Designation: C1175 – 99a (Reapproved 2010)

Standard Guide to Test Methods and Standards for Nondestructive Testing of Advanced Ceramics[1]

This standard is issued under the fixed designation C1175; 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.

1. Scope

1.1 This guide identifies and describes standard procedures and methods for nondestructive testing of advanced ceramics using radiology, ultrasonics, liquid penetrants, and acoustic emission.

1.2 This guide identifies existing standards for nondestructive testing that have been determined to be (or have been modified to be) applicable to the examination of advanced ceramics. These standards have been generated by, and are under the jurisdiction of, ASTM Committee E07 on Nondestructive Testing. Selection and application of these standards to be followed must be governed by experience and the specific requirements in each individual case, together with agreement between producer and user.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.4 *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
E165 Practice for Liquid Penetrant Examination for General Industry
E317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Instruments and Systems without the Use of Electronic Measurement Instruments
E494 Practice for Measuring Ultrasonic Velocity in Materials
E569 Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation
E587 Practice for Ultrasonic Angle-Beam Contact Testing
E650 Guide for Mounting Piezoelectric Acoustic Emission Sensors
E664 Practice for the Measurement of the Apparent Attenuation of Longitudinal Ultrasonic Waves by Immersion Method
E750 Practice for Characterizing Acoustic Emission Instrumentation
E797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method
E976 Guide for Determining the Reproducibility of Acoustic Emission Sensor Response
E999 Guide for Controlling the Quality of Industrial Radiographic Film Processing
E1000 Guide for Radioscopy
E1065 Practice for Evaluating Characteristics of Ultrasonic Search Units
E1079 Practice for Calibration of Transmission Densitometers
E1106 Test Method for Primary Calibration of Acoustic Emission Sensors
E1165 Test Method for Measurement of Focal Spots of Industrial X-Ray Tubes by Pinhole Imaging
E1208 Practice for Fluorescent Liquid Penetrant Testing Using the Lipophilic Post-Emulsification Process
E1209 Practice for Fluorescent Liquid Penetrant Testing Using the Water-Washable Process
E1210 Practice for Fluorescent Liquid Penetrant Testing Using the Hydrophilic Post-Emulsification Process
E1219 Practice for Fluorescent Liquid Penetrant Testing Using the Solvent-Removable Process
E1220 Practice for Visible Penetrant Testing Using Solvent-Removable Process
E1254 Guide for Storage of Radiographs and Unexposed Industrial Radiographic Films
E1255 Practice for Radioscopy
E1316 Terminology for Nondestructive Examinations

[1] This guide is under the jurisdiction of ASTM Committee C28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.03 on Physical Properties and Non-Destructive Evaluation.

Current edition approved Dec. 1, 2010. Published January 2011. Originally approved in 1991. Last previous edition approved in 2004 as C1175 – 99a (2004). DOI: 10.1520/C1175-99AR10.

[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.

E1324 Guide for Measuring Some Electronic Characteristics of Ultrasonic Testing Instruments
E1390 Specification for Illuminators Used for Viewing Industrial Radiographs
E1411 Practice for Qualification of Radioscopic Systems
E1441 Guide for Computed Tomography (CT) Imaging
E1453 Guide for Storage of Magnetic Tape Media that Contains Analog or Digital Radioscopic Data
E1570 Practice for Computed Tomographic (CT) Examination
E1647 Practice for Determining Contrast Sensitivity in Radiology
E1672 Guide for Computed Tomography (CT) System Selection
E1695 Test Method for Measurement of Computed Tomography (CT) System Performance
E1781 Practice for Secondary Calibration of Acoustic Emission Sensors
E1817 Practice for Controlling Quality of Radiological Examination by Using Representative Quality Indicators (RQIs)

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology E1316, Section F for liquid penetrants, Section I for ultrasonics, Section D for radiology, and Section B for acoustic emission.

4. Significance and Use

4.1 This guide is a compilation of standards intended to provide assistance in selecting appropriate nondestructive examination for advanced ceramics, and in turn, to provide guidance for performing the examination, as well as ensuring the proper performance of the equipment.

5. Apparatus

5.1 Use the equipment as specified in each standard.

6. Radiology

6.1 *Terminology:*

6.1.1 Terminology E1316, Section D, covers the consensus definitions used to describe the various aspects of radiology of materials.

6.1.2 *Significance and Use*—The identification and use of common terms and definitions are necessary to ensure proper communication between producers, examiners, and users of both nondestructive examination equipment and techniques and advanced ceramics.

