will follow documented procedures that ensure that the requirements of this standard are met and that confidentiality is preserved.

## CONCRETE INSPECTION AND TESTING

### 14. General

14.1 Concrete inspection and testing services will normally include some or all of the following: sampling and testing of ingredients, mix design, checking of production equipment and procedures, inspection of placement and curing, and laboratory testing of hardened specimens.

14.2 The agency shall comply with the most recent edition of Practice C 1077 and to the other requirements specified in Sections 6-13 of this specification.

14.2.1 Section 7 shall apply, except that the minimum experience for the supervising laboratory technician and the supervising field technician shall be three years.

## SOIL AND ROCK INSPECTION AND TESTING

### 15. General

15.1 Soil and rock inspection and testing services will normally include some or all of the following: sampling and testing of in-situ materials, sampling and testing of materials being processed, sampling and testing of processed materials, inspection and testing of soil and rock placement procedures, and sampling and testing of in-place constructed components.

15.2 The agency shall comply with the most recent edition of Practice D 3740 and to the other requirements specified in Sections 6-13 of this specification.

## STEEL INSPECTION AND TESTING

### 16. General

16.1 Steel inspection and testing services will normally include one or more of the following general functions: inspection at source of base material (the steel mill), inspection at fabrication shop, inspection at erection site, laboratory testing to determine physical and chemical properties of steel, laboratory tests of paints for use on steel structures, qualification of welding procedures and personnel, nondestructive testing (radiographic, magnetic particle, dye penetrant, ultrasonic, etc.), and inspection of cutting and bending of reinforcing bars and testing of same.



## 17. Equipment for Steel Inspection and Testing

17.1 The testing agency or inspection agency shall be equipped to meet the needs of the procedures required to fulfill the contract with the project sponsor. If the agency subcontracts work to other agencies, these agencies shall be properly equipped.

17.2 The agency will comply with the requirements of Practice A 880 in addition to the other requirements specified below.

17.3 *Laboratory Equipment*—The testing agency responsible for testing steel shall be equipped with at least the following:

17.3.1 Suitable facilities for preparing test specimens.

17.3.2 A screw or hydraulic type of testing machine of sufficient capacity to test any specimen which may be involved (normally a multiple-range machine with at least 200 000-lb (91 000-kg) capacity). The machine shall be equipped with suitable gripping and bending tools and with variable speed control. It shall be verified annually in accordance with a procedure specified by Practices E 4 and shall meet the accuracy requirement of these procedures. A report giving detail of the verification shall be readily available.

17.3.3 Hardness measuring device (Rockwell or Brinell).

17.3.4 Appropriate measuring equipment such as micrometers, rules, dividers.

17.3.5 Access to a chemical laboratory suitably equipped for the analysis of constituents and alloying elements of structural steels, and for analysis of paints to applicable specification.

17.3.6 AWS standard guided-bend test jig.

17.3.7 Bend test jig for reinforcing steel.

17.4 *Field Equipment (Mill, Fabrication, and Erection)*—The inspection agency should be equipped with the following items of equipment appropriate to the service to be rendered:

17.4.1 Steel tape, rule, calipers, and other appropriate measuring equipment.

17.4.2 Weld dimension gage.

17.4.3 Weld viewing shield.

17.4.4 Hammer for weld testing.

17.4.5 Battery operated hand light.

17.4.6 Paint thickness gage.

17.4.7 Thermometer (or temperature-measuring crayons).<sup>10</sup>

17.4.8 Inspector's identification stamp or tags.

17.4.9 Inspection wrench (a torque wrench used per AISC requirements) for high strength bolts.

17.4.10 Tension measuring device<sup>11</sup> for verifying slip critical bolt installation/inspection procedures. The accuracy of the tension measuring device shall be confirmed through calibration by an approved testing agency at least annually. Three of the AISC approved methods for installing pretension bolts in slip critical connections do not rely on any torque measurements at all. The turn-of-nut method (favored by AISC), the alternate design fastener method, and direct tension indicator method do not rely on torque measurements, but rather on

observing nut rotation, the snap off of a mandrel, or deformation of tension indicators; these methods require initial verification using a tension measuring device.

17.5 *Qualifications for Nondestructive Testing Agencies*—When nondestructive testing is required, the agency performing the testing shall meet in their entirety the requirements of Practice E 543.

## 18. Human Resources

18.1 Personnel performing visual inspection of structural steel or piping shall be familiar with the quality requirements of the particular project and the governing codes or standards. Visual weld inspection shall be performed by an AWS Certified Welding Inspector (AWS-QC-1) except as otherwise allowed by contract. The inspection of welds shall be supervised or overseen by an AWS Certified Welding Inspector or by a Licensed Professional Engineer.

