



# Standard Test Method for Forensic Comparison of Glass Using Micro X-ray Fluorescence ( $\mu$ -XRF) Spectrometry<sup>1</sup>

This standard is issued under the fixed designation E2926; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

One objective of a forensic glass examination is to compare glass specimens to determine if they can be discriminated using their physical, optical or chemical properties (for example, color, refractive index (RI), density, elemental composition). If the specimens are distinguishable, except for acceptable and explainable variations, in any of these observed and measured properties, it may be concluded that they did not originate from the same source of broken glass. If the specimens are indistinguishable in all of these observed and measured properties, the possibility that they originated from the same source of glass cannot be eliminated. The use of an elemental analysis method such as micro X-ray fluorescence spectrometry ( $\mu$ -XRF) yields high discrimination among sources of glass.

## 1. Scope

1.1 This test method is for the determination of major, minor, and trace elements present in glass fragments. The elemental composition of a glass fragment can be measured through the use of  $\mu$ -XRF analysis for comparisons of glass.

1.2 This test method covers the application of  $\mu$ -XRF using mono- and poly- capillary optics, and an energy dispersive X-ray detector (EDS).

1.3 This test method does not replace knowledge, skill, ability, experience, education, or training and should be used in conjunction with professional judgment.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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:<sup>2</sup>

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.01 on Criminalistics. Current edition approved June 15, 2013. Published July 2013. DOI: 10.1520/E2926-13.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E2330 Test Method for Determination of Concentrations of Elements in Glass Samples Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for Forensic Comparisons

## 3. Summary of Test Method

3.1  $\mu$ -XRF is a nondestructive elemental analysis technique based on the emission of characteristic X-rays following the excitation of the specimen by an X-ray source using capillary optics. Simultaneous multi-elemental analysis is typically achieved for elements of atomic number eleven or greater.

3.2 Glass fragments usually do not require sample preparation prior to analysis by  $\mu$ -XRF. Cleaning of specimens may be performed to remove any surface debris.

3.3 Specimens are mounted and placed into the instrument chamber and subjected to an X-ray beam. The characteristic X-rays emitted by the specimen are detected using an energy dispersive X-ray detector and displayed as a spectrum of energy versus intensity.

3.4 Qualitative analysis is accomplished by identifying elements present in the specimen based on their characteristic X-ray energies.

3.5 Semi-quantitative analysis is accomplished by comparing the relative area under the peaks of characteristic X-rays of certain elements.

3.6 Spectral and elemental ratio comparisons of the glass specimens are conducted for source discrimination or association.