6.2 Practice E1079 covers the calibration of transmission densitometers used to perform radiographic film density measurements.

6.2.1 *Summary of Practice*—Practice E1079 describes the necessary apparatus (film strips and instrument), measurement procedure, recording requirements, and periods of verification for calibrating transmission densitometers.

6.2.2 *Significance and Use*—Attaining proper film density is important to the establishment of valid radiographic film. Practice E1079 provides a means of evaluating the reliability of transmission densitometers used for the measurement of radiographic film density. The test is not intended to qualify the radiographs measured by transmission densitometers calibrated in accordance with this practice.

6.3 Guide E1000 is a guide for tutorial purposes only and outlines the general principles of radioscopic imaging. This guide describes practices and image quality measuring systems for real-time and near real-time non-film detection, display, and recording of radioscopic images. These images, used in materials inspection, are generated by penetrating radiation passing through the subject material and producing an image on the detecting medium. The image detection and display techniques are nonfilm, but the use of photographic film as a means for permanent recording of the image is not precluded.

6.3.1 *Summary of Guide*—Guide E1000 outlines the practices for the use of radioscopic methods and techniques for materials examinations. It is intended to provide a basic understanding of the method and the techniques involved. The selection of an imaging device, radiation source, and radiological and optical techniques to achieve a specified quality in radioscopic images is described.

6.3.2 *Significance and Use*—Radioscopy is a versatile nondestructive means for examining an object. It provides immediate information regarding the nature, size, location, and distribution of imperfections, both internal and external. It also provides a rapid check of the dimensions, mechanical configuration, and the presence and positioning of components in a mechanism. It indicates in real-time the presence of structural or component imperfections anywhere in a mechanism or an assembly. Through manipulation, it may provide three-dimensional information regarding the nature, sizes, and relative positioning of items of interest within an object, and can be further employed to check the functioning of internal mechanisms. Radioscopy permits timely assessments of product integrity, and allows prompt disposition of the product based on acceptance standards. Although closely related to the radiographic method, it has much lower operating costs in terms of time, manpower, and material. Long-term records of the radioscopic image may be obtained through motion-picture recording (cinefluorography), video recording, or "still" photographs using conventional cameras. The radioscopic image may be electronically enhanced, digitized, or otherwise processed for improved visual image analysis or automatic, computer-aided analysis, or both.

6.4 Practice E1255 provides application details for radioscopic examination using penetrating radiation. This includes real-time radioscopy and, for the purposes of this standard, radioscopy where the motion of the test object must be limited (commonly referred to as near-real-time radioscopy). Since the techniques involved and the applications for radioscopic examination are diverse, this practice is not intended to be limiting or restrictive, but rather to address the general applications of the technology and thereby facilitate its use.

6.4.1 The general principles discussed in Practice E1255 apply broadly to penetrating radiation radioscopic systems. However, this document is written specifically for use with X-ray and gamma-ray systems.

6.4.2 *Summary of Practice*—Manual evaluation as well as computer-aided automated radioscopic examination systems are used in a wide variety of penetrating radiation examination applications. A simple manual evaluation radioscopic examination system might consist of a radiation source and a directly viewed fluorescent screen, suitably enclosed in a radiation-protective enclosure. At the other extreme, a complex automated radioscopic examination system might consist of an X-ray source, a robotic test part manipulator, a radiation-protective enclosure, an electronic image detection system, a closed circuit television image transmission system, a digital image processor, a video display, and a digital image archiving system. All system components are supervised by the host computer, that incorporates the software necessary to not only operate the system components, but to make accept/reject decisions as well. Systems having a wide range of capabilities between these extremes can be assembled using available components. Guide E1000 lists many different system configurations.

6.4.3 While Practice E1255 outlines the approach to be taken in applying radioscopic real-time examination techniques, a supplemental document is required covering those areas where agreement between the provider[3] and user[4] of radioscopic examination services is required. Generally, those areas are application-specific and performance-related, covering such areas as system configuration, equipment qualification, performance measurement, and interpretation of results.

6.4.4 *Significance and Use*—As with conventional radiography, radioscopic examination is broadly applicable to any material or test object through which a beam of penetrating radiation may be passed and detected, including metals, plastics, ceramics, composites, and other nonmetallic materials. In addition to the benefits normally associated with radiography, radioscopic examination is a dynamic, filmless technique, allowing the test part to be manipulated and imaging parameters optimized while the test object is undergoing examination. Recent technological advances in the area of projection imaging, detectors, and digital image processing provide acceptable sensitivity for a wide range of applications.

