



Standard Method for Controlling Quality of Radiographic Testing¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This method² covers the radiographic testing of materials for internal discontinuities, and also the use of film and other recording media. Requirements expressed in this method are intended to control the reliability or quality of the radiographic images, and are not intended for controlling the acceptability or quality of materials or products.

1.2 The number of areas or parts to be radiographed and the acceptance standard to be applied shall be specified in the contract, purchase order, product specification, or drawings. The quality level required for radiography shall be at least 2 % (2-2T), unless a higher or lower quality is agreed upon by the purchaser and the supplier.

NOTE 1—For additional information, refer to Guide E 94, Test Methods E 1030 and E 1032.

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 problems, 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 specific safety precautionary information see Section 15.)*

2. Referenced Documents

2.1 ASTM Standards:

E 94 Guide for Radiographic Testing³

E 1025 Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology³

E 1030 Test Method for Radiographic Examination of Metallic Castings³

E 1032 Test Method for Radiographic Examination of Weldments³

E 1079 Practice for Calibration of Transmission Densitometers³

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² For ASME Boiler and Pressure Vessel Code Applications see Section V, Article 22 of Method SE-142.

³ *Annual Book of ASTM Standards*, Vol 03.03.

E 1316 Terminology for Nondestructive Examinations³

3. Terminology

3.1 *Definitions*— Refer to Terminology E 1316 for other terms used in this method.

4. Direction of Radiation

4.1 When not otherwise specified, the direction of the central beam of radiation shall be perpendicular, wherever possible, to the surface of the film.

5. Penetrators

5.1 The quality of all levels of radiographic testing shall be determined by a penetrator that conforms to the requirements of Practice E 1025.

6. Placement of Penetrators

6.1 Penetrators shall be placed on the source side of the section being examined and should be placed so that the plane of the penetrator is normal to the radiation beam. If this is not practicable, placement of the penetrator on a block is acceptable provided the block is of radiographically similar material, is placed as close as possible to the item being examined, and the resulting radiographic density of the block image is within prescribed penetrator/area of interest density variation tolerances.

6.2 When radiographing welds, the penetrators shall be placed on the source side adjacent to the weld being radiographed. When weld reinforcement or protruding backing ring is not removed, a shim of the same type of metal as the parent metal shall be placed under the penetrator to provide the same thickness of material under the penetrator as the average thickness through the weld. Shims shall exceed the penetrator dimensions such that the outline of at least three sides of the penetrator image shall be visible on the radiograph and the shimmed penetrator shall be placed so as not to overlap the backing strip or ring.

6.3 When examining double-walled parts such as piping or duct with a radiation source outside the pipe, the penetrator shall be placed, where practicable, on the outside of the pipe alongside the weld nearest the source of radiation.

6.3.1 In cases where placement of the penetrator on the source side is impracticable, the penetrator may be placed on the film side if one of the following conditions is met.

6.3.2 The radiographic technique shall be demonstrated with the applicable penetrameter placed on the source side and a continuous series of penetrameters placed on the film side of a like pipe section. The series of penetrameters shall range in thickness from 2 % to 0.5 % of the material thickness. If the penetrameter on the source side indicates the required sensitivity, the image of the smallest penetrameter hole visible on the film side shall be used to determine the penetrameter and penetrameter hole which shall be used on production radiographs.

6.3.3 When radiographing welds in which only the portion of the weld next to the film is viewed, the radiographic technique shall be demonstrated on a similar pipe section with the applicable penetrameters placed on the inside along the root of the weld, and a series of penetrameters, chosen as in 6.3.2, placed on the film side. If the penetrameter on the source side indicates the required sensitivity, the image of the smallest penetrameter hole visible on the film side shall be used to determine the penetrameter and penetrameter holes which shall be used on production radiographs.

6.4 In the inspection of irregular objects, the penetrameter shall be placed on the part of the object farthest from the film.

6.5 When shims are used with penetrameters in the radiography of welds, or when the penetrameters are placed on separate blocks, the shims or blocks may be made of any material in the pertinent materials group. For materials not categorized, the shims or blocks may be made of the penetrameter material or of material of similar specification analysis as the material being radiographed.

6.6 It is the intent of the foregoing stipulations for shims and separate blocks that wrought materials may be used for these items when castings or welds are being radiographed. This is to permit equitable evaluation of the penetrameter where diffraction effects may be encountered in the radiography of some cast or weld deposit materials.

7. Number of Penetrameters

7.1 One penetrameter shall represent an area within which radiographic densities do not vary more than -15% or $+30\%$ (Note 2). At least one penetrameter per radiograph, exposed simultaneously with the specimen, shall be used except as noted in 7.1.1 and 7.1.2 (Note 3). The radiographic density of the penetrameter shall be measured through the body of the penetrameter.

7.1.1 When film density varies more than -15% or $+30\%$ from that through to the penetrameter, two penetrameters used in the following manner will be satisfactory. If one penetrameter shows an acceptable sensitivity at the most dense portion of the radiograph and the second penetrameter, placed in accordance with Section 6, shows an acceptable sensitivity at the least dense portion of the radiograph, these two penetrameters will serve to qualify the radiograph.

7.1.2 *Simultaneous Exposures*—When a part or parts of the same design are exposed simultaneously under the same geometrical conditions in a 360° radiation beam, a minimum of one penetrameter shall be required in each quadrant.

NOTE 2—Radiographic densities may be measured by Practice E 1079. When films are exposed simultaneously in one film holder, density variations should be determined on the single or superimposed films, referred to the manner in which they are interpreted.

NOTE 3—For parts of irregular geometry or widely varying thickness, it may be necessary to radiograph the first unit of a given design to determine proper placement of penetrameters for subsequent radiography.

8. Location of Markers

8.1 The image of the location markers for the coordination of the part with the film shall appear on the film, without interfering with the interpretation, with such an arrangement that it is evident that complete coverage was obtained. These marker positions shall be marked on the part, and the position of the markers shall be maintained on the part during radiography.

9. Identification of Radiograph

9.1 A system of positive identification of the film shall be provided. Any or all of the following may appear: the name of the inspecting laboratory, the date, the part number, the view, and whether original or subsequent exposure.

10. Multiple Film Techniques

10.1 Film techniques with two or more films of equal or different speeds in the same holder will be permitted provided that the appropriate penetrameter sensitivity for a specific area is demonstrated.

11. Non-Film Techniques

11.1 The use of non-film imaging techniques will be permitted provided that the applicable penetrameter sensitivity is demonstrated in the resultant image.

12. Image Quality

12.1 The radiographic image shall be free of blemishes which interfere with its interpretation.

13. Source-Film Distance

13.1 Any source-film distance will be satisfactory provided that the required quality level is attained.

14. Records

14.1 Complete records of the technique details shall accompany the radiographs and shall be maintained by the inspecting laboratory.

15. Safety Precautions

15.1 Radiographic procedure shall be carried out under protected conditions so that the radiographer will not receive a maximum whole body radiation dosage exceeding that permitted by city, state, or national codes.

16. Keywords

16.1 penetrameters (IQI's); radiographic examination; radiography; quality level

 **E 142**

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