



Designation: E 1172 – 87 (Reapproved 1996)

Standard Practice for Describing and Specifying a Wavelength-Dispersive X-Ray Spectrometer¹

This standard is issued under the fixed designation E 1172; 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 practice describes the components of a wavelength-dispersive X-ray spectrometer that are basic to its operation and to the quality of its performance. It is not the intent of this practice to specify component tolerances or performance criteria, as these are unique for each instrument. The document does, however, attempt to identify which of these are critical and thus which should be specified.

1.2 *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.* Specific safety hazard statements are given in Note 1 and Note 2, and in Section 7.

1.3 There are several books and publications from the National Institute of Standards and Technology² and the U.S. Government Printing Office^{3,4} which deal with the subject of X-ray safety. Refer also to Practice E 416⁵.

2. Referenced Documents

2.1 ASTM Standards:

E 135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials⁵

E 416 Practice for Planning and Safe Operation of a Spectrochemical Laboratory⁶

E 876 Practice for Use of Statistics in the Evaluation of Spectrometric Data⁶

3. Terminology

3.1 For terminology relating to X-ray spectrometry, refer to Terminology E 135.

4. Significance and Use

4.1 This practice describes the essential components of a wavelength-dispersive X-ray spectrometer. This description is presented so that the user or potential user may gain a cursory understanding of the structure of an X-ray spectrometer system. It also provides a means for comparing and evaluating different systems as well as understanding the capabilities and limitations of each instrument.

5. Description of Equipment

5.1 *Types of Spectrometers*—X-ray spectrometers can be classified as sequential, simultaneous, or a combination of these two (hybrid).

5.1.1 *Sequential Spectrometers*—The sequential spectrometer disperses and detects secondary X rays by means of an adjustable monochromator called a goniometer. In flat-crystal instruments, secondary X rays are emitted from the specimen and nonparallel X rays are eliminated by means of a Soller slit (collimator). The parallel beam of X rays strikes a flat analyzing crystal which disperses the X rays according to their wavelengths. The dispersed X rays are then measured by suitable detectors. Adjusting the goniometer varies the angle between the specimen, crystal, and detector, permitting the measurement of different wavelengths and therefore different elements. Sequential instruments containing curved-crystal optics are less common. This design substitutes curved for flat crystals and entrance and exit slits for collimators.

5.1.2 *Simultaneous Spectrometers*—Simultaneous spectrometers use separate monochromators to measure each element. These instruments are for the most part of fixed configuration, although some simultaneous instruments have a scanning channel with limited function. A typical monochromator consists of an entrance slit, a curved (focusing) analyzing crystal, an exit slit, and a suitable detector. Secondary X rays pass through the entrance slit and strike the analyzing crystal, which diffracts the wavelength of interest and focuses it through the exit slit where it is measured by the detector.

¹ This practice is under the jurisdiction of ASTM Committee E-1 on Analytical Chemistry for Metals, Ores and Related Materials and is the direct responsibility of Subcommittee E01.20 on Fundamental Practices.

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² NBS Handbook, *X-Ray Protection*, HB76, and NBS Handbook 111, ANSI N43.2-1971, available from National Institute of Standards and Technology, Gaithersburg, MD 20899.

³ *Radiation Safety Recommendations for X-Ray Diffraction and Spectrographic Equipment*, No. MORP 68-14, 1968, available from U.S. Department of Health, Education, and Welfare, Rockville, MD 20850.

⁴ U.S. Government Handbook 93, *Safety Standards for Non-Medical X-Ray and Sealed Gamma-Ray Sources*, Part 1, General, Superintendent of Documents, available from U.S. Government Printing Office, Washington, DC 22025.

⁵ *Annual Book of ASTM Standards*, Vol 03.05.

⁶ *Annual Book of ASTM Standards*, Vol 03.06.