6.5 Test Method E1165 provides instructions for determining the length and width dimensions of line focal spots in industrial X-ray tubes (see Note 1). This determination is based on the measurement of an image of a focal spot that has been radiographically recorded with a "pinhole" projection/imaging technique.

NOTE 1—Line focal spots are associated with vacuum X-ray tubes whose maximum voltage rating does not generally exceed 500 kV.

6.5.1 Test Method E1165 may not yield meaningful results on focal spots whose nominal size is less than 0.3 mm (0.011 in. (see Note 2)). This test method may also be used to determine the presence or extent of focal spot damage or deterioration that may have occurred due to tube age, tube overloading, and the like. This would entail the production of a focal spot radiograph (with the pinhole method) and an evaluation of the resultant image for pitting, cracking, and the like.

NOTE 2—The X-ray tube manufacturer may be contacted for nominal focal spot dimensions.

6.5.2 *Significance and Use*—One of the factors affecting the quality of a radiographic image is geometric unsharpness. The degree of geometric unsharpness is dependent upon the focal size of the radiation source, the distance between the source and the object to be radiographed, and the distance between the object to be radiographed and the film. This test method allows the user to determine the focal size of the X-ray source and to use this result to establish source-to-object and object-to-film distances appropriate for maintaining the desired degree of geometric unsharpness.

6.6 Guide E999 establishes guidelines that may be used for the control and maintenance of industrial radiographic film processing equipment and materials. The provisions in this guide are intended to control the reliability of the chemical process only and are not intended for controlling the acceptability or quality of industrial radiographic films or of the materials or products radiographed.

6.6.1 *Summary of Guide*—Guide E999 provides instructions for the mixing of radiographic processing chemicals for both manual and automatic processes and for their storage, replenishment, and cautions about temperature, deterioration, and contamination. Recommendations are provided for both manual and automated processing of film. Instructions are given for the activity testing of processing solutions and for maintenance of records.

6.6.2 *Significance and Use*—Effective use of these guidelines aids in controlling the consistency and quality of industrial radiographic film processing. Improper processing can obscure the desired radiographic detail even though the proper radiographic procedure may have been used. The necessity of applying specific control procedures such as those described in this guide is dependent, to a certain extent, on the degree to which a facility adheres to good processing practices as a matter of routine procedure.

6.7 Guide E1254 covers the control and maintenance of industrial radiographs and unexposed films used for industrial radiography.

6.7.1 *Summary of Guide*—Guide E1254 provides recommendations for storage of unexposed film including temperature and humidity for both opened and unopened containers. For completed radiographs, recommendations are relative to testing for proper processing to minimize aging stain, to enclosure (interleaving) materials, and to storage area conditions including air impurities, temperature, humidity, and fire resistance.

6.7.2 *Significance and Use*—Poor storage practice can render unexposed film unusable for radiography and exposed radiographs can become so degraded as to be uninterpretable for later reference. The provisions of Guide E1254 are intended

[3] As used within this guide, the provider of radioscopic services refers to the entity that physically provides the radioscopic services. The provider may be a part of the same organization as the user, or an outside organization.

[4] As used within this guide, the user of radioscopic services refers to the entity that requires the radioscopic services. The user may be a part of the same organization as the provider or an outside organization.

to control the quality of industrial radiographs and unexposed films only and are not intended for controlling the acceptability of the materials or products radiographed. The necessity for applying specific control procedures such as those described in this guide is dependent to a certain extent, on the degree to which a user adheres to good processing and storage practices as matter of routine procedure.

6.8 Guide E1390 provides the recommended requirements for illuminators used for viewing film radiographs using transmitted light.

6.8.1 *Significance and Use*—The function of the illuminator is to provide sufficient illumination and viewing capabilities to visually review industrial film radiographs by light transmitted through them for the purpose of identification and interpretation of images.

6.9 Practice E1411 provides test and measurement details for measuring the performance of X-ray and Gamma ray radioscopic systems. Radioscopic examination applications are diverse. Therefore, system configurations are also diverse and constantly changing as the technology advances.

6.9.1 Practice E1411 is intended as a means of initially qualifying and requalifying a radioscopic system for a specified application by determining its performance level when operated in a static mode. System architecture including the means of radioscopic examination record archiving and the method for making the accept/reject decision are also unique system features and their effect upon system performance must be evaluated.

