



Standard Practice for the Performance Evaluation of the Portable X-Ray Fluorescence Spectrometer for the Measurement of Lead in Paint Films¹

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1. Scope

1.1 This practice covers portable x-ray fluorescence (XRF) instruments intended for the measurement of lead in paint. It is intended that manufacturers apply this practice to one unit of a particular model of an instrument when that model is initially available. Replicate tests on additional units of the same model of an instrument are to be performed at the discretion of the manufacturer. This practice also is intended for use by third parties performing independent evaluation of portable x-ray fluorescence instruments.

1.2 All performance evaluation data are to be in International System of Units (SI) units.

1.3 Tests of performance are based on replicate measurements of certified reference paint films on a variety of substrate materials. Tests are performed to determine: bias, precision, linearity, limit of detection, interferences, substrate affects, and stability.

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:

D 3332 Test Methods for Mechanical Shock Fragility of Products, Using Shock Machines²

E 344 Terminology Relating to Thermometry and Hydrometry³

E 456 Terminology Relating to Quality and Statistics⁴

E 1605 Terminology Relating to Abatement of Hazards from Lead-Based Paint in Buildings and Related Structures⁵

2.2 ANSI Standards:

American National Standard N538–1979, “Classification of Industrial Ionizing Radiation Gauging Devices”⁶

American National Standard N542–1977, “Sealed Radioactive Sources, Classification”⁶

2.3 Underwriters Laboratory Standards:

Underwriters Laboratory Standard 544, “Medical and Dental Equipment”⁷

Underwriters Laboratory Standard 3101–1, “Chemical Analyzers”⁷

3. Terminology

3.1 Definitions:

3.1.1 *accuracy, n*—the theoretical maximum error of a measurement, expressed as the proportion of the amount being measured without regard for the direction of the error, that is achieved with a given probability (typically 0.95) by the method.⁸

3.1.2 *bias, n*—the discrepancy between the mean of the distribution of measurements from a method and the true concentration being measured.

3.1.3 *limit of detection, n*—the smallest (true) signal that will be detected with a probability $1 - \beta$ (β is the probability of an error of the second kind, failing to decide that a substance is present when it is), where the a posteriori decision mechanism has a built-in protection level, α (α is the probability of an error of the first kind, deciding that the substance is present when it is not), against falsely concluding that a blank observation represents a “real” signal. The β and α terms typically are 5 % or 1 %, depending on the requirements of the testing program.⁹

3.1.4 *precision, n*—the closeness of agreement between repetitive test results obtained under prescribed conditions (see

¹ This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.23 on Abatement of Hazards from Lead in Buildings and Related Structures.

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² *Annual Book of ASTM Standards*, Vol 15.09.

³ *Annual Book of ASTM Standards*, Vol 14.03.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ *Annual Book of ASTM Standards*, Vol 04.11.

⁶ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

⁷ Available from Underwriters Laboratories, Inc., Research Triangle Park, NC.

⁸ Kennedy, E.R., T.J. Fischbach, R. Song, P.M. Miller, and S.A. Shulman, *Guidelines for Air Sampling and Analytical Method Development and Evaluation* DHHS (NIOSH) Publication No. 95–117. National Institute for Occupational Safety and Health, Cincinnati, OH 45226, May 1995.

⁹ Currie, L.A., “Limits for Qualitative Detection and Quantitative Determination,” *Anal. Chem.*, 40 (3), pp. 586–593, 1968.