



Designation: ~~E1025-05~~ 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

B150M Specification for Aluminum Bronze, Rod, Bar, and Shapes [Metric]

~~B161 Specification for Nickel Seamless Pipe and Tube~~ 150/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

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~~ 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.

<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 Radiographic Practice and Penetrators.

Current edition approved June 1, 2005. Published June 2005. Originally approved in 1984. Last previous edition approved in 1998 as E1025-98. DOI: 10.1520/E1025-05 on Radiology (X and Gamma) Method.

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<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.

<sup>4</sup> Superston is a registered trademark of Superston Corp., Jersey City, NJ.

<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.

#### 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 Standard Hole-Type IQIs:

4.1.1.1 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.

4.1.1.2 Image quality indicators (IQIs) shall dimensionally conform to the requirements of

##### 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.

4.1.1.3 Both the rectangular and the circular IQI 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

##### 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.

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  $\pm 10\%$  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.

4.1.1.4 Alloy-group identification shall be in accordance with

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: Rectangular IQI's shall be notched. Image quality indicators (IQI's) shall be vibrotooled or etched as specified:

##### 4.1.2 Modified Hole-Type IQI:

4.1.2.1 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, 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.

4.1.2.2 The IQI's shall be identified as specified in 4.1.1.3, except that the identification numbers may be placed adjacent to the IQI if placement on the IQI is impractical.

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

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:

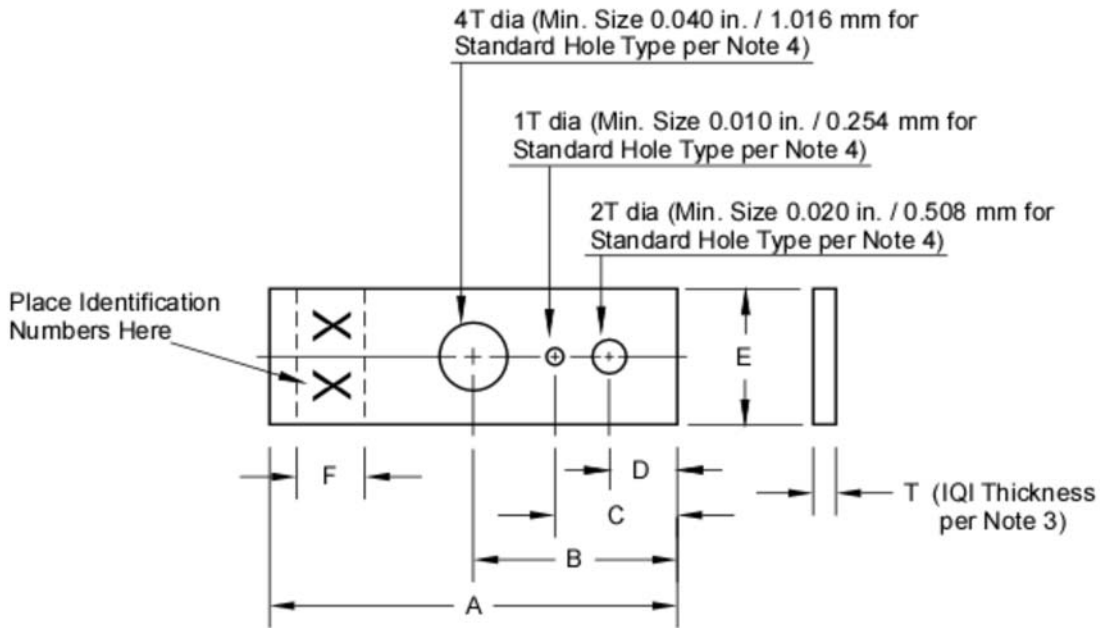
5.1.1 Determine the alloy group(s) of the material to be examined.

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

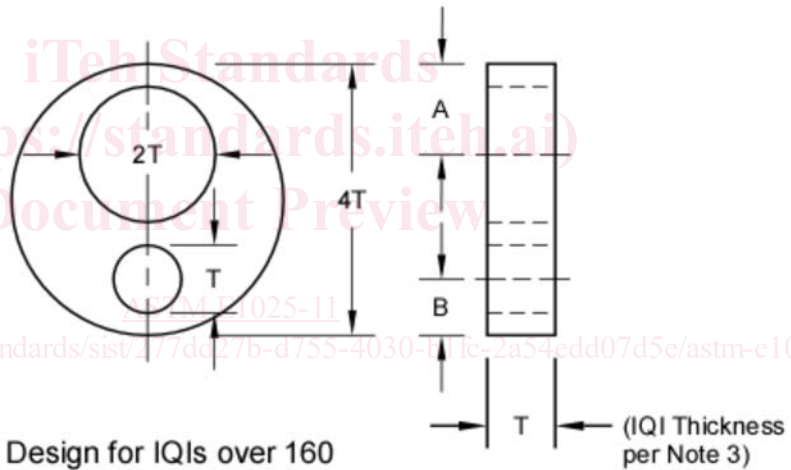
5.1.3 Select the applicable IQI's that represent the required IQI thickness and alloy(s).

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

(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

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

Group 001 IQI  
for Non-Metals



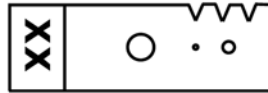
Group 03 IQI  
for Magnesium



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



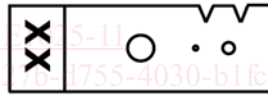
Group 3 IQI  
for Nickel-Chromium-Iron



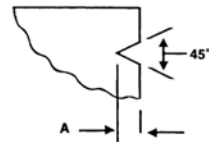
Group 4 IQI  
for Nickel-Copper (70-30)



Group 5 IQI  
for Tin Bronze



Detail of Notch



A = 1/16 in. (1.588 mm)

**NOTCH TOLERANCES**

Width +15°

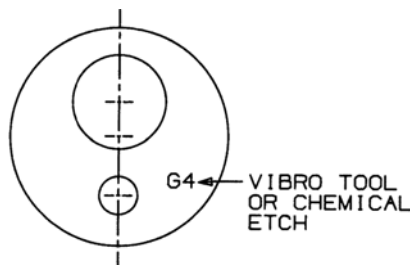
-0°

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

-1/32 in. (0.794 mm)

**FIG. 2 Rectangular IQI Notch Identification and Material Grouping**

CIRCULAR IQI  
IDENTIFICATION



**FIG. 3 Circular IQI Identification**