6.9.2 The general principles, as stated in Practice E1411, apply broadly to transmitted-beam penetrating radiation radioscopy systems. Other radioscopic systems, such as those employing neutrons and Compton back-scattered X-ray imaging techniques, are not covered as they may involve equipment and application details unique to such systems.

6.9.3 *Summary of Practice:*

6.9.3.1 Practice E1411 provides a standardization procedure for the initial qualification and requalification of a radioscopic system to establish radioscopic examination capabilities for a specified range of applications.

6.9.3.2 Practice E1411 is intended for use in association with a standard practice governing the use of radioscopic examination, such as Practice E1255. (See 6.4.)

6.9.3.3 Practice E1411 specifies the procedures to be used in determining the performance level of the radioscopic system. Unique system features, including component selection, system architecture, programmability and image archiving capabilities are important factors and are taken into account in this practice. The overall system performance level, as well as key system features, are to be recorded in a qualification document which shall qualify the performance level of the total radioscopic system.

6.9.4 *Significance and Use:*

6.9.4.1 As with conventional radiography, radioscopic examination is broadly applicable to the many materials and test object configurations which may be penetrated with X-rays or gamma rays. The high degree of variation in architecture and performance among radioscopic systems due to component selection, physical arrangement and test object variables, makes it necessary to establish the level of performance which the selected radioscopic system is capable of achieving in specific applications. The manufacturer of the radioscopic system, as well as the user, require a common basis for determining the performance level of the radioscopic system.

6.9.4.2 Practice E1411 does not purport to provide a method to measure the performance of individual radioscopic system components which are manufactured according to a variety of industry standards. Practice E1411 covers measurement of the combined performance of the radioscopic system elements when operated together as a functional radioscopic system.

6.9.4.3 Practice E1411 addresses the performance of radioscopic systems in the static mode only. Radioscopy can also be a dynamic, real-time or near real-time examination technique which can allow test-part motion as well as parameter changes during the radioscopic examination process. The use of Practice E1411 is not intended to be limiting concerning the use of the dynamic properties of radioscopy. Users of radioscopy are cautioned that the dynamic aspects of radioscopy can have beneficial as well as detrimental effects upon system performance and must be evaluated on a case-by-case basis.

6.9.4.4 The qualification procedures are intended to benchmark radioscopic system performance under selected operating conditions to provide a measure of system performance. Qualification shall not restrict operation of the radioscopic system at other radioscopic examination parameter settings which may provide improved performance on actual test objects.

6.9.4.5 Radioscopic system performance measured pursuant to Practice E1411 does not guarantee the level of performance which may be realized in actual operation. The effects of test part-geometry and test part-generated scattered radiation cannot be reliably predicted by a standardized test. All radioscopic systems age and degrade in performance as a function of time. Maintenance and operator adjustments, if not correctly made, can adversely affect the performance of radioscopic systems.

6.9.4.6 The performance of the radioscopic system operator in manual and semi-automatic radioscopic systems is not taken into account in Practice E1411 and can have a major effect upon radioscopic system performance. Operator qualifications are an important aspect of system operation and should be covered in a separate written procedure.

6.10 Guide E1441 provides a tutorial introduction to the technology and terminology of CT. It deals extensively with the physical and mathematical basis of CT, discusses the basic hardware configuration of all CT systems, defines a comprehensive set of fundamental CT performance parameters, and presents a useful method of characterizing and predicting system performance. Also, extensive descriptions of terms and references to publications relevant to the subject are provided.

6.10.1 *Summary of Guide*—Computed tomography (CT) is a radiographic method that provides an ideal examination technique whenever the primary goal is to locate and size planar and volumetric detail in three dimensions. Because of the relatively good penetrability of X-rays, as well as the sensitivity of absorption cross sections to atomic chemistry, CT permits the nondestructive physical and, to a limited extent, chemical characterization of the internal structure of materials.

Also, since the method is X-ray based, it applies equally well to metallic and non-metallic specimens, solid and fibrous materials, and smooth and irregularly surfaced objects. When used in conjunction with other nondestructive evaluation (NDE) methods, such as ultrasound, CT data can provide evaluations of material integrity that cannot currently be provided nondestructively by any other means.

