



Designation: **E543–09 E543 – 13**

Standard Specification for Agencies Performing Nondestructive Testing¹

This standard is issued under the fixed designation E543; 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 (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope*

- 1.1 This specification covers minimum requirements for agencies performing nondestructive testing (NDT).
- 1.2 When using this specification to assess the capability of, or to accredit NDT agencies, Guide **E1359** shall be used as a basis for the survey. It can be supplemented as necessary with more detail in order to meet the auditor's specific needs.
- 1.3 This specification can be used as a basis to evaluate testing or inspection agencies, or both, and is intended for use for the qualifying or accrediting, or both, of testing or inspection agencies, public or private.
- 1.4 The use of SI or inch-pound units, or combination thereof, will be the responsibility of the technical committee whose standards are referred to in this standard.
- 1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards*:²

- [E94 Guide for Radiographic Examination](#)
- [E114 Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing](#)
- [E125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings](#)
- [E127 Practice for Fabricating and Checking Aluminum Alloy Ultrasonic Standard Reference Blocks](#)
- [E164 Practice for Contact Ultrasonic Testing of Weldments](#)
- [E165 Practice for Liquid Penetrant Examination for General Industry](#)³
- [E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing](#)
- [E214 Practice for Immersed Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves \(Withdrawn 2007\)](#)³
- [E215 Practice for Standardizing Equipment for Electromagnetic Testing of Seamless Aluminum-Alloy Tube](#)
- [E243 Practice for Electromagnetic \(Eddy-Current\) Examination of Copper and Copper-Alloy Tubes](#)
- [E273 Practice for Ultrasonic Testing of the Weld Zone of Welded Pipe and Tubing](#)
- [E309 Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation](#)
- [E317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Instruments and Systems without the Use of Electronic Measurement Instruments](#)
- [E376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current \(Electromagnetic\) Testing Methods](#)
- [E426 Practice for Electromagnetic \(Eddy-Current\) Examination of Seamless and Welded Tubular Products, Titanium, Austenitic Stainless Steel and Similar Alloys](#)
- [E427 Practice for Testing for Leaks Using the Halogen Leak Detector\(Alkali-Ion Diode\)](#)
- [E428 Practice for Fabrication and Control of Metal, Other than Aluminum, Reference Blocks Used in Ultrasonic Testing](#)
- [E431 Guide to Interpretation of Radiographs of Semiconductors and Related Devices](#)
- [E432 Guide for Selection of a Leak Testing Method](#)

¹ This specification is under the jurisdiction of ASTM Committee **E07** on Nondestructive Testing and is the direct responsibility of Subcommittee **E07.09** on Nondestructive Testing Agencies.

Current edition approved ~~June 1, 2009~~ March 1, 2013. Published ~~July 2009~~ March 2013. Originally approved in 1976. Last previous edition approved in ~~2008~~ 2009 as ~~E543–08~~ E543 - 09. DOI: ~~10.1520/E0543-09-10~~ 10.1520/E0543-13.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

