



Standard Test Method for Radiographic Examination of Weldments¹

This standard is issued under the fixed designation E 1032; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method provides a uniform procedure for radiographic examination of weldments using industrial radiographic film. Requirements expressed in this method are intended to control the quality of the radiographic images and are not intended for controlling acceptability or quality of welds.

1.2 The radiographic extent, the quality level, and the acceptance criteria to be applied shall be specified in the contract, purchase order, product specification, or drawings.

1.3 The radiographic test method is highly sensitive to detection of volumetric discontinuities. The radiographic techniques stated herein provide adequate assurance for defect detectability; however, it is recognized that, for special applications, specific techniques using more stringent requirements may be required to provide additional detection capability. The use of specific radiographic techniques shall be agreed upon between purchaser and supplier.

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.* (For more specific safety precautionary information, see Section 7.)

2. Referenced Documents

2.1 ASTM Standards:

- E 94 Guide for Radiographic Testing²
- E 242 Reference Radiographs for Appearances of Radiographic Images as Certain Parameters are Changed²
- E 390 Reference Radiographs for Steel Fusion Welds²
- E 543 Practice for Evaluating Agencies that Perform Non-destructive Testing²
- E 746 Test Method for Determining Relative Image Quality Response of Industrial Radiographic Film²
- E 747 Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology²
- E 999 Guide for Controlling the Quality of Industrial Ra-

diographic Film Processing²

E 1025 Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology²

E 1316 Terminology for Nondestructive Examinations²

2.2 ASNT Standards:

Recommended Practice No. SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing³
ANSI/ASNT-CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel³

2.3 Military Standard:

MIL-STD-410 Nondestructive Testing Personnel Qualification and Certification⁴

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, see Terminology E 1316.

4. Basis of Application

4.1 *Personnel Qualification*—Nondestructive testing (NDT) personnel shall be qualified in accordance with a nationally recognized NDT personnel qualification practice or standard such as ANSI/ASNT-CP-189, SNT-TC-1A, MIL STD-410, or a similar document. The practice or standard used and its applicable revision shall be specified in the contractual agreement between the using parties.

4.2 *Qualification of Nondestructive Agencies*—If specified in the contractual agreement, NDT agencies shall be qualified and evaluated in accordance with Practice E 543. The applicable edition of Practice E 543 shall be specified in the contractual agreement.

4.3 *Time of Examination*—The time of examination shall be in accordance with 8.1 unless otherwise specified.

4.4 *Procedures*—The procedures to be utilized shall be as described in 7.1.

4.5 *Extent of Examination*—The extent of the examination shall be in accordance with 7.2.

4.6 *Reporting Criteria/Acceptance Criteria*—Reporting criteria of the examination results shall be in accordance with Section 11.

4.7 *Reexamination of Repaired or Reworked Items*—

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

³ Available from American Society for Nondestructive Testing (ANST), 1711 Arlingate Lane, P.O. Box 28518, Columbus, OH 43228-0518.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

Reexamination of repaired or reworked items is not addressed in this test method and if required shall be specified in the contractual agreement.

4.8 *Radiographic Quality Level*—The radiographic quality level shall be in accordance with 5.6.

5. Apparatus

5.1 *Radiation Source (X-Ray or Gamma-Ray)*—Selection of the appropriate source is dependent upon variables regarding the weld being examined (material composition and thickness). The suitability of the source shall be demonstrated by attainment of the required IQI sensitivity and compliance with all other requirements stipulated herein (film density and area of interest density tolerances, etc.).

5.2 *Film Holders and Cassettes*—Film holders and cassettes shall be light tight and shall be handled properly to reduce the likelihood that they may be damaged. They may be flexible vinyl, plastic, or other durable material, or they may be made from metallic materials. In the event that light leaks into the film holder and produces images on the radiograph, the radiograph need not be rejected unless the images encroach on the radiographic area of interest. If the film holder exhibits light leaks, it shall be repaired before reuse or discarded. Film holders and cassettes should be routinely examined to minimize the likelihood of light leaks.

