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Standard Guide for Selecting Components for Wavelength-Dispersive X-Ray Fluorescence (XRF) Systems[1]

This standard is issued under the fixed designation C 1118; 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.

1. Scope

1.1 This guide describes the components for a wavelength-dispersive X-ray fluorescence system for materials analysis. This guide can be used as a reference in the apparatus section of test methods for wavelength-dispersive X-ray fluorescence (XRF) analyses of nuclear materials.

1.2 The components recommended include X-ray detectors, signal processing electronics, excitation sources, and dispersing crystals.

1.3 Detailed data analysis procedures are not described or recommended, as they may be unique to a particular analysis problem. Some applications may require the use of complex computer software during data reduction to correct for matrix effects.

1.4 The values stated in SI units are to be regarded as the standard.

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:*

E 135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials[2]

3. Significance and Use

3.1 This guide describes typical prospective analytical X-ray fluorescence systems that may be used for qualitative and quantitative elemental analyses of materials related to the nuclear fuel cycle.

3.2 Standard test methods for the determination of materials using wavelength-dispersive XRF[3] usually employ apparatus with the components described in this guide.

4. Technical Precautions

4.1 XRF equipment analyzes by the interaction of ionizing radiation with the sample. Applicable safety regulation and standard operating procedures must be reviewed before use of such equipment. All current XRF spectrometers are equipped with safety interlocks to prevent accidental penetration of X-ray beam by the user. Do not override these interlocks without proper training or a second person present during such operation. (See NBS Handbook 111[4])

4.2 Instrument performance may be influenced by environmental factors such as heat, vibration, humidity, dust, stray electronic noise, and line voltage stability. These factors and performance criteria should be reviewed with equipment manufacturers.

4.3 The quality of quantitative XRF results can be dependent on a variety of factors, such as sample preparation and mounting. Consult the specific analysis method for recommended procedures.

4.4 Sample chambers are available commercially for operation in air, vacuum, or helium atmospheres, depending on the elements to be determined and the physical form of the sample.

5. Excitation Sources

5.1 *X-Ray Generator*— The X-ray generator should consist of, but not be limited to, an X-ray power supply with an output rating of at least 3000-W constant power. The voltage should be adjustable from at least 10 to 60 kV in not greater than 5-kV increments (100-kV generators are available if the specific application requires). Tube current should be adjustable from at

[1] This guide is under the jurisdiction of ASTM Committee C-26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.05 on Methods of Test.
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[2] *Annual Book of ASTM Standards*, Vol 03.05.

[3] General references for XRF include the following:
Bertin, Eugene P., *Principles and Practices of X-ray Spectrometric Analysis*, Second Edition, Plenum Press, New York and London, 1975.
Jenkins, Ron, *An Introduction to X-ray Spectrometry*, Hayden and Sons Limited, London, New York, Rhine, 1974.
Jenkins, Ron, Gould, R. W., and Gedke, Dale, *Quantitative X-ray Spectrometry*, Marcel Dekker, Inc., New York and Basel.

[4] NBS Handbook 111, *Radiation Safety for X-Ray Diffraction and X-Ray Fluorescence Analysis Equipment*, National Institute of Standards and Technology, Washington, DC.