***A Summary of Changes section appears at the end of this standard**

- E433 Reference Photographs for Liquid Penetrant Inspection
- E479 Guide for Preparation of a Leak Testing Specification
- E493 Test Methods for Leaks Using the Mass Spectrometer Leak Detector in the Inside-Out Testing Mode
- E494 Practice for Measuring Ultrasonic Velocity in Materials
- E498 Test Methods for Leaks Using the Mass Spectrometer Leak Detector or Residual Gas Analyzer in the Tracer Probe Mode
- E499 Test Methods for Leaks Using the Mass Spectrometer Leak Detector in the Detector Probe Mode
- E515 Practice for Leaks Using Bubble Emission Techniques
- E545 Test Method for Determining Image Quality in Direct Thermal Neutron Radiographic Examination
- E566 Practice for Electromagnetic (Eddy-Current) Sorting of Ferrous Metals
- E569 Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation
- E570 Practice for Flux Leakage Examination of Ferromagnetic Steel Tubular Products
- E571 Practice for Electromagnetic (Eddy-Current) Examination of Nickel and Nickel Alloy Tubular Products
- E587 Practice for Ultrasonic Angle-Beam Contact Testing
- E592 Guide to Obtainable ASTM Equivalent Penetrator Sensitivity for Radiography of Steel Plates ¼ to 2 in. (6 to 51 mm) Thick with X Rays and 1 to 6 in. (25 to 152 mm) Thick with Cobalt-60
- E650 Guide for Mounting Piezoelectric Acoustic Emission Sensors
- E664 Practice for the Measurement of the Apparent Attenuation of Longitudinal Ultrasonic Waves by Immersion Method
- E690 Practice for In Situ Electromagnetic (Eddy-Current) Examination of Nonmagnetic Heat Exchanger Tubes
- E703 Practice for Electromagnetic (Eddy-Current) Sorting of Nonferrous Metals
- E709 Guide for Magnetic Particle Testing
- E746 Practice for Determining Relative Image Quality Response of Industrial Radiographic Imaging Systems
- E747 Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology
- E748 Practices for Thermal Neutron Radiography of Materials
- E749 Practice for Acoustic Emission Monitoring During Continuous Welding
- E750 Practice for Characterizing Acoustic Emission Instrumentation
- E751 Practice for Acoustic Emission Monitoring During Resistance Spot-Welding
- E797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method
- E801 Practice for Controlling Quality of Radiological Examination of Electronic Devices
- E803 Test Method for Determining the *L/D* Ratio of Neutron Radiography Beams
- E908 Practice for Calibrating Gaseous Reference Leaks
- E976 Guide for Determining the Reproducibility of Acoustic Emission Sensor Response
- E999 Guide for Controlling the Quality of Industrial Radiographic Film Processing
- E1001 Practice for Detection and Evaluation of Discontinuities by the Immersed Pulse-Echo Ultrasonic Method Using Longitudinal Waves
- E1004 Test Method for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method
- E1025 Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology
- E1030 Test Method for Radiographic Examination of Metallic Castings
- E1032 Test Method for Radiographic Examination of Weldments
- E1033 Practice for Electromagnetic (Eddy-Current) Examination of Type F-Continuously Welded (CW) Ferromagnetic Pipe and Tubing Above the Curie Temperature
- E1067 Practice for Acoustic Emission Examination of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels
- E1118 Practice for Acoustic Emission Examination of Reinforced Thermosetting Resin Pipe (RTRP)
- E1139 Practice for Continuous Monitoring of Acoustic Emission from Metal Pressure Boundaries
- E1211 Practice for Leak Detection and Location Using Surface-Mounted Acoustic Emission Sensors
- E1212 Practice for Quality Management Systems for Nondestructive Testing Agencies
- E1254 Guide for Storage of Radiographs and Unexposed Industrial Radiographic Films
- E1312 Practice for Electromagnetic (Eddy-Current) Examination of Ferromagnetic Cylindrical Bar Product Above the Curie Temperature
- E1315 Practice for Ultrasonic Examination of Steel with Convex Cylindrically Curved Entry Surfaces (Withdrawn 2006)³
- E1316 Terminology for Nondestructive Examinations
- E1359 Guide for Evaluating Capabilities of Nondestructive Testing Agencies
- E1417 Practice for Liquid Penetrant Testing
- E1419 Practice for Examination of Seamless, Gas-Filled, Pressure Vessels Using Acoustic Emission
- E1444 Practice for Magnetic Particle Testing
- E1496 Test Method for Neutron Radiographic Dimensional Measurements (Withdrawn 2012)³
- E1571 Practice for Electromagnetic Examination of Ferromagnetic Steel Wire Rope

