



Designation: E1025 – 11

# Standard Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology<sup>1</sup>

This standard is issued under the fixed designation E1025; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This practice<sup>2</sup> covers the design, material grouping classification, and manufacture of hole-type image quality indicators (IQI) used to indicate the quality of radiologic images.

1.2 This practice is applicable to X-ray and gamma-ray radiology.

1.3 The values stated in inch-pound units are to be regarded as standard.

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:<sup>3</sup>

**B139/B139M** Specification for Phosphor Bronze Rod, Bar, and Shapes

**B150/B150M** Specification for Aluminum Bronze Rod, Bar, and Shapes

**B164** Specification for Nickel-Copper Alloy Rod, Bar, and Wire

**B166** Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696), Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617), and Nickel-Iron-Chromium-Tungsten Alloy (UNS N06674) Rod, Bar, and Wire

<sup>1</sup> 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.

Current edition approved Dec. 15, 2011. Published January 2012. Originally approved in 1984. Last previous edition approved in 2005 as E1025 - 05. DOI: 10.1520/E1025-11.

<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Practice SE-1025 in Section II of that Code.

<sup>3</sup> 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.

**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

**E1735** Test Method for Determining Relative Image Quality of Industrial Radiographic Film Exposed to X-Radiation from 4 to 25 MeV

**E1316** Terminology for Nondestructive Examinations

**E2662** Practice for Radiologic Examination of Flat Panel Composites and Sandwich Core Materials Used in Aerospace Applications

### 2.2 Department of Defense (DoD) Documents:

**MIL-I-24768** Insulation, Plastics, Laminated, Thermosetting; General Specification for<sup>4</sup>

## 3. Terminology

3.1 *Definitions*—The definitions of terms relating to gamma and X-radiology in Terminology E1316, Section D, shall apply to the terms used in this practice.

## 4. Hole-Type IQI Requirements

4.1 Image quality indicators (IQIs) used to determine radiologic-image quality levels shall conform to the following requirements.

4.1.1 All image quality indicators (IQIs) shall be fabricated from materials or alloys identified or listed in accordance with 7.3. Other materials may be used in accordance with 7.4.

### 4.1.2 Standard Hole-Type IQIs:

4.1.2.1 Standard Hole-Type Image quality indicators (IQIs) shall dimensionally conform to the requirements of Fig. 1.

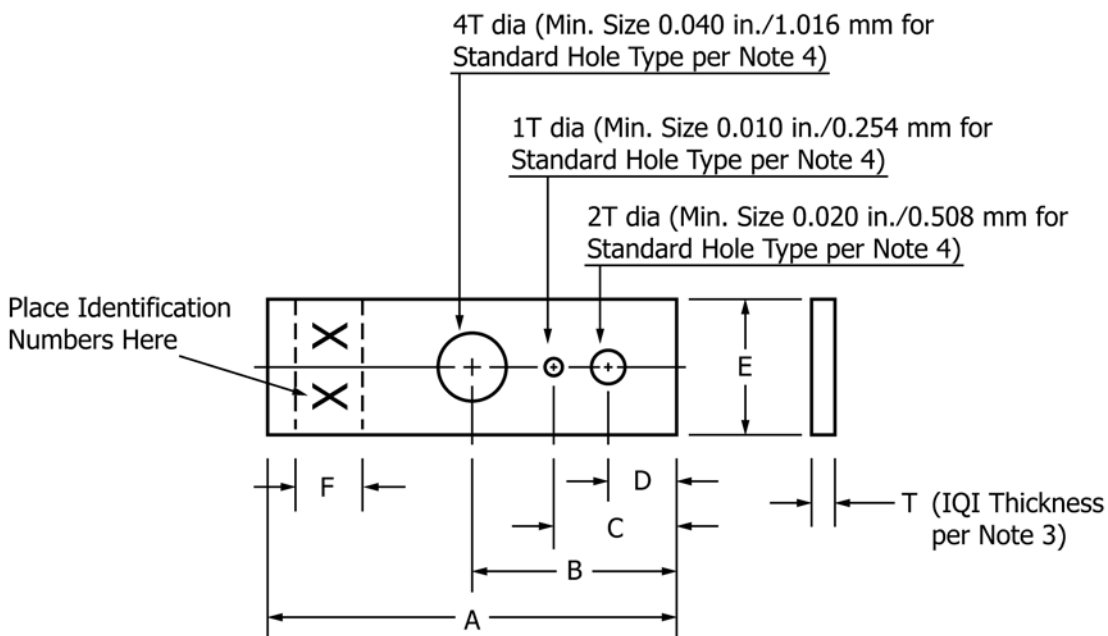
### 4.1.3 Modified Hole-Type IQI:

4.1.3.1 The rectangular IQI may be modified in length and width as necessary for special applications, provided the hole size(s) and IQI thickness conform to Fig. 1 or 4.1.4, as applicable.