6.10.2 *Significance and Use:*

6.10.2.1 Guide E1441 provides a tutorial introduction to the theory and use of computed tomography. Guide E1441 begins with an overview intended for the interested reader with a general technical background. Subsequent, more technical sections describe the physical and mathematical basis of CT technology, the hardware and software requirements of CT equipment, and the fundamental measures of CT performance. Guide E1441 includes an extensive glossary (with discussion) of CT terminology and an extensive list of references to more technical publications on the subject. Most importantly, Guide E1441 establishes consensus definitions for basic measures of CT performance, enabling purchasers and suppliers of CT systems and services to communicate unambiguously with reference to a recognized standard. Guide E1441 also provides a few carefully selected equations relating measures of CT performance to key system parameters.

6.10.2.2 Guide E1441 is intended to satisfy two general needs for users of industrial CT equipment: (*1*) the need for a tutorial guide addressing the general principles of X-ray CT as they apply to industrial imaging; and (*2*) the need for a consistent set of CT performance parameter definitions, including how these performance parameters relate to CT system specifications. Potential users and buyers, as well as experienced CT inspectors, will find Guide E1441 a useful source of information for determining the suitability of CT for particular examination problems, for predicting CT system performance in new situations, and for developing and prescribing new scan procedures.

6.11 Guide E1453 provides for the control and maintenance of recorded and unrecorded media of analog or digital electronic data from industrial radioscopy.

6.11.1 *Significance and Use:*

6.11.1.1 The provisions of Guide E1453 intended to control and maintain the quality of industrial electronic data from radioscopy and unrecorded media only and are not intended for controlling the acceptability of the materials or products examined. It is further intended that Guide E1453 be used as an adjunct to Guide E1000, Practice E1255, and Terminology E1316. (See 6.1, 6.3, and 6.4, respectively.)

6.11.1.2 The necessity for applying specific control procedures such as those described in Guide E1453 is dependent to a certain extent on the degree to which the user adheres to good recording and storage practices as a matter of routine procedure.

6.12 Guide E664 provides information for X-ray and gamma-ray radiographic examination as applied to industrial radiographic film recording.

6.12.1 *Summary of Guide*—The guide discusses preferred practice and incorporates a bibliography for additional information. It covers types of materials to be examined; radiographic examination techniques and production methods; radiographic film selection, processing, viewing and storage; and maintenance of inspection records.

6.12.2 *Significance and Use*—Guide E94 is generally applicable to available materials, processes, and techniques where industrial X-ray films are used as the recording media. Radiography will be consistent in sensitivity and resolution only if the effects of all details of techniques such as geometry, film, filtration, viewing, etc., are properly established and maintained.

6.13 Practice E1570 provides procedural information for performing computed tomographic examinations.

6.13.1 The CT systems addressed in this practice utilize a set of X-ray transmission measurements made along a set of paths through the test object for many different directions. Each of the transmission measurements is digitized and stored in a computer, where they are subsequently normalized, corrected, and reconstructed by one of a variety of techniques.

6.13.2 *Summary of Practice*

6.13.2.1 Practice E1570 describes CT that can be used to establish procedures for nondestructive testing and evaluation. Requirements in this practice are intended to control the reliability and quality of the CT images.

6.13.2.2 CT systems are composed of a number of subsystems. The function served by each subsystem is common in almost all CT scanners. The practice describes the following subsystems: sources of penetrating radiation detector(s), mechanical scanning system, and computer system. The computer system includes image reconstruction software/hardware, image display/analysis system, data storage system, and operator interface.

6.13.2.3 The practice describes and defines the procedures for establishing and maintaining quality control of CT examination services.

6.13.2.4 The extent to which a CT image faithfully reproduces an object or a feature within an object is influenced by spatial resolution, statistical noise, slice plane thickness, and artifacts of the imaging system. Operating parameters should strike an overall balance between image quality, inspection time, and cost. These parameters should be considered for CT system configurations, components and procedures. The setting and optimization of CT system parameters are discussed in this practice. Also, provided are methods for the measurement of CT system performance.

6.13.3 *Significance and Use*—Practice E1570 is applicable for the systematic assessment of the internal structure of a material or assembly. It may be used to prescribe CT operating procedures. It provides a basis for the formation of a program for quality control and its continuation through calibration, standardization, reference samples, inspection plans and procedures. Typical applications of this practice are expected to be for final acceptance examinations required by purchase order or specification.

6.14 Practice E1647 covers the design and materials selection of a contrast sensitivity measuring gage used to determine the minimum change in material thickness of density that may be imaged without regard to spatial resolution limitations when using a radioscopic imaging system.

