



Designation: E 1025 – 98

Standard Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology¹

This standard is issued under the fixed designation E 1025; 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 practice² 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:

B 139 Specification for Phosphor Bronze Rod, Bar, and Shapes³

B 150 Specification for Aluminum Bronze Rod, Bar, and Shapes³

B 161 Specification for Nickel Seamless Pipe and Tube⁴

B 164 Specification for Nickel-Copper Alloy Rod, Bar, and Wire⁴

B 166 Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, and N06690) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Rod, Bar, and Wire⁴

E 1316 Terminology for Nondestructive Examinations⁵

¹ This practice is under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.01 on Radiographic Practice and Penetrators.

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

³ *Annual Book of ASTM Standards*, Vol 02.01.

⁴ *Annual Book of ASTM Standards*, Vol 02.04.

⁵ *Annual Book of ASTM Standards*, Vol 03.03.

3. Terminology

3.1 *Definitions*—The definitions of terms relating to gamma and x-radiology in Terminology E 1316, 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.

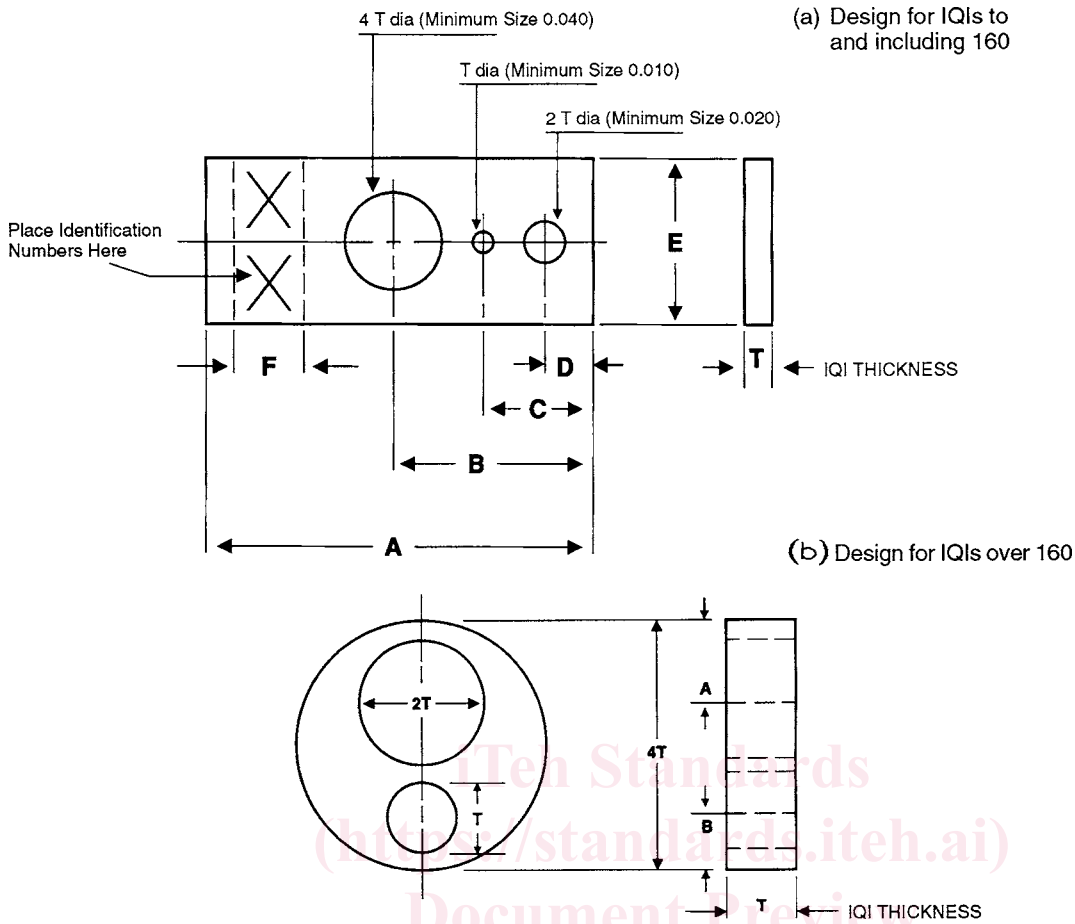
4.1.1.4 Alloy-group identification shall be in accordance with Fig. 2. Rectangular IQI's shall be notched. Image quality indicators (IQI's) shall be vibrotooled or etched as specified.

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.



- 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 ± 0.015	0.750 ± 0.015	0.438 ± 0.015	0.250 ± 0.015	0.500 ± 0.015	0.250 ± 0.030	$\pm 10\%$
5-20	1.500 ± 0.015	0.750 ± 0.015	0.438 ± 0.015	0.250 ± 0.015	0.500 ± 0.015	0.250 ± 0.030	± 0.0005
21-50	± 0.0025
Over 50-160	2.250 ± 0.030	1.375 ± 0.030	0.750 ± 0.030	0.375 ± 0.030	1.000 ± 0.030	0.375 ± 0.030	± 0.005
Over 160	1.330T ± 0.005	0.830T ± 0.005	± 0.010

FIG. 1 IQI Design

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).

