



## Standard Test Method for Determining Relative Image Quality Response of Industrial Radiographic Film<sup>1</sup>

This standard is issued under the fixed designation E 746; 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 test method covers the determination of the relative image quality response of industrial radiographic film when exposed to 200-kV X rays. The evaluation of the film is based upon the threshold visibility of penetrameter holes in a special image quality indicator (IQI). Results for a given film type may vary, depending upon the particular development system used. It is, therefore, necessary to state the development system and geometric conditions used in this determination. By holding the technique parameters (except exposure time) and processing parameters constant, the image quality response of radiographic film may be evaluated on a relative basis.

1.2 Alternately this test method may be used for determination of the relative image quality response of a radiographic film when exposed to 200-KV X-rays as any other single component of the system (such as screens) is varied.

1.3 *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 152 Specification for Copper Sheet, Strip, Plate, and Rolled Bar<sup>2</sup>

#### 2.2 ANSI Standard:

ANSI PH2.8 Sensitometry of Industrial X-ray Films for Energies up to 3 Million Electron Volts<sup>3</sup>

### 3. Test Specimen

3.1 The test specimen shall consist of a special image quality indicator (IQI) placed on the tube side of a 19-mm ( $3/4$ -in.) steel plate.

3.1.1 The special image quality indicator (IQI) shall be fabricated from mild steel. The dimensions shall conform to

Fig. 1. The IQI steps may be fabricated separately and taped together to form the penetrameter array as shown. The tape shall not cover any of the holes in the IQI.

3.1.2 The absorber plate shall be made of mild steel. It shall be at least 200 by 250 mm (8 by 10 in.) and  $19 \pm 0.12$  mm ( $0.750 \pm 0.005$  in.) thick. The surface finish of the absorber plate shall be a maximum of  $6.3 \mu\text{m}$  ( $250 \mu\text{in.}$ )  $R_a$ , ground finish (both faces).

### 4. Calibration of X-Ray Source

4.1 The voltage calibration of the X-ray source is based on ANSI PH2.8. With an 8-mm (0.32-in.) copper filter at the X-ray tube and a target to detector distance of at least 750 mm (29.5 in.), adjust the kilovoltage until the half value layer in copper is 3.5 mm (0.14 in.) (see Specification B 152). Make a reading of the detector with 8 mm of copper at the tube, and then make a second reading with a total of 11.5 mm (0.45 in.) at the tube.

4.2 Calculate the ratio of the two readings. If this ratio is not 2, adjust the kilovoltage up or down and repeat the measurement until a ratio of 2 (within 5 %) is obtained. Record the machine settings and use for the film tests. During tests, remove the 8 mm (0.32 in.) and 3.5 mm (0.14 in.) of copper.

### 5. Film Holder and Screens

5.1 Enclose a single film in a cassette with low absorption. *The cassette shall provide a means for ensuring good film-screen contact.*

5.2 Place the film between lead-foil screens, the front screen being  $0.130 \pm 0.013$  mm ( $0.005 \pm 0.0005$  in.) thick and the back screen  $0.250 \pm 0.025$  mm ( $0.010 \pm 0.001$  in.) thick.

NOTE 1—These thicknesses reflect commercially available tolerances in lead foil for use as radiographic screens.

5.3 When the component to be evaluated is a screen or screen system, other than lead screen as specified in 5.2, place the film in the proper position with the screen or screen system.

5.4 Use a  $6.3 \pm 0.8$  mm ( $1/4 \pm 1/32$  in.) thick lead “backup” behind the cassette. The backup lead shall extend at least 25 mm (1 in.) beyond each edge of the cassette.

