Designation: E 2002 – 98 (Reapproved 2003)ε1

Standard Practice for Determining Total Image Unsharpness in Radiology[1]

This standard is issued under the fixed designation E 2002; 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.

ε[1] NOTE—Editorial corrections were made throughout in June 2003.

1. Scope

1.1 This practice covers the design and basic use of a gage used to determine the total image unsharpness of radiographs and radioscopic systems.

1.2 This practice is applicable to radiographic and radioscopic imaging systems utilizing X-ray and gamma ray radiation sources.

1.3 The values stated in SI units are to be regarded as standard.

1.4 The gage described can be used effectively with radiation energies up to 400 kv. When using energies in the megavolt range the results may not be completely satisfactory.

1.5 *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 747 Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology[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 1647 Practice for Determining Contrast Sensitivity in Radioscopy[2]

2.2 *EN Standard:*

EN-462-5:1994 Nondestructive Testing—Image Quality of Radiographs—Part 5: Image Quality Indicators (Duplex Wire Type)—Determination of Total Image Unsharpness Value[3]

3. Terminology

3.1 *Definitions*—Definitions of terms applicable to this practice may be found in Terminology E 1316.

4. Summary of Practice

4.1 When it is determined necessary to evaluate and measure the Total Image Unsharpness (Spatial Resolution) of an imaging system separately and apart from contrast sensitivity measurements, a tool or gage as described in this practice can be used. Conventional IQIs described in Practices E 747 and E 1025 combine the contrast sensitivity and resolution measurements into an overall figure of merit. Such figures of merit may not be adequate to detect subtle changes in the imaging system's performance. For example, in a high-contrast image, spatial resolution can degrade with almost no noticeable effect upon the overall image quality. Similarly, in an application in which the imaging system provides a very sharp image, contrast can fade with little noticeable effect upon the overall image quality, as determined using conventional IQIs. These situations often develop and may go undetected until the system performance deteriorates below acceptable image quality limits.

5. Significance and Use

5.1 The gage is intended to provide a means for measuring total image unsharpness as independently as practicable from the imaging system contrast sensitivity limitations. Further description and details of the gage are provided in EN-462-5.

5.2 The gage can be used in conjunction with a contrast sensitivity measuring gage, as described in Practice E 1647.

6. Gage Construction

6.1 The gage shall be fabricated in accordance with Fig. 1, using the tolerances given in Table 1. This gage is identical to

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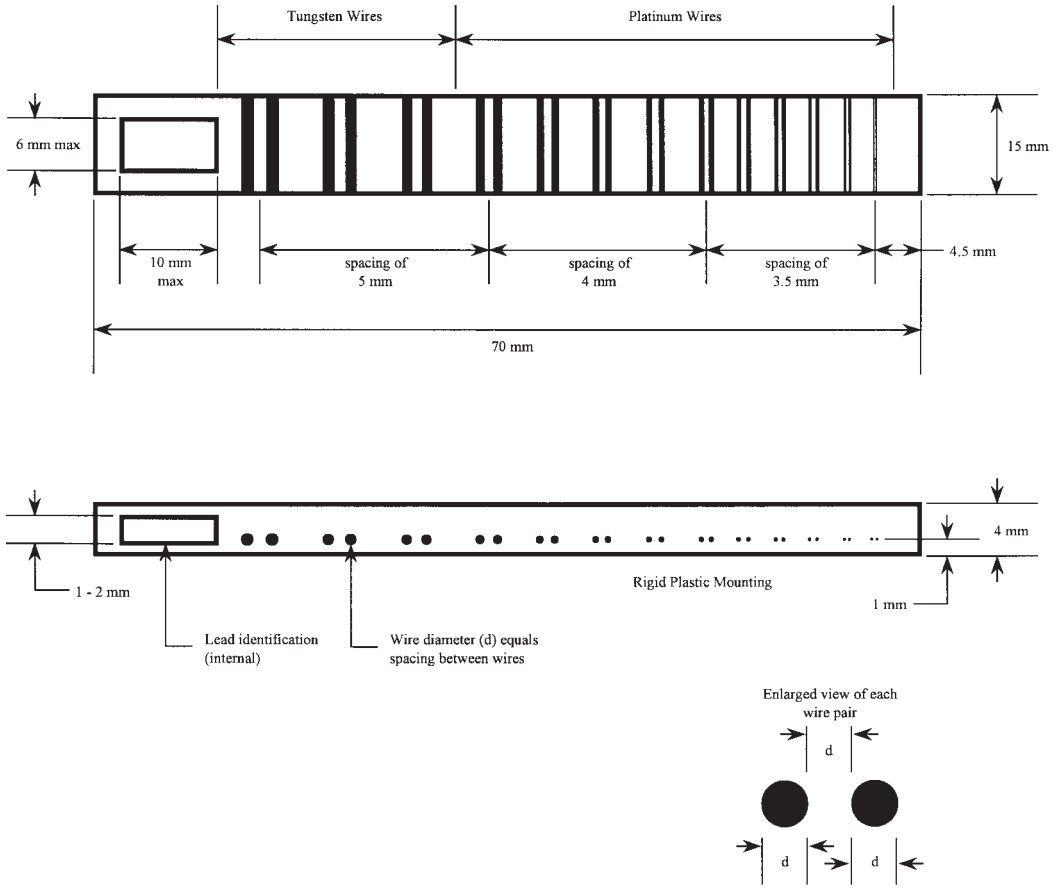
[2] *Annual Book of ASTM Standards*, Vol 03.03.

