



Designation: E1025 – 05

# 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]<sup>4</sup>

**B161** Specification for Nickel Seamless Pipe and Tube

**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)\* and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) 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

## 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 *Standard Hole-Type IQIs:*

4.1.1.1 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 **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 **7.2**.

4.1.1.4 Alloy-group identification shall be in accordance with **Fig. 2**. Rectangular IQI's shall be notched. Image quality indicators (IQI's) shall be vibrotooled or etched as specified.

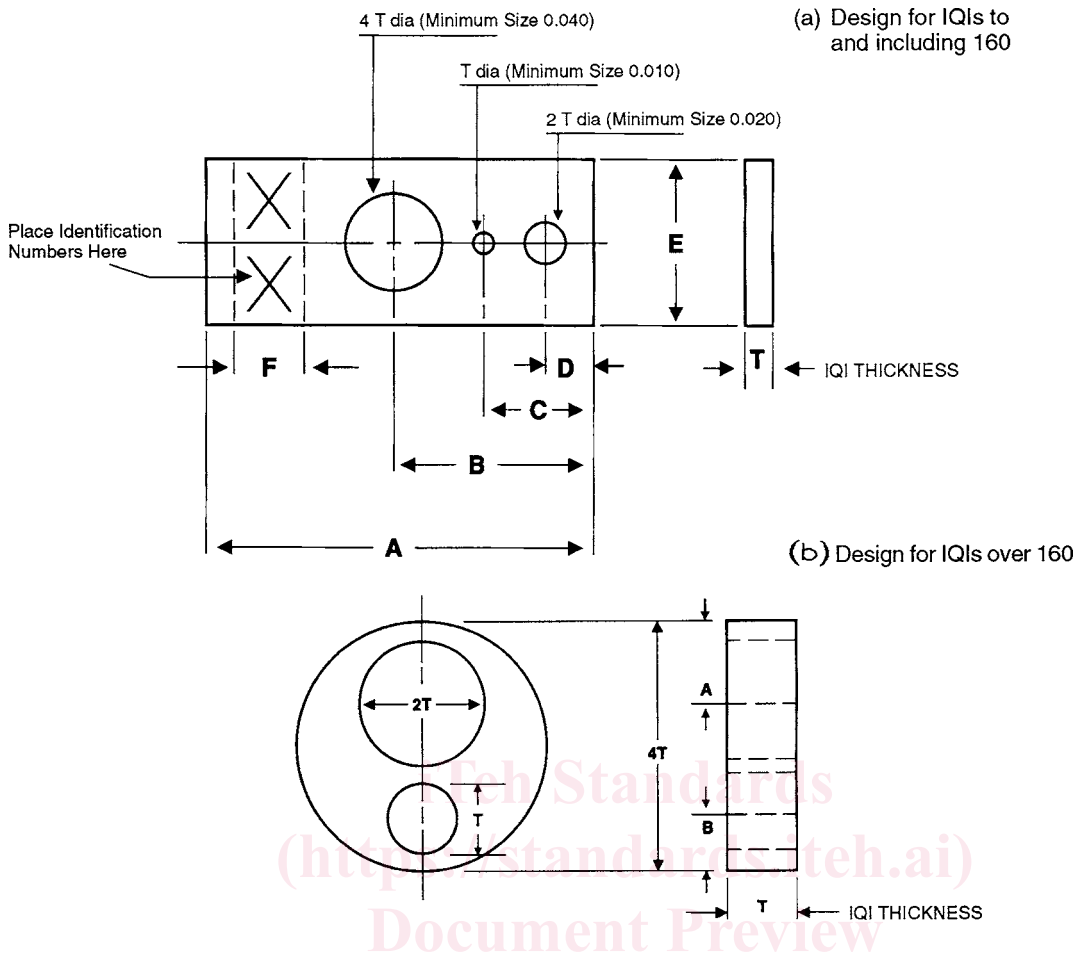
<sup>1</sup> This practice is under the jurisdiction of ASTM Committee **E07** on Nondestructive Testing and is the direct responsibility of Subcommittee **E07.01** on Radiographic Practice and Penetrators.

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.

<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> Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.



NOTE 1—All dimensions in inches (Note 6).

NOTE 2—Tolerances for IQI thickness and hole diameter.

NOTE 3—XX identification number equals  $T$  in .001 inches.

NOTE 4—IQIs No. 1 through 9 are not  $1T$ ,  $2T$ , and  $4T$ .

NOTE 5—Holes shall be true and normal to the IQI. Do not chamfer.

NOTE 6—To convert inch dimensions to metric, multiply by 25.4.

Identification Number $T$ (Note 3)	A	B	C	D	E	F	Tolerances (Note 2)
1–4	1.500	0.750	0.438	0.250	0.500	0.250	$\pm 10\%$
	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.030$	
5–20	1.500	0.750	0.438	0.250	0.500	0.250	$\pm 0.0005$
	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.030$	
21–50	...	...	...	...	...	...	$\pm 0.0025$
Over 50–160	2.250	1.375	0.750	0.375	1.000	0.375	$\pm 0.005$
	$\pm 0.030$	$\pm 0.030$	$\pm 0.030$	$\pm 0.030$	$\pm 0.030$	$\pm 0.030$	
Over 160	1.330T	0.830T	...	...	...	...	$\pm 0.010$
	$\pm 0.005$	$\pm 0.005$					

FIG. 1 IQI Design

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.

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.

