



Designation: **E592 – 99 (Reapproved 2009)^{ε1} E592 – 15**

Standard Guide to Obtainable ASTM Equivalent Penetrameter Sensitivity for Radiography of Steel Plates 1/4 to 2 in. (6 to 51 mm) Thick with ~~X Rays~~ X-Rays and 1 to 6 in. (25 to 152 mm) Thick with Cobalt-60¹

This standard is issued under the fixed designation E592; 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.

~~^{ε1} NOTE—Reapproved with editorial changes in June 2009.~~

1. ~~Scope~~ Scope*

1.1 This guide to obtainable equivalent penetrameter sensitivity covers the minimum penetrameter thicknesses for which the image of the 1T and 2T holes is visible for a few practical radiographic conditions. The values represent near optimum sensitivity for flat steel plates. Radiographic conditions that give higher values of scatter buildup from the specimen or backscattered radiation at the image plane will give poorer sensitivity.

1.2 Eight radiographs that illustrate sensitivities obtainable with practical radiographic systems are included as adjuncts to this guide and may be obtained from ASTM.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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:²

[E746 Practice for Determining Relative Image Quality Response of Industrial Radiographic Imaging Systems](#)

[E999 Guide for Controlling the Quality of Industrial Radiographic Film Processing](#)

[E1025 Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators \(IQI\) Used for Radiology](#)

[E1316 Terminology for Nondestructive Examinations](#)

[E1742 Practice for Radiographic Examination](#)

[E1735 Test Method for Determining Relative Image Quality of Industrial Radiographic Film Exposed to X-Radiation from 4 to 25 MeV](#)

[E1815 Test Method for Classification of Film Systems for Industrial Radiography](#)

2.2 ISO Standard:

[ISO 7004 Photography—Industrial Radiographic Films—Determination of ISO Speed, ISO Average Gradient, and ISO Gradients G2 and G4 When Exposed to X- and Gamma-Radiation³](#)

2.3 Military Standard:

~~[MIL-STD-271 Nondestructive Testing Requirements for Metals⁴](#)~~

[NAVSEA Technical Publication ~~T9074-AS-Gib-010/271~~ T9074-AS-GIB-010/271 Requirements for Nondestructive Testing Methods](#)

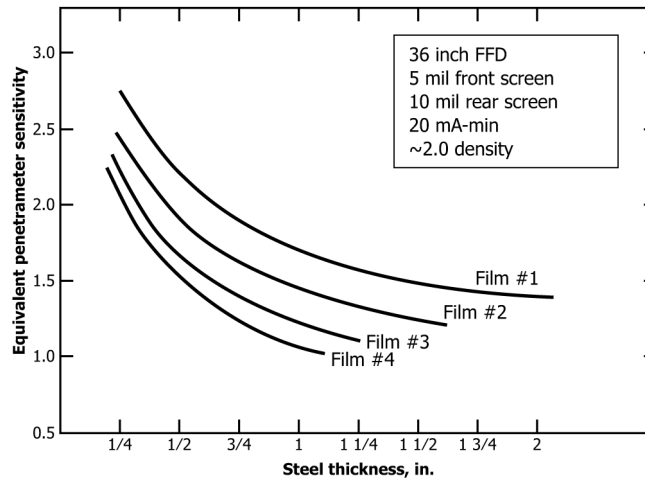
¹ This guide is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.02 on Reference Radiological Images.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

*A Summary of Changes section appears at the end of this standard



NOTE 1—See 5.1.3.1.4 for exposure conditions.

FIG. 1 Obtainable Penetrameter Sensitivity for 1/4 to 2-in. (6 to 51-mm) Thick Steel When Radiographing with X-Rays-X-Rays.

2.4 ASTM Adjuncts:

Guide for Equivalent Penetrameter Sensitivity Between X-Rays-X-Rays and Cobalt-60⁴

3. Terminology

3.1 Definitions: For definitions of terms used in this standard, refer to Terminology E1316, Section D.

4. Significance and Use

4.1 A key consideration with any radiographic system is its capability to resolve detail contrast resolution and spatial resolution capability (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, system class, type and thickness of intensifying screens, exposure (density), etc. This guide permits the user to estimate the degree of sensitivity that may be obtained with X-rays-X-rays and cobalt-60 gamma rays when using a prescribed set of radiographic parameters. This guide may also be used in conjunction with Test Method Methods E746 or E1735 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. An alternate to this approach is the use of those adjunct radiographic illustrations detailed in Section 6.

5. Procedure

5.1 Sensitivity for 1/4 to 2-in. (6 to 51-mm) Thick Steel Using X-Rays-X-Rays:

5.1.1 The values of sensitivity were determined from a statistical study of visibility of images of penetrameter holes. Near 100 % certainty of seeing the image of a hole on any radiograph was taken as the criterion for determining sensitivity. Most radiographs will show slightly better sensitivity than indicated in Figs. 1-3 because of the statistical nature of recording information from a beam of X-rays-X-rays but occasionally, one will not show quite as good sensitivity.