5.3 *Intensifying Screens:*

5.3.1 *Metallic Screens:*

5.3.1.1 Intensifying screens of the lead-foil type are generally used for production radiography. Screens shall be of the same approximate dimensions as the film being used and shall be in direct intimate contact with the film during exposure.

5.3.1.2 For X-ray voltages between 200 kV and 1 MeV, front- and rear-screen thicknesses should be a minimum of 0.005 in. thick. Below 200 kV, screen thicknesses up to 0.005 in. should be used if they improve radiographic quality. For isotope and high-voltage X radiography (greater than 1 MeV) increased thicknesses may be appropriate for improvements in radiographic quality and should be used accordingly. When double-load exposures are made, intermediate screens (between film) may be used if desired.

5.3.2 *Fluorescent or Fluorometallic Screens*—Such screens may be used; however, they must be capable of demonstrating the required IQI sensitivity.

5.3.3 *Screen Care:*

5.3.3.1 All screens should be handled carefully to avoid dents, scratches, grease, or dirt on active surfaces. Screens that render nonrelevant indications on radiographs shall be visually examined and discarded if physical damage is observed.

5.3.3.2 Screens, with or without backing, shall be free of dust, dirt, oxidation, or any other foreign material that render undesirable nonrelevant images on the film.

5.4 *Filters*—Filters shall be used whenever the contrast reductions caused by low energy, scattered radiation, or the extent of undercut (edge burn-off) occurring on production radiographs is of significant magnitude to cause difficulty in meeting the quality level or radiographic coverage requirements stipulated by the job order or contract (see Guide E 94).

5.5 *Masking*—Masking material may improve radiographic quality (see Guide E 94).

5.6 *IQI's (Penetrators)*—Unless otherwise specified by the applicable job order or contract, only those IQI's that comply with the design and identification requirements specified in Practice E 1025 or Practice E 747 shall be used.

5.7 *Shims, Separate Blocks, or Like Sections*—Shims, separate blocks, or like sections made of the same or radiographically similar materials (as defined in Practice E 1025) may be used to facilitate IQI positioning. There is no restriction on shim or separate block maximum thickness, provided the IQI and area-of-interest density variation requirements of 8.8.2 are met. The like section should be geometrically similar to the object being radiographed.

5.8 *Radiographic Location and Identification Markers*—Lead numbers and letters are used to designate the part number and location number. The size and thickness of the markers shall depend on the ability of the radiographic technique to discern the markers on the radiograph. As a general rule, markers $\frac{1}{16}$ in. thick will suffice for most low energy (less than 1 MeV) X ray and Iridium 192 radiography; for higher energy radiography it may be necessary to use markers that are thicker ($\frac{1}{8}$ in. thick or more).

5.9 *Radiographic Density Measurement Apparatus*—Either a transmission densitometer or a step-wedge comparison film shall be used for judging film-density requirements. Step-wedge comparison films or densitometers calibration, or both, shall be verified by comparison with a calibrated step-wedge film traceable to the National Institute of Standards and Technology. Where applicable, a film digitization and analysis system may be substituted for a transmission densitometer provided the film digitization and analysis system has been calibrated and verified by comparison with a calibrated step-wedge film traceable to the National Institute of Standards and Technology.

6. Materials

6.1 *Films*—Selections of film type should be determined by such factors as the required radiographic quality level, equipment capability, materials, etc. The films selected must be capable of demonstrating the required image quality indicator (IQI) sensitivity.

NOTE 1—Test Method E 746 provides a system for determining the relative image quality response of industrial radiographic film using an IQI.

7. Requirements

7.1 *Procedure Requirement*—Unless otherwise specified by the applicable job order or contract, radiographic examination shall be performed in accordance with a written procedure. Specific requirements regarding the preparation and approval of the written procedures shall be dictated by purchaser and supplier agreement. The production procedure shall address all applicable portions of this document and shall be available for review during interpretation of the radiographs.

7.2 *Radiographic Coverage*—Unless otherwise specified by purchaser and supplier agreement, the extent of radiographic coverage shall include 100 % of the volume of the weld.

7.3 *Radiographic Film Quality*—All radiographs shall be free of mechanical, chemical, handling-related, or other blemishes which could mask or be confused with the image of any