6.14.1 *Summary of Practice*—Practice E1647 provides fabrication details for the construction of contrast sensitivity measuring gages and a method for calculation of the resultant contrast sensitivity.

6.14.2 *Significance ad Use*—It is often useful to evaluate the contrast sensitivity of a penetrating radiation imaging system separately from spatial resolution measurements. Conventional image quality indicators (IQIs) combine the contrast sensitivity and resolution measurements into an overall performance figure of merit that is often inadequate to detect subtle changes in imaging system and performance. For example, in a high-contrast image, spatial resolution can degrade with almost no noticeable effect upon overall image quality. Similarly, in a application in which the imaging system provides a very sharp image, contrast can fade with little noticeable effect upon the overall image quality. These situations may develop and go unnoticed until the system performance deteriorates below acceptable image quality limits. The contrast sensitivity gage measures contrast sensitivity independent of the imaging system spatial resolution limitations. The thickness recess dimensions are large with respect to the spatial resolution limitations of most imaging systems. The measurements cited in E-1647 are appropriate of the qualification and performance monitoring of radiographic and radioscopic imaging systems. For ceramics or other nonmetallic materials, it will be necessary to establish equivalence to the selected material used for the gage.

6.15 Guide E1672 covers guidelines for translating application requirements into computed tomography (CT) system requirements/specifications and establishes a common terminology to guide both purchaser and supplier in the CT system selection process.

6.15.1 *Summary of Guide*—Guide E1672 describes the capabilities and limitations of the various CT subsystems and identifies the typical purchaser's examination requirements that must be met. These requirements factor into the system design. Some of the requirements identified are the ability to support the size and weight of the object to be examined; detection capability for size of flaws (both spatial resolution and contrast discrimination); dimensioning precision; artifact level; throughput; ease of use; and archival procedures. The guide also describes the tradeoff between the CT performance as required by the purchaser and the choice of system components and subsystems.

The guide also covers some management cost considerations as well as other recommendations related to the procurement of CT systems.

6.15.2 *Significance and Use*—Guide E1672 will aid the purchaser in generating a CT system specification through the conversion of purchaser's requirements (for specific or general examination application) to system components for preparation of a useful specification for a CT system.

The guide is applicable to purchasers seeking CT scan services.

6.16 Test Method E1695 provides instructions for determining the spatial and contrast sensitivity in X-ray and gamma-ray computed tomography (CT) images.

6.16.1 *Summary of Test Method*—The determination of spatial resolution and contrast sensitivity 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.

6.16.2 *Significance and Use*

6.16.2.1 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, i.e., its ability to image fine structural detail in an object. Random noise limits the contrast sensitivity of a CT system, i.e., its ability to detect the presence or absence of features in an object. E-1695 allows the purchaser or the provider of CT systems or services to measure and specify spatial resolution and contrast sensitivity.

6.16.2.2 Test Method E1695 provides a method that 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. The method may not yield meaningful results if the disk image occupies less than a significant fraction of the field of view.

6.17 Practice E1817 describes methods of assessing the image quality for radiological examination of unique materials or processes, or both, for which conventional image quality indicators (IQIs), such as thin plaques containing holes or small-diameter wires, may be inadequate for controlling the quality and repeatability of radiological images. Where appropriate, representative quality indicators (RQIs) also may represent criteria levels for the acceptance or rejection of discontinuities whose images are displayed.

6.17.1 *Summary of Practice*—Practice E1817 provides rationale for the use of RQIs as well as details for the design and use of RQIs.

6.17.2 *Significance and Use:*

6.17.2.1 The use of RQIs is a significant departure from standard practice in industrial radiology because the RQI is a custom design rather than a standard design and is dependent on the application, material, and process, and therefore, cannot be a simple plaque or wire. The use of an RQI provides documented evidence that radiological images have the level of quality necessary to reveal those nonconformances for which the parts are being examined by assuring adequate spatial resolution and contrast sensitivity in the areas of interest.

6.17.2.2 The designer also may use the RQI, when in compliance with the requirements of E1817, to set accept or reject criteria, as applicable to the part designed.

7. Ultrasonics

7.1 *Terminology:*

7.1.1 See Terminology E1316, Section I.

7.1.2 *Significance and Use*—The identification and use of common terms and definitions are necessary to ensure proper communication between producers, examiners, and users of both nondestructive examination equipment and techniques and advanced ceramics.