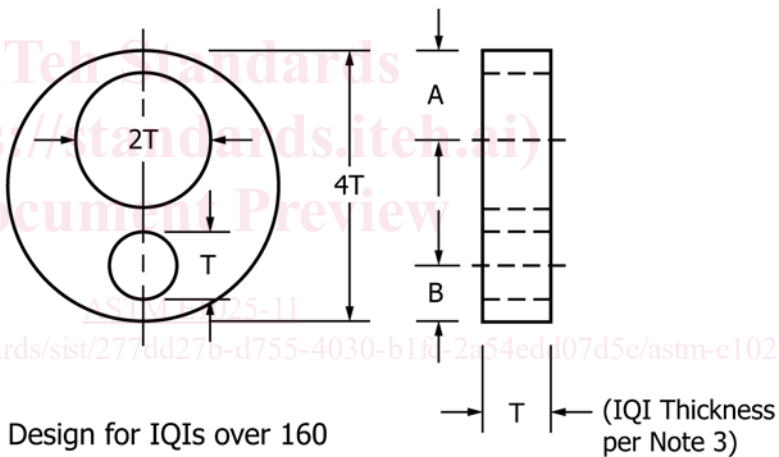
<sup>4</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

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

(A) Design for IQIs up to 160



(B) Design for IQIs over 160



- NOTE 1—Tolerances for IQI thickness and hole diameter.
- NOTE 2—Tolerances for True T-hole Diameter IQI thickness and hole diameter shall be  $\pm 10\%$ .
- NOTE 3—XX identification number equals T in .001 inches.
- NOTE 4—IQIs No. 1 through 9 for Standard Hole Type IQI's (4.1.2) are not 1T, 2T, and 4T.
- NOTE 5—Holes shall be true and normal to the IQI. Do not chamfer.

Identification Number T (Note 3)	A in. (mm)	B in. (mm)	C in. (mm)	D in. (mm)	E in. (mm)	F in. (mm)	Tolerances (Note 2)
1-4	1.500 (38.1) $\pm 0.015$ (0.38)	0.750 (19.05) $\pm 0.015$ (0.38)	0.438 (11.13) $\pm 0.015$ (0.38)	0.250 (6.35) $\pm 0.015$ (0.38)	0.500 (12.7) $\pm 0.015$ (0.38)	0.250 (6.35) $\pm 0.030$ (0.76)	$\pm 10\%$
5-20	1.500 (38.1) $\pm 0.015$ (0.38)	0.750 (19.05) $\pm 0.015$ (0.38)	0.438 (11.13) $\pm 0.015$ (0.38)	0.250 (6.35) $\pm 0.015$ (0.38)	0.500 (12.7) $\pm 0.015$ (0.38)	0.250 (6.35) $\pm 0.030$ (0.76)	$\pm 0.0005$ (0.127)
21-50	1.500 (38.1) $\pm 0.015$ (0.38)	0.750 (19.05) $\pm 0.015$ (0.38)	0.438 (11.13) $\pm 0.015$ (0.38)	0.250 (6.35) $\pm 0.015$ (0.38)	0.500 (12.7) $\pm 0.015$ (0.38)	0.250 (6.35) $\pm 0.030$ (0.76)	$\pm 0.0025$ (0.635)
51-160	2.250 (57.15) $\pm 0.030$ (0.762)	1.375 (34.93) $\pm 0.030$ (0.762)	0.750 (19.05) $\pm 0.030$ (0.762)	0.375 (9.53) $\pm 0.030$ (0.762)	1.000 (25.4) $\pm 0.030$ (0.762)	0.375 (9.53) $\pm 0.030$ (0.762)	$\pm 0.005$ (0.127)
Over 160	1.330T $\pm 0.005$ (0.127)	0.830T $\pm 0.005$ (0.127)	...	...	...	...	$\pm 0.010$ (0.254)

FIG. 1 IQI Design

4.1.3.2 The IQI's shall be identified as specified in 4.1.5 to 4.1.5.2, as applicable, except that the identification numbers may be placed adjacent to the IQI if placement on the IQI is impractical.

