



Designation: E1570 – 19

Standard Practice for Fan Beam Computed Tomographic (CT) Examination¹

This standard is issued under the fixed designation E1570; 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 reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This practice establishes the minimum requirements for computed tomography (CT) examination of test objects using fan beam systems (systems that generate one or a few CT cross sectional slices at a time). The examination may be used to nondestructively disclose physical features or anomalies within a test object by providing radiological density and geometric measurements. This practice implicitly assumes the use of penetrating radiation, specifically X-ray and γ -ray.

1.2 CT is broadly applicable to any material or test object through which a beam of penetrating radiation passes. The principal advantage of CT is that it provides densitometric (that is, radiological density and geometry) images of thin cross sections through an object without the structural superposition in projection radiography.

1.3 There are areas in this practice that may require agreement between the purchaser and the supplier, or specific direction from the cognizant engineering organization. These items should be addressed in the purchase order or the contract. Generally, the items are application specific or performance related, or both.

1.4 Techniques and applications employed with CT are diverse. This practice is not intended to be limiting or restrictive. Refer to Guides E1441 and E1672 that provide additional information and guidance on CT fundamentals and tradeoffs in designing or purchasing a CT system, or both.

1.5 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

¹ This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.01 on Radiology (X and Gamma) Method.

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1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- E1316 Terminology for Nondestructive Examinations
- E1441 Guide for Computed Tomography (CT) Imaging
- E1672 Guide for Computed Tomography (CT) System Selection
- E1695 Test Method for Measurement of Computed Tomography (CT) System Performance
- E2339 Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE)
- E2767 Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE) for X-ray Computed Tomography (CT) Test Methods

2.2 ASNT Documents:³

- SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing
- ANSI/ASNT-CP-189 Qualification and Certification of Nondestructive Testing Personnel

2.3 AIA Standard:⁴

- NAS-410 Certification and Qualification of Nondestructive Testing Personnel

2.4 ISO Standards:⁵

- ISO 9712 International Standard for Nondestructive Testing Personnel Qualification and Certification

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

⁴ Available from Aerospace Industries Association of America, Inc. (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209-3928, <http://www.aia-aerospace.org>.

⁵ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

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

ISO 15708-1:2017-02 International Standard for Non-destructive Testing - Radiation Methods for Computed Tomography - Part 1: Terminology

ISO 15708-2:2017-02 International Standard for Non-destructive Testing - Radiation Methods for Computed Tomography - Part 2: Principles, Equipment and Samples

ISO 15708-3:2017-02 International Standard for Non-destructive Testing - Radiation Methods for Computed Tomography - Part 3: Operation and Interpretation

ISO 15708-4:2017-02 International Standard for Non-destructive Testing - Radiation Methods for Computed Tomography - Part 4: Qualification

2.5 *SMPTE Standard*:⁶

SMPTE RP 133 Specifications for Medical Diagnostic Imaging Test Pattern for Television Monitors and Hard-Copy Recording Cameras

3. Terminology

3.1 *Definitions*—The definitions of terms relating to CT, that appear in Terminology **E1316**, shall apply to the terms used in this practice.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *digital driving level (DDL), n*—for computer graphics display boards, the digital value that corresponds to a particular monochrome grayscale level.

3.2.1.1 *Discussion*—A particular DDL “drives out” a particular visible shade of gray. For example, in an 8-bit display, a DDL assumes 256 values from 0 to 255.

3.2.2 *effective energy, n*—the equivalent monoenergetic energy for a polyenergetic CT system; thus, the actual, polyenergetic CT system yields the same measured attenuation coefficient for an examination object as a theoretical, monoenergetic CT system at the effective energy.

3.2.3 *fan beam, n*—a beam of radiation that is restricted to one dimension in linear extent with a thickness limited to the detector height.

3.2.4 *purchaser, n*—as used within this document, the purchaser of computed tomographic services refers to the entity that requires the computed tomographic services; the purchaser may be a part of the same organization as the supplier, or an outside organization.

3.2.5 *supplier, n*—as used within this document, the supplier of computed tomographic service refers to the entity that physically provides the computed tomographic services; the supplier may be a part of the same organization as the purchaser, or an outside organization.

4. Summary of Practice

4.1 This practice is organized as follows:

4.1.1 Section **7** describes CT Equipment;

4.1.2 Section **8** describes the minimum requirements of a CT examination; Section **9** describes the CT system performance requirements; and

4.1.3 Section **10** describes the documentation for an archive of the CT examination.

5. Significance and Use

5.1 This practice establishes the basic parameters for the application and control of fan-beam CT examinations. This practice is written so it can be specified on the engineering drawing, specification, or contract. It will require a detailed procedure delineating the technique or procedure requirements and shall be approved by the Cognizant Engineering Organization (CEO).

5.2 The requirements in this practice shall be used when placing a CT system into NDT service and establishing a baseline of system performance measures. Monitoring the system performance over time shall be performed, including calibration procedures, performance measurements, and system maintenance in accordance with Section **9**.

6. Basis of Application

6.1 The following items are subject to contractual agreement between the parties using or referencing this standard.

6.2 *Personnel Qualification*

6.2.1 If specified in the contractual agreement, personnel performing examinations to this standard shall be qualified in accordance with a nationally or internationally recognized NDT personnel qualification practice or standard such as ANSI/ASNT-CP-189, SNT-TC-1A, NAS-410, ISO 9712, or a similar document and certified by the employer or certifying agency, as applicable. The practice or standard used and its applicable revision shall be identified in the contractual agreement between the using parties.

6.3 *Procedures and Techniques*—The procedures and techniques to be utilized shall be as specified in the contractual agreement.

6.4 *Reporting Criteria/Acceptance Criteria*—Reporting criteria for the examination results shall be in accordance with Section **10** unless otherwise specified. Since acceptance criteria are not specified in this standard, they shall be specified in the contractual agreement.

7. Equipment

7.1 Many different CT system configurations are possible. It is important that the user understands the advantages and limitations of each (see Guide **E1441**). The provider and the user of the system should be fully aware of the capabilities and limitations of each system proposed.

7.2 All CT systems have four major subsystems: radiation source, radiation detectors, mechanical handling system, and computer system. The following represents the requirements on each subsystem for a CT examination.

7.2.1 *Source Setup*—The radiation source shall be selected to provide the maximum signal-to-noise ratio (SNR), contrast to noise ratio (CNR), and contrast sensitivity while maintaining the necessary spatial resolution. See Guide **E1441** for a detailed discussion.

7.2.2 *Radiation Detection Systems*—The detection system may consist of a single sensing element, a linear array of

⁶ Available from Society of Motion Picture and Television Engineers (SMPTE), White Plains Plaza, 445 Hamilton Ave Ste 601, White Plains, NY 10601-1827, <https://www.smpte.org>.