- [E1606 Practice for Electromagnetic \(Eddy-Current\) Examination of Copper Redraw Rod for Electrical Purposes](#)
- [E1629 Practice for Determining the Impedance of Absolute Eddy-Current Probes](#)
- [E1742 Practice for Radiographic Examination](#)
- [E1774 Guide for Electromagnetic Acoustic Transducers \(EMATs\)](#)
- [E1781 Practice for Secondary Calibration of Acoustic Emission Sensors](#)
- [E1816 Practice for Ultrasonic Testing Using Electromagnetic Acoustic Transducer \(EMAT\) Techniques](#)
- [E1888/E1888M Practice for Acoustic Emission Examination of Pressurized Containers Made of Fiberglass Reinforced Plastic with Balsa Wood Cores](#)
- [E1901 Guide for Detection and Evaluation of Discontinuities by Contact Pulse-Echo Straight-Beam Ultrasonic Methods](#)
- [E1930 Practice for Examination of Liquid-Filled Atmospheric and Low-Pressure Metal Storage Tanks Using Acoustic Emission](#)
- [E1932 Guide for Acoustic Emission Examination of Small Parts](#)
- [E1961 Practice for Mechanized Ultrasonic Testing of Girth Welds Using Zonal Discrimination with Focused Search Units](#)
- [E1962 Practice for Ultrasonic Surface Testing Using Electromagnetic Acoustic Transducer \(EMAT\) Techniques](#)
- [E2001 Guide for Resonant Ultrasound Spectroscopy for Defect Detection in Both Metallic and Non-metallic Parts](#)
- [E2075 Practice for Verifying the Consistency of AE-Sensor Response Using an Acrylic Rod](#)
- [E2076 Test Method for Examination of Fiberglass Reinforced Plastic Fan Blades Using Acoustic Emission](#)
- [E2096 Practice for In Situ Examination of Ferromagnetic Heat-Exchanger Tubes Using Remote Field Testing](#)
- [E2191 Practice for Examination of Gas-Filled Filament-Wound Composite Pressure Vessels Using Acoustic Emission](#)
- [E2192 Guide for Planar Flaw Height Sizing by Ultrasonics](#)
- [E2223 Practice for Examination of Seamless, Gas-Filled, Steel Pressure Vessels Using Angle Beam Ultrasonics](#)
- [E2261 Practice for Examination of Welds Using the Alternating Current Field Measurement Technique](#)
- [E2338 Practice for Characterization of Coatings Using Conformable Eddy-Current Sensors without Coating Reference Standards](#)
- [E2373 Practice for Use of the Ultrasonic Time of Flight Diffraction \(TOFD\) Technique](#)
- [E2374 Guide for Acoustic Emission System Performance Verification](#)
- [E2375 Practice for Ultrasonic Testing of Wrought Products](#)
- [E2479 Practice for Measuring the Ultrasonic Velocity in Polyethylene Tank Walls Using Lateral Longitudinal \(\$L_{CR}\$ \) Waves](#)
- [E2491 Guide for Evaluating Performance Characteristics of Phased-Array Ultrasonic Testing Instruments and Systems](#)
- [E2534 Practice for Process Compensated Resonance Testing Via Swept Sine Input for Metallic and Non-Metallic Parts](#)
- [E2580 Practice for Ultrasonic Testing of Flat Panel Composites and Sandwich Core Materials Used in Aerospace Applications](#)
- [E2700 Practice for Contact Ultrasonic Testing of Welds Using Phased Arrays](#)

2.2 Other Documents:

- [ASNT Recommended Practice No. SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing⁴](#)
- [ANSI/ASNT-CP-189 ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel⁴](#)
- [NAS-410 Certification and Qualification of Nondestructive Personnel \(Quality Assurance Committee\)⁵](#)

3. Terminology

~~3.1 Definitions—Additional definitions are contained in the specific specification or in Terminology E1316.~~

~~3.1 Definitions—Additional definitions are contained in the specific specification or in Terminology E1316.~~

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *agency*—the public, independent, or in-house nondestructive testing organization selected by the authority to perform the examination(s) required by the purchase order or specification.

3.2.2 *authority*—the owner, prime contractor, engineer, architect, or purchasing agent in responsible charge of the work, or duly recognized or designated representative.

⁴ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlington Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

⁵ Available from Aerospace Industries Association of America, Inc. (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209-3928, <http://www.aia-aerospace.org>.

3.2.2.1 Discussion—

The agency and the authority may be the same in some cases.

4. Significance and Use

4.1 This specification is applicable where the systematic assessment of the competence of a nondestructive testing agency by a user or other party is desired.

4.2 It is intended that the requirements specified in this specification apply to independent, public, or in-house agencies to the extent required by the purchase order or specification. This specification does not apply to in-house equipment, methods, and examinations used for the exclusive purpose of internal process control. It is intended that this specification apply to all examination(s) used for the final acceptance examination(s) if such examination(s) are required by the purchase order or specification.

4.3 Criteria are provided for evaluating the capability of an agency to properly perform designated examinations and establishes essential characteristics pertaining to the organization, personnel, facilities, and quality systems of the agency. This specification may be supplemented by more specific criteria and requirements for particular projects.

5. Organization of the Agency

5.1 The following information concerning the organization of the agency shall be provided by documentation:

5.1.1 A description of the organization including:

5.1.1.1 The complete legal name and address of the main office,

5.1.1.2 The names and positions of the principal officers and directors,

5.1.1.3 The agency's ownership, managerial structure, and principal members,

5.1.1.4 The functional description of the agency's organization structure, operational departments, and support departments and services. This may be demonstrated in the form of charts that depict all the divisions, departments, sections and units, and their relationships,

5.1.1.5 All relevant organizational affiliates of the agency and the principal officers of affiliates and directors of the affiliates where applicable,

5.1.1.6 External organizations and organizational components and their functions that are utilized for significant technical support services, and

5.1.1.7 A brief history of the agency including its relationship with its organizational component affiliations and other supporting information.