## BITUMINOUS INSPECTION AND TESTING

### 19. General

19.1 Bituminous inspection and testing services will normally include some or all of the following services:

19.1.1 Sampling of the bituminous material at the refinery, terminal, mix plant, or project site,

19.1.2 Testing of bituminous materials and mixtures in the laboratory,

19.1.3 Investigation of aggregate at source for compliance with the specification requirements,

19.1.4 Preparation of mix design with or without stability determinations such as Marshall, Hubbard-Field, Hveem, or others,

19.1.5 Inspection of proportioning and mixing at the plant or project site,

19.1.6 Determination of percent bitumen and grading of aggregates in plant mix,

19.1.7 Determination of stability in plant mix,

19.1.8 Inspection of spreading and rolling,

19.1.9 Determination of thickness of compacted mix, and

19.1.10 Determination of density of samples from compacted surface.

19.2 The agency shall comply with the most recent edition of Practice D 3666 and to the other requirements specified in Sections 6-13 of this specification.

## MASONRY INSPECTION AND TESTING

### 20. General

20.1 Masonry inspection and testing services will normally include some or all of the following services:

20.1.1 sampling and inspecting the raw materials used in the manufacture of masonry units,

20.1.2 inspecting the manufacture of masonry units,

20.1.3 sampling and testing masonry units,

20.1.4 preparing grout and mortar mix design,

20.1.5 inspecting and testing the production and placement of grout and mortar, and

20.1.6 inspecting and testing the reinforcing steel used in masonry construction.

<sup>10</sup> Tempilstiks, available from Tempil Corp., 132 W. 22 St., New York, NY, have been found satisfactory for this purpose.

<sup>11</sup> Skidmore-Wilhelm or equivalent.



20.2 The agency shall comply with the most recent edition of Practice C 1093 and to the other requirements specified in Sections 6-13 of this specification.

21.2 The agency shall comply with the most recent edition of Practice E 543 and to the other requirements specified in Sections 6-13 of Specification E 329.

21. Nondestructive Testing Agencies

21.1 Nondestructive Testing will usually include tests performed by the following methods: Radiographic Testing (RT), Ultrasonic Testing (UT), Liquid Penetrant Testing (LT) and Magnetic Particle Testing (MT).

22. Keywords

22.1 accreditation; competency; construction materials; evaluating; inspection agencies; personnel qualifications; testing agencies; verification

APPENDIX

(Nonmandatory Information)

X1. Additional Information

X1.1 The following is a listing of germane certifications for the listed types of inspections and/or tests. Additional certifications by a nationally or regionally recognized certification body may be added to this listing.

Work being Performed	Appropriate Certification
A) Concrete Field Testing:	ACI 'Concrete Field Technician' – or NICET 'Construction Materials Testing-Concrete'
B) Concrete Lab Testing:	ACI 'Concrete Lab I or II Technician'; or Concrete Strength Testing Technician (for strength testing only) or NICET 'Construction Materials Testing – Concrete'
C) Aggregate Testing(only):	ACI 'Aggregate Testing Technician' or NICET-'Construction Materials Testing Concrete, Asphalt or Soils'
D) Concrete Reinforcing and/or Placement Inspection	a) ACI 'Concrete Construction Inspector' (CCI). (Certificates and program expire by 9/2003); or b) ICC (BOCA, ICBO, SBCCI) 'Reinforced Concrete Special Inspector' (replaces ACI 'CCI' programs as of 9/98); or c) ACI 'Concrete Transportation Construction Inspector (CTCI); or d) NICET 'Associate Engineering Technician' in the field of 'Construction Materials – Concrete'.
E) Precast Concrete Testing:	ACI 'Concrete Field Technician'; or PCI 'Level I' or NICET in 'Construction Materials Testing – Concrete'
F) Precast Inspection including Prestressed and post tensioned:	PCI Level II or Level III as appropriate, or ICC (ICBO, BOCA) 'Prestressed Concrete Inspector'

Work being Performed	Appropriate Certification
G) Soil Density or Lab Testing:	NICET in 'Construction Materials Testing Soils'; Supervisors should have NICET 'Engineering Technician' or higher.
H) Structural Steel, Welding and Bolting Inspection	a) AWS 'Certified Welding Inspector (CWI), or b) ICC (ICBO) 'Structural Steel and Welding Inspector' c) Supervisors: AWS 'Senior Certified Welding Inspector' (SCWI).
I) Nondestructive Testing (NDT)	a) ASNT Level II in appropriate fields, or b) AWS 'NDT Inspector' c) Supervisors should be ASNT Level III, Nationally Certified by ASNT directly.
J) Spray-on Fireproofing:	ICC (ICBO) 'Spray-on Fireproofing Inspector'
K) Masonry Lab Testing:	NCMA 'Concrete Masonry Testing Technician'
L) Masonry Inspection:	ICC (ICBO, SBCCI) 'Structural Masonry Inspector'
M) Bituminous and Hot Mix Materials:	a) State, nation or regional recognized 'QC/QA', or; b) NICET – 'Construction Materials Testing Asphalt'. Supervisors should be NICET- 'Engineering Technician' or higher.

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