Designation: E 1817 – 03

Standard Practice for Controlling Quality of Radiological Examination by Using Representative Quality Indicators (RQIs)[1]

This standard is issued under the fixed designation E 1817; 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 practice covers the radiological examination of unique materials or processes, or both, for which conventionally designed image quality indicators (IQIs), such as those described in Practices E 747 and E 1025, may be inadequate in controlling the quality and repeatability of the radiological image.

1.2 Where appropriate, representative image quality indicators (RQIs) may also represent criteria levels of the acceptance or rejection of images of discontinuities.

1.3 This practice is applicable to most radiological methods of examination.

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:*

E 543 Practice for Evaluating Agencies that Perform Nondestructive Testing[2]

E 747 Practice for Design, Manufacture, and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology[2]

E 1000 Guide for Radioscopy[2]

E 1025 Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology[2]

E 1316 Terminology for Nondestructive Examinations[2]

E 1441 Guide for Computed Tomography (CT) Imaging[2]

2.2 *ASNT Standards:*[3]

SNT-TC-1A Recommended Practice for Personnel Qualification in Nondestructive Testing

ANSI/ASNT CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel

2.3 *Aerospace Industries Association Document:*

NAS 410 Certification and Qualification of Nondestructive Testing Personnel[4]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology E 1316.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *representative quality indicator (RQI)*—a real part, or a fabrication of similar geometry in radiologically similar material to a real part, that has features of known characteristics that represent all of the features for which the parts to be purchased are being examined.

4. Summary of Practice

4.1 The information from an RQI image may be used to control all of the parameters necessary for production examination images (which look essentially like the RQI images) and is particularly effective in the practice of radioscopic and tomographic techniques. Refer to Guides E 1000 and E 1441, respectively.

4.2 The designer may also use the RQI, when in compliance with the requirements set out in this practice, to set accept or reject criteria, as applicable, to that part design.

5. Significance and Use

5.1 The use of RQIs is a significant departure from normal practice in industrial radiology because it is not 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 radiologic images have the level of quality necessary to reveal those nonconformances for which the parts are being examined by ensuring adequate spatial resolution and contrast sensitivity in the areas of interest.

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[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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[2] *Annual Book of ASTM Standards*, Vol 03.03.

[3] Available from American Society for Nondestructive Testing, 1711 Arlingate Plaza, P.O. Box 28518, Columbus, OH 43228-0518.

[4] Available from Aerospace Industries Association of America, Inc., 1250 Eye St., NW, Washington, DC 20005.

5.2 Where conventional IQIs conforming to Practice E 747 or E 1025 can be used effectively, those practices should be followed.

6. Basis of Application

6.1 The following items shall be agreed upon between the purchaser and the supplier and specified in the contract or job order:

6.1.1 Nondestructive testing (NDT) personnel 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, or a similar document. The practice or standard used and its applicable revision shall be specified in the contractual agreement between the using parties.

6.1.2 *Nondestructive Testing Agency Evaluation*—If a systematic assessment of the capability of an NDT agency is specified, a documented procedure such as that described in Practice E 543 shall be used as the basis for evaluation.

6.1.3 *Quality Levels*—Quality levels to be used shall be specified in accordance with 7.1 and 7.2.

6.1.4 *System Performance Using RQIs*—Nonconformances in RQIs used to determine system performance shall be specified in accordance with 8.1.1-8.1.3.

6.1.5 *RQI Fabrication*—The design and manufacture of RQIs shall be specified in accordance with 8.3.1 and 8.3.2.

6.1.6 *Frequency of RQI Usage*—If not in accordance with 8.7.1, the frequency of RQI usage shall be specified in accordance with 8.7.2.

6.1.7 *Accept and Reject Criteria*—If used, acceptance levels shall be specified in accordance with 8.8.1 and 8.8.2.

7. Quality Levels

7.1 There is no standard table of image quality levels associated with RQI images.

7.2 Quality levels using RQIs shall be determined by agreement between the purchaser and the supplier and shall be specified in the applicable job order or contract.

8. Requirements

8.1 *System Performance Using RQIs*:

8.1.1 The manufacturing development of unique materials or processes, or both, may produce a wide range of nonconformances. The radiologic system should be capable of revealing examples of the smallest deviations from the engineering drawing requirements in images of examined parts.

8.1.2 The cognizant design authority for the parts being examined shall agree that the RQI (whether actual parts or fabricated) can be used to assess and verify image quality with regard to detection of all of the nonconformances of concern.

8.1.3 The choice of known nonconformances that the system should have the capability of revealing in the images shall be determined between the purchaser and the supplier and shall be specified in the applicable job order or contract.

8.2 *RQI Requirements*—Radiologic image quality requirements shall be determined by RQIs that conform to the following conditions:

8.2.1 The geometry of the RQI must be as near as possible (±5 %) to that of the parts to be examined.

8.2.2 The RQIs shall be identified permanently and referred to in the examination scanplan.

8.2.3 It shall be a requirement to keep an RQI register, a scanplan describing all of the parameters used to make the images, and a precise technical description (including reference images) of all of the imperfections or characteristics for which the RQI is being used.

8.3 *RQI Fabrication*:

8.3.1 The RQIs shall be fabricated (where they are not actual parts or sections from actual parts) from radiologically similar material and from manufacturing process parameters similar to those of the parts to be examined.

8.3.2 Large structures can be sectioned into smaller pieces to provide examples of nonconformances, provided that they are contained within a relevant geometry that produces a radiologic image similar to the original. Scatter radiation due to part geometric configuration can influence radiologic image quality significantly.

8.4 *Number of RQIs*—There is no limit to the number of RQIs for the parts to be examined, provided that each RQI is in compliance with the requirements stated in 8.1-8.3.

8.5 *RQI Placement*—RQIs shall be exposed in strict compliance with the scanplan or shooting sketch. Unlike conventional IQIs, RQIs should be in the same position relative to the source and detector as the part to be examined to represent the quality level accurately. When the RQI cannot be placed in the same position relative to the source and detector as the examination part, place the examination part in the direct center of where the radiation beam is normal to the detector, and place the RQI further away from this center.

8.6 *RQI Imaging*:

8.6.1 The RQI images with artifacts in the areas of interest shall be reimaged.

8.6.2 The RQI image shall be provided, along with the examination images, as part of the examination record.

8.6.3 The complete set of imaging conditions shall be recorded and used when reviewing the reference images of the features in the RQI or the part being examined, or both.

8.7 *Frequency of Use*:

8.7.1 In most applications, it is not practical to image the RQI with each exposure of the part(s) being examined, but it should as a minimum be imaged before the commencement and at the conclusion of the examination. This is applicable whether the examination involves a single item or a batch of similar items.

8.7.2 Other frequencies of use shall be determined between the purchaser and the supplier and shall be specified in the applicable job order or contract.

8.8 *Acceptance Levels*:

8.8.1 The cognizant design authority for the parts being examined may also choose to use the RQI images as reference images for indicating acceptable or rejectable conditions in the parts to be examined, provided that the original set of reference images is kept for reference during subsequent use of the RQI(s).

8.8.2 The choice of known and quantified image(s) of features in the RQI to be used as accept or reject criteria shall

be determined between the purchaser and the supplier and shall be specified in the applicable job order or contract.

9. Precision and Bias

9.1 No statement is made about either the precision or bias of this practice for controlling the radiologic quality of images made from the examination of unique materials or processes, or both, since the result indicates merely whether there is conformance to the criteria for success specified in this practice.

10. Keywords

10.1 radiologic images; representative quality indicator; RQI