5. IQI Procurement

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

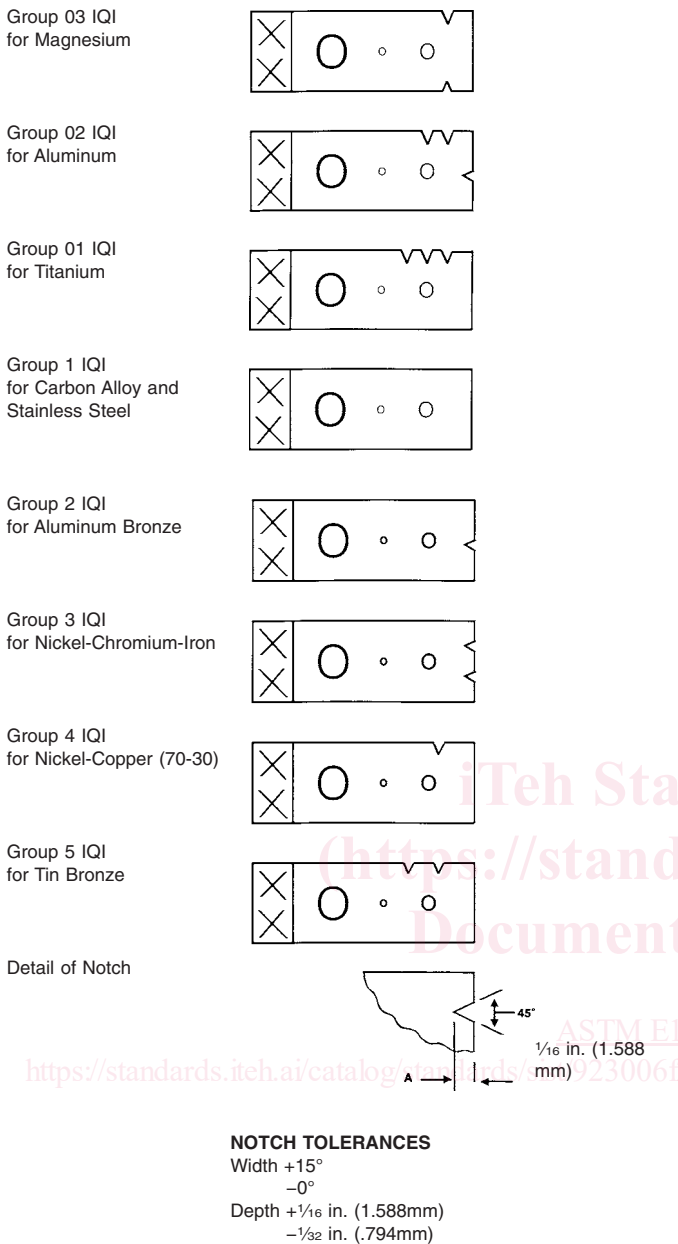


FIG. 2 Rectangular IQI Notch Identification and Material Grouping

- 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).

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

TABLE 1 Typical Image Quality Levels

Standard Image Quality Levels			
Image Quality Levels	IQI Thickness	Minimum Preceptible Hole Diameter	Equivalent IQI Sensitivity, % <sup>A</sup>
2-1T	1/50 (2 %) of Specimen Thickness	1T	1.4
2-2T <sup>B</sup>		2T	2.0
2-4T		4T	2.8
Special Image Quality Levels			
1-1T	1/100 (1 %) of Specimen Thickness	1T	0.7
1-2T		2T	1
4-2T		2T	4

<sup>A</sup>Equivalent IQI sensitivity is that thickness of the IQI, expressed as a percentage of the part thickness, in which the 2T hole would be visible under the same conditions.

<sup>B</sup>For Level 2-2T Radiologic—The 2T hole in an IQI, 1/50 (2 %) of the specimen thickness, is visible.

diameter of the hole and is expressed as a multiple of the IQI thickness, *T*. The image quality level 2-2T means that the IQI thickness *T* is 2 % of the specimen thickness and that the diameter of the IQI imaged hole is 2 × the IQI thickness.

NOTE 2—Image Quality Indicators (IQI's) less than number 10 have hole sizes 0.010, 0.020, and 0.040 in. diameter regardless of the IQI thickness. Therefore, IQI's less than number 10 do not represent the quality levels specified in 6.1 and Table 1. The equivalent sensitivity can be computed from data furnished in Appendix X1.

6.2 Typical image quality level designations are shown in Table 1. The level of inspection specified should be based on service requirements of the product. Care should be taken in specifying image quality levels 2-1T, 1-1T, and 1-2T by first determining that these levels can be maintained in production.

6.3 In specifying image quality levels, the contract, purchase order, product specification, or drawing should state the proper two-part expression and clearly indicate the thickness of the metal to which the level refers. In place of a designated two-part expression, the IQI number and minimum discernible hole size shall be specified.

6.4 Appendix X1 of this practice provides methods for determining equivalent penetrometer sensitivity (EPS) in percent. Under certain conditions (as described within the purchaser-supplier agreement), EPS may be useful in relating a discernible hole size of the IQI thickness with the section thickness radiographed for establishing an overall technical image quality equivalency. This is not an alternative IQI provision for the originally specified IQI requirement of this practice, but may be a useful tool for establishing technical image equivalency on a case basis need with specific customer approvals.

6.5 Practice E747 contains provisions for wire IQI's that use varying length and diameter wires to affect image quality requirements. The requirements of Practice E747 are different from this standard; however, Practice E747 (see Table 4) contains provisions whereby wire sizes equivalent to corresponding 1T, 2T and 4T holes for various plaque thicknesses are provided. Appendix X1 of Practice E747 also provides methods for determining equivalencies between wire and hole type IQI's. This is not an alternative IQI provision for the originally specified IQI requirements of this practice, but may be useful for establishing technical image equivalency on a case basis need with specific customer approvals.