



Standard Reference Radiographs for Appearances of Radiographic Images as Certain Parameters Are Changed¹

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1. Scope

1.1 This document describes the appearance of a radiographic image where fundamental components of image quality are changed, that is, variables such as whether a X-ray or gamma ray source was used, the characteristics of the radiographic film and intensifying screens, and the geometrical configuration of the object under investigation as well as its associated radiographic set-up.

1.2 These reference radiographs² consist of four composite illustrations³ and show how such factors as radiation energy, specimen thickness, and film properties affect the radiographic image.

1.3 The values stated in inch-pound units are to be regarded as the 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:

- E 94 Guide for Radiographic Testing⁴
- E 746 Test Method for Determining Relative Image Quality Response of Industrial Radiographic Film⁴
- E 1316 Terminology for Nondestructive Examinations⁴

2.2 ASTM Adjuncts:

- Reference Radiographs for Appearances of Radiographic Images as Certain Parameters Are Changed³

3. Terminology

3.1 *Definitions:* For definitions of terms used in this document, see Terminology E 1316, Section D.

¹ These reference radiographs are under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing and are the direct responsibility of Subcommittee E 07.02 on Reference Radiographs.

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² For ASME Boiler and Pressure Code applications see related Reference Radiographs SE-242 in the Code.

³ Available from ASTM Headquarters. Order PCN 17-502420-22.

⁴ *Annual Book of ASTM Standards*, Vol 03.03.

4. Significance and Use

4.1 A key consideration with any radiographic system is its capability to resolve detail (that is, sensitivity). The degree of obtainable sensitivity with a given system is dependent upon several radiographic parameters such as source energy level, film type, type and thickness of intensifying screens, and material thickness radiographed. These reference radiographs permit the user to estimate the degree of sensitivity change that may be obtained when these parameters are varied from a specific technique. This standard may also be used in conjunction with Test Method E 746 to provide a basis for developing data for evaluation of a user's specific system. This data may assist a user in determining appropriate parameters for obtaining desired degrees of radiographic system sensitivity.

5. Factors Affecting Radiographic Appearance

5.1 The final interpretation of the radiograph is greatly affected by the appearance of a discontinuity. A poor technique can minimize the radiographic appearance of a discontinuity and conversely the optimum technique can emphasize this appearance. The appearance of a radiographic image is affected mainly by:

- 5.1.1 X-ray or gamma ray energy.
- 5.1.2 Section thickness,
- 5.1.3 Unsharpness, and
- 5.1.4 Film and screen combinations.

5.2 The equation that considers most of the above factors is:

$$\Delta x = [c(d_1 - d_2)/G\mu](kx + 1) \quad (1)$$

where:

- Δx = thickness of discontinuity,
- c = constant,
- $d_1 - d_2$ = minimum density change perceptible by eye,
- G = film gradient,
- μ = linear absorption coefficient (effective),
- k = scattering coefficient, and
- x = section thickness.

As the above equation shows, the minimum thickness of detectable discontinuity (Δx) is:

- 5.2.1 A function of X-ray energy,
- 5.2.2 A function of section thickness, and
- 5.2.3 An inverse function of film gradient.

5.3 Although not clearly indicated by the above relation, the