4.1.3.3 When modified IQI's are used, details of the modification shall be documented in the records accompanying the examination results.

4.1.4 True T-hole Diameter IQI:

4.1.4.1 It may be desirable for non-film applications to use true T-hole diameter IQI's for numbers 1 through 9.

4.1.4.2 Hole sizes for true T-hole diameter IQI's may be made by using laser or an electric discharge machining (EDM) process and shall be within ±10 % of 1T, 2T and 4T (See Fig. 1, Note 3 for T)

4.1.4.3 When true T-hole-diameter IQI's are used, details of the modifications shall be documented in the records accompanying the examination results.

4.1.5 Both the rectangular and the circular IQIs shall be identified with number(s) made of lead or a material of similar radiation opacity. The number shall be bonded to the rectangular IQI's and shall be placed adjacent to circular IQI's to provide identification of the IQI on the image. The identification numbers shall indicate the thickness of the IQI in thousandths of an inch, that is, a number 10 IQI is 0.010 in. thick, a number 100 IQI is 0.100 in. thick, etc. Additional identification requirements are provided in 7.2.

4.1.5.1 Alternative Identification Method—It may be desirable for non-film applications to eliminate the lead number identifiers and replace them with either material addition or material removal methods as stated below:

(1) Material Addition Method—Numbers may be made of the same material as that of the IQI and of sufficient thickness to be clearly discernable within the radiologic image.

(2) Material Removal Method—Numbers may be cut into the IQI in such a manner as to be clearly discernable in the radiologic image. Processes such as laser etching, chemical etching, precision stamping, etc., may be used to create the numbers within the IQI.

4.1.5.2 Alloy-group identification shall be in accordance with 7.2. Rectangular IQI's shall be notched as shown in Fig. 2, except the corner notch for Group 001 is at a 45 degree angle. Round IQI's shall be vibrotooled or etched as shown in Fig. 3.

4.1.5.3 True T-hole diameter IQI identification numbers shall be rotated 90° as compared to Standard Hole Type IQIs. See Fig. 4.

5. IQI Procurement

5.1 When selecting IQI's for procurement, the following factors should be considered:

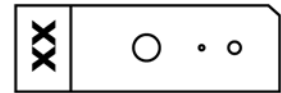
5.1.1 Determine the alloy group(s) of the material to be examined.

5.1.2 Determine the thickness or thickness range of the material(s) to be examined.

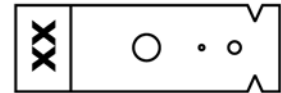
5.1.3 Determine the Image Quality Level requirements as described in Section 6 and Table 1.

5.1.4 Select the applicable IQI's that represent the required IQI thickness and alloy(s).

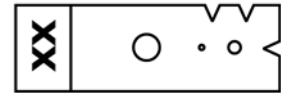
Group 001 IQI for Non-Metals



Group 03 IQI for Magnesium



Group 02 IQI for Aluminum



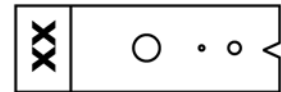
Group 01 IQI for Titanium



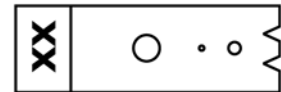
Group 1 IQI for Carbon Alloy and Stainless Steel



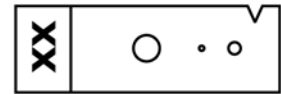
Group 2 IQI for Aluminum Bronze



Group 3 IQI for Nickel-Chromium-Iron



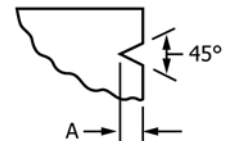
Group 4 IQI for Nickel-Copper (70-30)



Group 5 IQI for Tin Bronze



Detail of Notch



A = 1/16 in. (1.588 mm)

NOTCH TOLERANCES

Width +15°

-0°

(A) Depth +1/16 in. (1.588mm)

-1/32 in. (0.794 mm)

FIG. 2 Rectangular IQI Notch Identification and Material Grouping

NOTE 1—This practice does not recommend or suggest specific IQI sets to be procured. Section 5 is an aid in selecting IQI's based on specific needs.

6. Image Quality Levels

6.1 Image quality levels are designated by a two part expression; X-YT. The first part of the expression, X, refers to the IQI thickness expressed as a percentage of the specimen thickness. The second part of the expression, YT, refers to the diameter of the required hole and is expressed as a multiple of