



Standard Test Method for Measurement of Coating Thickness by X-Ray Spectrometry¹

This standard is issued under the fixed designation B568; 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.

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

1. Scope

1.1 This test method covers the use of X-ray spectrometry to determine thickness of metallic and some nonmetallic coatings.

1.2 The maximum measurable thickness for a given coating is that thickness beyond which the intensity of the characteristic secondary X radiation from the coating or the substrate is no longer sensitive to small changes in thickness.

1.3 This test method measures the mass of coating per unit area, which can also be expressed in units of linear thickness provided that the density of the coating is known.

1.4 Problems of personnel protection against radiation generated in an X-ray tube or emanating from a radioisotope source are not covered by this test method. For information on this important aspect, reference should be made to current documents of the National Committee on Radiation Protection and Measurement, Federal Register, Nuclear Regulatory Commission, National Institute of Standards and Technology (formerly the National Bureau of Standards), and to state and local codes if such exist.

1.5 *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

E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials

2.2 International Standard:

ISO 3497 Metallic Coatings—Measurement of Coating Thickness—X-ray Spectrometric Methods

¹ This test method is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.10 on Test Methods.

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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. Terminology

3.1 Definitions of technical terms used in this test method may be found in Terminology **E135**.

4. Summary of Test Method

4.1 *Excitation*—The measurement of the thickness of coatings by X-ray spectrometric methods is based on the combined interaction of the coating and substrate with incident radiation of sufficient energy to cause the emission of secondary radiations characteristic of the elements composing the coating and substrate. The exciting radiation may be generated by an X-ray tube or by certain radioisotopes.

4.1.1 *Excitation by an X-Ray Tube*—Suitable exciting radiation will be produced by an X-ray tube if sufficient potential is applied to the tube. This is on the order of 35 to 50 kV for most thickness-measurement applications. The chief advantage of X-ray tube excitation is the high intensity provided.

4.1.2 *Excitation by a Radioisotope*—Of the many available radioisotopes, only a few emit gamma radiations in the energy range suitable for coating-thickness measurement. Ideally, the exciting radiation is slightly more energetic (shorter in wavelength) than the desired characteristic X rays. The advantages of radioisotope excitation include more compact instrumentation essentially monochromatic radiation, and very low background intensity. The major disadvantage of radioisotope excitation is the much lower intensities available as compared with X-ray tube sources. X-ray tubes typically have intensities that are several orders of magnitude greater than radioisotope sources. Due to the low intensity of radioisotopes, they are unsuitable for measurements on small areas (less than 0.3 mm in diameter). Other disadvantages include the limited number of suitable radioisotopes, their rather short useful lifetimes, and the personnel protection problems associated with high-intensity radioactive sources.

4.2 *Dispersion*—The secondary radiation resulting from the exposure of an electroplated surface to X radiation usually contains many components in addition to those characteristic of the coating metal(s) and the substrate. It is necessary, therefore, to have a means of separating the desired components so that their intensities can be measured. This can be done either by diffraction (wavelength dispersion) or by electronic discrimination (energy dispersion).