



Standard Test Method for Measurement of Computed Tomography (CT) System Performance¹

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

1. Scope

1.1 This test method provides instruction for determining the spatial resolution and contrast sensitivity in X-ray and γ -ray computed tomography (CT) images. The determination is based on examination of the CT image of a uniform disk of material. The spatial resolution measurement is derived from an image analysis of the sharpness at the edge of the disk. The contrast sensitivity measurement is derived from an image analysis of the statistical noise at the center of the disk.

1.2 This test method is more quantitative and less susceptible to interpretation than alternative approaches because the required disk is easy to fabricate and the analysis is immune to cupping artifacts. This test method may not yield meaningful results if the disk image occupies less than a significant fraction of the field of view.

1.3 This test method may also be used to evaluate other performance parameters. Among those characteristics of a CT system that are detectable with this test method are: the mid-frequency enhancement of the reconstruction kernel, the presence (or absence) of detector crosstalk, the undersampling of views, and the clipping of unphysical (that is, negative) CT numbers (see Air Force Technical Report WL-TR-94-4021²). It is highly likely that other characteristics as well can be detected with this test method.

1.4 The values stated in SI units are to be regarded as the standard. Inch-pound units are provided for information only.

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 appro-*

priate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:³

- E1316 Terminology for Nondestructive Examinations
- E1441 Guide for Computed Tomography (CT) Imaging
- E1570 Practice for Computed Tomographic (CT) Examination

3. Terminology

3.1 *Definitions*—The definitions of terms relating to Gamma- and X-Radiology, which appear in Terminology E1316 and Guide E1441, shall apply to the terms used in this test method.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *phantom*—a part or item being used to quantify CT system performance.

3.2.2 *examination object*—a part or specimen being subjected to CT examination.

3.3 Acronyms:

3.3.1 *ERF*—edge response function.

3.3.2 *PSF*—point spread function.

3.3.3 *MTF*—modulation transfer function.

3.3.4 *CDF*—contrast discrimination function.

4. Significance and Use

4.1 Two factors affecting the quality of a CT image are geometrical unsharpness and random noise. Geometrical unsharpness limits the spatial resolution of a CT system, that is, its ability to image fine structural detail in an object. Random noise limits the contrast sensitivity of a CT system, that is, its ability to detect the presence or absence of features in an object. Spatial resolution and contrast sensitivity may be measured in various ways. ASTM specifies spatial resolution

¹ This test method 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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² X-Ray Computed Tomography Standards (WL-TR-94-4021). Bossi, R. H. and Nelson, J. M. Air Force Contract No. F33615-88-C-5404. Source document available from Air Force Research Laboratory, AFRL/MLLP Building 655, 2230 Tenth Street, Suite 1, Wright-Patterson AFB, OH 45433-7814.

³ 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.