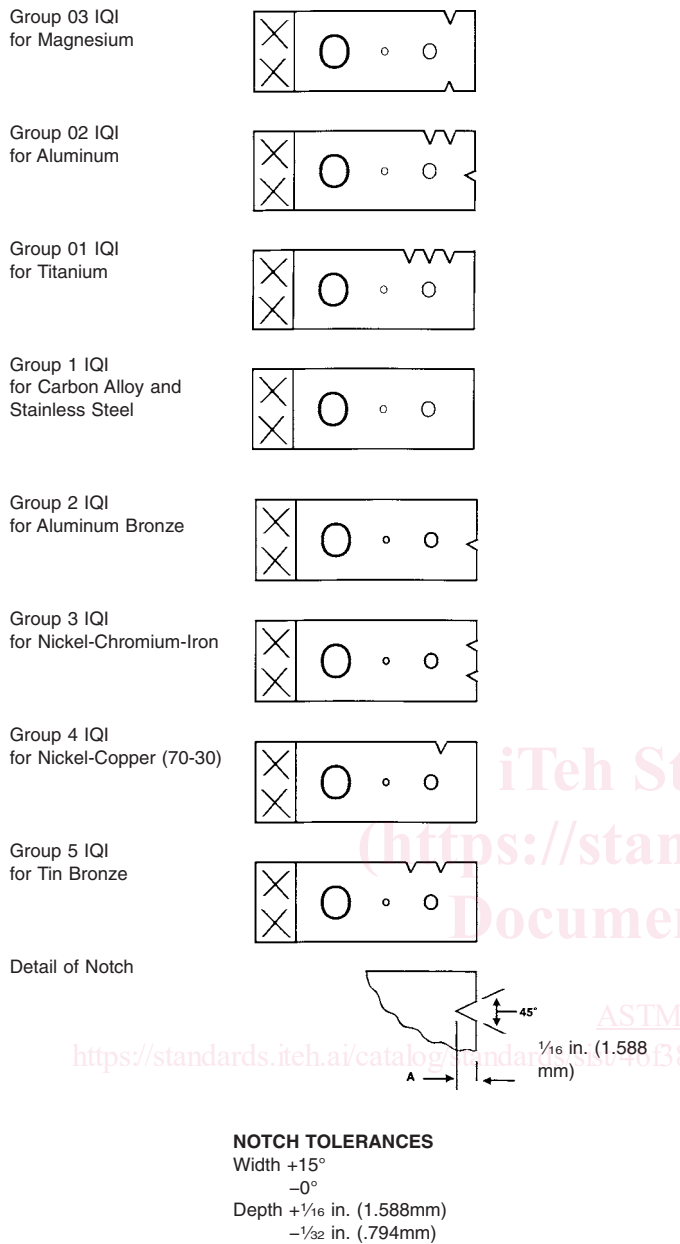


FIG. 2 Rectangular IQI Notch Identification and Material Grouping

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 hole and is expressed as a multiple of the IQI thickness, *T*. The image quality level 2-2*T* 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 2-1*T*, 1-1*T*, and 1-2*T* 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.

7. Material Groups

7.1 General:

7.1.1 Materials have been designated in eight groups based on their radiation absorption characteristics: Groups 03, 02, and 01 for light metals and Groups 1 through 5 for heavy metals.

7.1.2 The light metal groups, magnesium (Mg), aluminum (Al), and titanium (Ti) are identified 03, 02, and 01 respectively for their predominant alloying constituent. The materials are listed in order of increasing radiation absorption.

7.1.3 The heavy metal groups, steel, copper base, nickel base, and kindred alloys are identified 1 through 5. The materials increase in radiation absorption with increasing numerical designation.

NOTE 3—These groups were established experimentally at 180 kV on 3/4 -in. (19-mm) thick specimens. They apply from 125 kV to the multivolt range.

7.1.4 Common trade names or alloy designations have been used for clarification of the pertinent materials.

7.1.5 The materials from which the IQI for the group are to be made are designated in each case, and these IQI's are applicable for all materials listed in that group. In addition, any group IQI may be used for any material with a higher group number, provided the applicable quality level is maintained.

7.2 Identification System:

7.2.1 A notching system has been designated for the eight groups of IQI's and is shown in Fig. 2.

7.2.2 For circular IQI's, a group designation shall be vibro-tooled or chemically etched on the IQI to identify it by using

TABLE 1 Typical Image Quality Levels

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

^AEquivalent IQI sensitivity is that thickness of the IQI, expressed as a percentage of the part thickness, in which the 2*T* hole would be visible under the same conditions.

^BFor Level 2-2*T* Radiologic—The 2*T* hole in an IQI, $\frac{1}{50}$ (2 %) of the specimen thickness, is visible.