### 6. Procedure

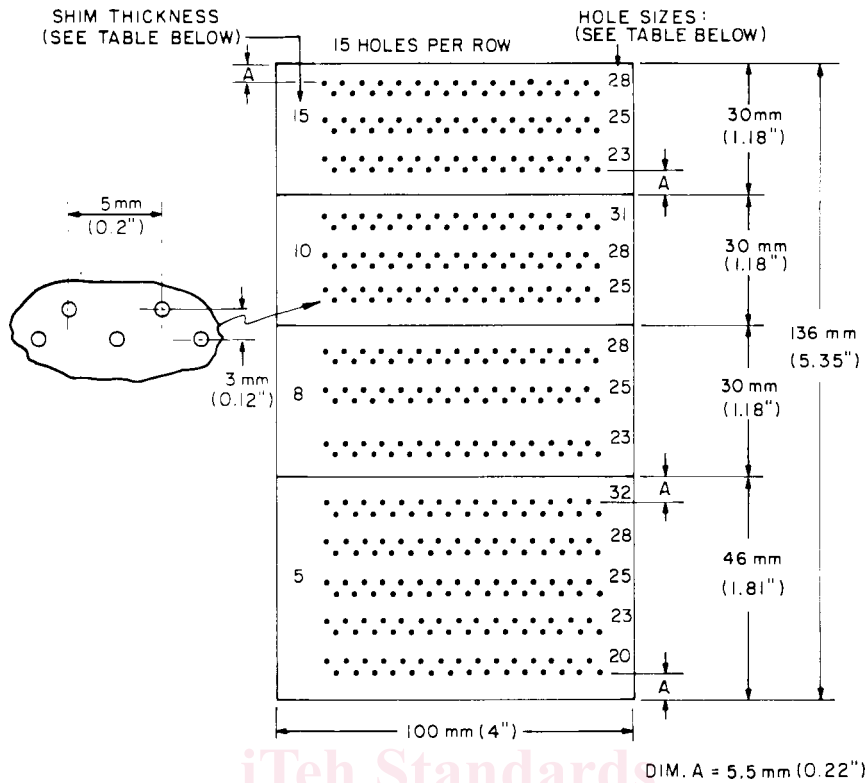
6.1 The sources to film distance is based upon achieving a geometrical unsharpness ( $U_g$ ) of 0.05 mm (0.002 in.) or less on

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.01.

<sup>3</sup> Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.



Step Identification	Shim Thickness, mm (in.)	Hole Identification	Hole Size, mm (in.)
15	0.38 ± 0.012 (0.015 ± 0.0005)	32	0.81 ± 0.025 (0.032 ± 0.001)
10	0.25 ± 0.012 (0.010 ± 0.0005)	31	0.79 ± 0.025 (0.031 ± 0.001)
8	0.20 ± 0.012 (0.008 ± 0.0005)	28	0.71 ± 0.025 (0.028 ± 0.001)
5	0.13 ± 0.012 (0.005 ± 0.0005)	25	0.64 ± 0.025 (0.025 ± 0.001)
		23	0.58 ± 0.025 (0.023 ± 0.001)
		20	0.50 ± 0.025 (0.020 ± 0.001)

Hole Spacing (horizontal): 5 ± 0.1 mm (0.2 ± 0.004 in.) Nonaccumulative  
 Row Spacing: 3 ± 0.1 mm (0.2 ± 0.004 in.)  
 Spacing between hole sets: 5 ± 0.1 mm (0.2 ± 0.004 in.)  
 All other dimensions shall be in accordance with standard engineering practice.

FIG. 1 Image Quality Indicator

a 19-mm (¾-in.) thick absorber plate. Calculate the minimum source to film distance, *D*, in millimetres, as follows:

$$D = 381 \phi$$

where:

*D* = source to film distance, mm, and  
 $\phi$  =  $\phi$  focal spot size, mm.

The distance shall be not less than 1 m (39.4 in.).

6.2 See the physical set up as shown in Fig. 2. Position the X-ray tube directly over the center of the test specimen and film. The plane of the film and test specimen must be normal to the central ray of the X-ray beam. Use a diaphragm at the tube to limit the field of radiation to the film area.

6.3 Exposure:

6.3.1 Expose the film at the kV setting as determined in Section 4. Remove all copper filters at the tube before the exposure. Adjust the exposure time to give a film density of  $2.00 \pm_{0.00}^{0.10}$  in the center of the film as measured with a densitometer calibrated with a density step wedge traceable to National Institute of Standards and Technology, (NIST).

6.3.2 Make three separate exposures using the same film cassette each time.

6.3.3 Identify the film number, type, exposure, and other technique data by means of lead letters, or numerals, placed in the upper righthand corner of the steel plate. Do not place so as to interfere with the image of the holes in the IQI. Make these identification symbols as small and unobtrusive as possible. Record this identification number on the data sheet for this exposure (see Section 7).

6.3.4 In order to minimize any effects caused by latent image instability, process the exposed film not more than 8 h after exposure.

6.4 Processing—The image quality response of the film may vary with the processing variables such as chemistry, temperature, and method of processing (manual or automatic). The solutions must be fresh and properly seasoned (see 6.4.1).

6.4.1 Automatic Processing—Use industrial X-ray processing solutions in the tests. Keep a record of:

- 6.4.1.1 The brand name of the processor.
- 6.4.1.2 The length of time (±1 s) that the film is in the developer, that is, leading edge in to leading edge out.
- 6.4.1.3 The brand name of the developer, including the “starter,” the temperature measured to within 0.5°C, and the rate