5.1.2 Equivalent Penetrameter Sensitivity (EPS) is defined in Eq 1. For a full discussion of EPS see Appendix X1 of Practice E1025.

$$EPS, \% = 70.7 (dT)^{1/2}t \tag{1}$$

where:

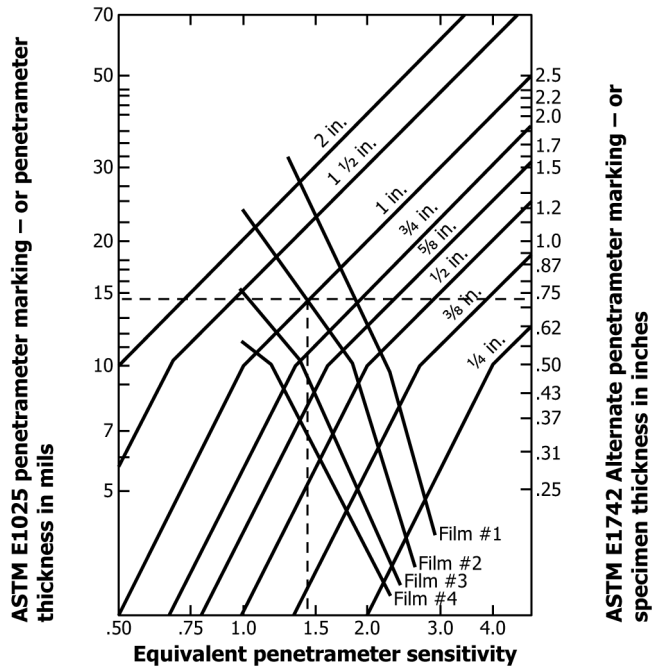
- d = diameter of penetrameter hole,
- T = thickness of penetrameter, and
- t = specimen thickness.

A clear definition of equivalent penetrameter sensitivity has not been established for penetrameters less than 10 mils (0.25 mm) thick. For this work it was calculated as in Eq 1. The change in slope of the steel thickness curves on Fig. 2 and Fig. 3 is a result of the established 10-mil minimum hole diameter in Practice E1025 and Practice E1742, Appendix A1.

5.1.3 Fig. 1 illustrates obtainable equivalent penetrameter sensitivity (see Appendix X1 of Practice E1025) for four X-ray films. The films are identified by reciprocal roentgen speed-speed (see Test Method E1815) when exposed in accordance with ISO 7004 in a 200-kV range, and processed in accordance with the manufacturer’s recommendations (see Guide E999).

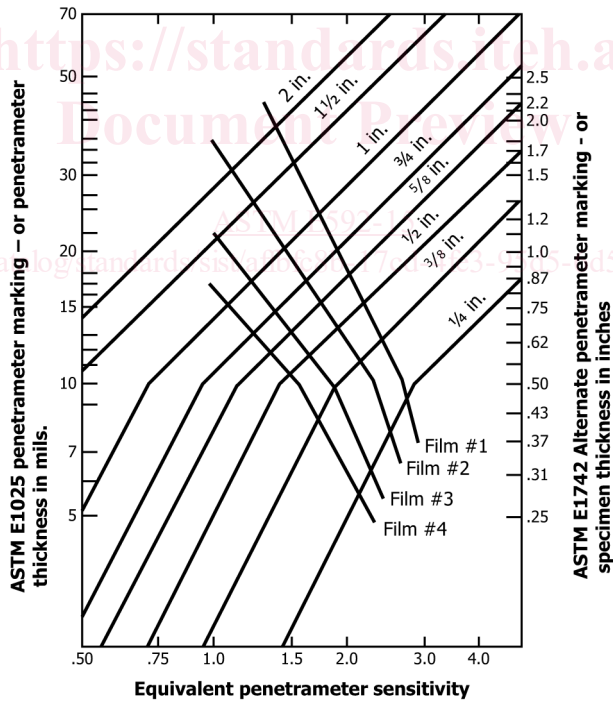
⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

⁴ Available from ASTM Headquarters. Order RRE0592.



NOTE 1—See 5-1.35.1.4 for exposure conditions.

FIG. 2 Penetrator Sensitivity and Minimum Penetrator Markings for Showing the 2T Hole When Radiographing 1/4 to 2-in. (6 to 51-mm) Thick Steel with X-Rays.



NOTE 1—See 5-1.35.1.4 for exposure conditions.

FIG. 3 Penetrator Sensitivity and Minimum Penetrator Markings for Showing the 1T Hole When Radiographing 1/4 to 2-in. (6 to 51-mm) Thick Steel with X-Rays.

| Film No. | Speed |
|----------|-------|
| 1 | 17 |
| 2 | 4.0 |
| 3 | 1.2 |
| 4 | 0.35 |