[3] Available from British Standards Institution, British Standards House, 389 Chiswick High Road, London, W4 4AL United Kingdom.



NOTE 1—Not to Scale.

FIG. 1 Total Image Unsharpness Gage (see EN-462-5)

TABLE 1 Element Number, Corresponding Unsharpness and Wire Diameter[A]

	Element Number	Corresponding Unsharpness (mm)	Wire Diameter and Spacing, *d* (mm)	Tolerance of Wire Diameter and Wire Sparing (mm)
Pt[B]	13	0.10	0.05	
Pt	12	0.13	0.063	
Pt	11	0.16	0.08	±0.005
Pt	10	0.20	0.10	
Pt	9	0.26	0.13	
Pt	8	0.32	0.16	
Pt	7	0.40	0.20	
Pt	6	0.50	0.25	±0.01
Pt	5	0.64	0.32	
Pt	4	0.80	0.40	
W[C]	3	1.00	0.50	
W	2	1.26	0.63	±0.02
W	1	1.60	0.80	

[A] This table is based on data provided in EN 462-5.
[B] Pt = Platinum.
[C] W = Tungsten.

the gage described in EN-462-5 and if necessary, EN-462-5 should be reviewed for additional detailed information.

6.2 The gage shall consist of 13 elements. Each element shall consist of a pair of wires with circular cross-section. Elements 1 through 3 are of tungsten material and elements 4 through 13 are of platinum material. The 13 elements are mounted in a rigid plastic holder.

6.3 The gage shall be identified by marking "EN-462-5." Marking shall be performed by any suitable means.

6.4 The gage manufacturer shall provide a certificate of conformance with each gage.

7. Application

7.1 A radiograph shall be made or an image displayed on a monitor with the gage placed on the source side of the item being examined, or the gage may be placed on a block representing the material and total thickness of the item being examined. The gage should be aligned, as closely as possible, normal to the axis of the radiation beam.

7.2 The image of the gage shall be examined using magnification up to 4×. The largest element, (that is, pair of wires), of which the image has just merged into single form without an identifiable space between the images of the two wires, is taken as the limit of discernibility. The total image unsharpness U_{total} is given as 2d where d is the diameter of the wire and also is the spacing between the pair of wires (see Fig. 1 and Table 1).

7.3 Performance levels of unsharpness of images are relative to the user's applications and shall be specified in the purchaser/supplier agreement.

8. Records

8.1 The results of the image unsharpness measurement should be recorded along with the imaging parameters and maintained as a part of the initial qualification and performance monitoring records for the imaging system. Changes in image unsharpness can be an early indicator of deteriorating imaging system performance.

9. Precision and Bias

9.1 No statement is made about the precision and bias for indicating the total image unsharpness of a imaging system using the gage as described in this practice.

10. Keywords

10.1 contrast sensitivity gage; gamma ray; imaging system; radiation; radiation energy; spatial resolution; total image unsharpness; x-ray