5.1.2 A general description of the type of users of the agency's services.

5.1.3 A listing of the relevant technical services offered.

5.1.4 A list giving applicable dates of the qualifications, accreditations, and recognition of the agency by others.

6. Responsibilities and Duties

6.1 A nondestructive testing agency's capabilities should include, but not be limited to, one or more of the following methods: magnetic particle, penetrant, radiographic/fluoroscopic, ultrasonic, eddy current, and leak testing.

NOTE 1—A comparison of selected NDE Methods is provided as [Appendix X1](#).

6.2 It is the responsibility of the agency to ensure that:

6.2.1 It performs only examinations for which it is adequately equipped and staffed.

6.2.2 Its employees perform only examinations for which they are adequately qualified.

6.2.3 Its equipment is calibrated and personnel are certified in accordance with applicable specifications.

6.2.4 All equipment is properly maintained.

6.2.5 It informs the authority of any discrepancy or limitation imposed on the testing accuracy by such factors as surface finish, form, shape, or procedure.

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

6.3.1 To perform all examinations in accordance with specified standards or quality-control criteria, or both. (The necessary documents shall be furnished by the authority, or the agency, or both, as specified in the applicable purchase agreements.) The agency should call to the attention of the authority at once any irregularity or deficiency noted in the documents.

6.3.2 To submit promptly to the authority formal reports of all examinations that indicate compliance or noncompliance of the material with [6.3.1](#). The agency should be prepared to substantiate examination results when required.

6.4 The agency may, in accordance with an agreement with the authority, report only compliance or noncompliance with the applicable specifications or control documents. The authority reserves the right for disposition of noncomplying material.

6.5 The authority may, at its discretion, inspect the procedures, equipment, and personnel program of the agency.

7. Personnel

7.1 The agency shall document the following:

7.1.1 Written outline or chart defining operational personnel positions and their lines of responsibility and authority.

7.1.2 Summary job description for each professional, scientific, supervisory, and technical position category, documenting the required education, training, or experience, or a combination thereof.

7.1.3 Records or resumes that document the qualifications, work experience, and training history of each person in a position described in [7.1.2](#).

7.2 The agency shall make available a description of its means of ensuring the continued competence of its personnel to perform NDT, including the maintenance of written records to document the results.

8. Personnel Qualification/Certifications

8.1 Nondestructive testing (NDT) personnel shall be qualified and certified in accordance with a nationally or internationally recognized NDT personnel qualifications practice or standards such as ANSI/ASNT-CP-189, SNT-TC-1A, NAS-410, or a similar document. The practice or standard used and the applicable revision shall be specified in the contractual agreement between parties.

PROCEDURE MANUAL

9. Minimum Requirements

9.1 Each agency shall have prepared a written Procedures Manual for the type of work for which the agency is contracted. The manual shall be prepared in accordance with the requirements of Practice E1212. Additional requirements or clarifications are contained in 9.2 through 9.6. The manual shall be of sufficient detail to provide complete guidance for their use by the agency's personnel.

9.1.1 The agency management shall designate a person or persons within the agency who has responsibility for maintaining the agency's quality system. This person(s) shall have direct access to top management. This person shall conduct and document an internal audit at least once every year to verify that the quality system is functioning properly.

9.2 *Process Control (Operational Procedures)*—This section shall contain the information necessary to control the various activities necessary for the examination of materials. Items covered shall include receiving and preparing material, identification and marking, test procedures and specifications to use, reports, and return of material.

9.3 *Personnel Qualification*—The requirements, procedures for training, certification, and recertification for each level of qualification.

9.4 *Equipment Maintenance and Calibration*—This section shall contain all of the following:

9.4.1 *Inventory Listing*—All available equipment shall be listed with the following information noted:

9.4.1.1 Name of the manufacturer.

9.4.1.2 Equipment model and serial number.

9.4.1.3 Characteristics subject to calibration.

9.4.1.4 Range of operation and range of calibration.

9.4.1.5 Reference to recognized standardization procedures acceptable to the authority, if applicable.

9.4.1.6 Frequency of calibration.

9.4.1.7 Allowable tolerances or maximum sensitivity.

9.4.1.8 Source of verification.

9.4.2 *Calibration*—Each instrument or machine, when calibration is required, shall have either a calibration sticker affixed, or record of certification on file, containing the following:

9.4.2.1 Instrument calibrated.

9.4.2.2 Serial number.

9.4.2.3 Calibration date.

9.4.2.4 Calibration next due.

9.4.2.5 Name of individual who performed last calibration. If calibration is not required, a sticker, stating no calibration is necessary shall be affixed, or a record shall be on file to this effect.

9.4.3 The equipment shall be calibrated against currently certified standards calibrated by accepted government or industrial agencies (or shall indicate that it is calibrated as used, or that no calibration is necessary) at least at the following specific intervals in accordance with a written procedure which shall also specify who is to calibrate each equipment type:

9.4.3.1 *Magnetic Particle:*

(1) *Timer and Ammeter*—Check every 90 days, unless subjected to electrical repair or inadvertently damaged, at which time calibration is required prior to use.

(2) *Black Lights*—Maintain a minimum level of intensity, as specified by the agency.

(3) *Suspension Concentration Test*—Check prior to use or daily, whichever is less restrictive.

9.4.3.2 *Penetrant:*

(1) *Penetrants and Emulsifiers*—Check monthly for contamination.

(2) *Dryers*—Check monthly for thermostat accuracy.

(3) *Black Lights*—Maintain a minimum level of intensity, as specified by the agency.

9.4.3.3 *Radiographic*—Calibrate densitometers prior to each use, utilizing calibrated film strips.

9.4.3.4 *Ultrasonic*—The authority shall approve the required calibration intervals.

9.4.3.5 *Leak Testing:*

(1) The equipment shall be calibrated at the beginning of each shift.

(2) The standards shall be calibrated at 6-month intervals.

9.4.3.6 *Eddy Current*—Calibration of the system at the start and end of each run and at the beginning of each shift (or turn) using the reference standard (secondary) is normally required. This or other required calibration intervals shall be approved by the authority.

9.4.3.7 Written records of the results of the checks and calibrations are to be maintained at a central location. The above checks are minimum and do not relieve the responsibility of constantly checking and immediately repairing any item which may affect test results. A history of the repairs, modifications, or substitutions shall be maintained.

9.5 Equipment Operation and Technique File:

9.5.1 Each type of equipment in use shall have a complete manual which contains all information necessary to operate and maintain the equipment in accordance with applicable codes and specifications. The manual shall include the maintenance procedures and schedules for each type of equipment and the calibration schedule of each type of equipment.

9.5.2 A technique file should be maintained for each type of equipment. It should be available for the guidance of the technician. The manual shall include:

- 9.5.2.1 Summary of test procedure.
- 9.5.2.2 Step-by-step preparation of material for examination.
- 9.5.2.3 Reference standard.
- 9.5.2.4 Control of essential variables, such as the time required for each test step (if applicable).
- 9.5.2.5 What indications should appear at each step.
- 9.5.2.6 Indications and their evaluations.
- 9.5.2.7 Recording of test results.

9.6 Records and Documentation:

9.6.1 *Records*—All applicable records pertaining to 9.2 through 9.5 shall be maintained in a central file and in other accessible files as necessary, and should be available for examination by the authority.

9.6.2 The internal process forms or job record forms shall be filed with the written report to the authority and become a part of the permanent record. They should include the following minimum information:

- 9.6.2.1 Order and reference numbers.
 - 9.6.2.2 Specification.
 - 9.6.2.3 Type of test and procedure identification.
 - 9.6.2.4 Serial or part numbers, alloy numbers, heat and lot numbers, as applicable.
 - 9.6.2.5 Special instructions from the customer.
 - 9.6.2.6 Customer's (authority's) name.
 - 9.6.2.7 Results of the examination.
 - 9.6.2.8 A notation of all known deviations from any standard test method(s) referenced and all requirements of the test method(s) that were not performed by the agency.
- 9.6.3 All applicable internal reports should be signed by the technician performing the work and by Level II or Level III personnel. A procedure for auditing of reports by Level III personnel must be included.
- 9.6.4 Personnel qualification records should be developed in accordance with 8.1 and be available in an active file as long as employment continues. When personnel leave the agency, the records may be transferred to an inactive file but should not be discarded for a period of five years or as otherwise specified.

9.6.5 *Specification File*—The company should maintain an orderly file containing all codes, specifications, and amendments under which it is performing work. The company does not have to possess codes and specifications for which it has no use.

10. Keywords

10.1 equipment calibration; laboratory evaluation; NDT laboratories; personnel certification; quality control; quality manual

ANNEX

(Mandatory Information)

A1. EQUIPMENT FOR NONDESTRUCTIVE TESTING

A1.1 General

A1.1.1 The agency responsible for nondestructive examination of material should be equipped with, or have access to, at least the equipment listed for the applicable processes.