ICS 97.140
CCS Y 80

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 46747-2025

Rapid determination of heavy metals in furniture coatings - X-ray fluorescence spectrometry

家具涂层中重金属元素的快速测定 X射线荧光光谱法

Issued on: October 31, 2025 **Implemented on: May 1, 2026**

Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC

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1 Scope

GB/T 46747-2025 is the Chinese national standard covering screening furniture finishes for lead, cadmium, chromium and mercury with a handheld or benchtop XRF - the calibration and the reference materials, the effect of coating thickness on the reading, and the threshold at which a laboratory confirmation is required. It is a screening method: it says which pieces need the destructive test, not which pass. First edition, in force from 1 May 2026. Issued on 31 October 2025, it has been in force since 1 May 2026.

This document describes the X-ray fluorescence spectrometry for the rapid determination of eight heavy metals-lead, cadmium, chromium, barium, mercury, arsenic, selenium, and antimony-in furniture coatings. This document is applicable to the rapid determination of lead, cadmium, chromium, barium, mercury, arsenic, selenium, and antimony in the surface paint coatings of wooden and metal furniture; it is also applicable to the screening of the migration levels of these eight elements within such coatings. NOTE. If the elemental content exceeds the prescribed migration limit, chemical analysis methods shall be employed to further verify the actual migration level.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to

this document.

GB/T 16597 Analytical methods of metallurgical products - General rule for X-ray fluorescence spectrometric methods

GB/T 37361 Determination of the film thickness - Ultrasonic thickness gauge method

JB/T 12962.1 Energy dispersive X-ray fluorescence spectrometer - Part

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Fundamental Parameter Method A theoretical calculation method for determining the elemental content of a sample. It involves utilizing mathematical models based on a fundamental parameter library to theoretically calculate the spectral distribution of primary incident X-rays, the interactions between X-rays and matter (including mass absorption coefficients, fluorescence yields, spectral line fractions, absorption edge ratios, scattering, etc.), and instrumental optical path influence factors. This process generates a calculated spectrum, which is then iteratively refined against the spectrum acquired by the detector-using an iterative algorithm-until the required level of precision is achieved.

4 Principle

Primary X-rays generated by an X-ray tube are filtered or monochromated before irradiating the sample surface. This excitation causes inner-shell electrons of the elements under analysis to undergo energy-level transitions, thereby emitting characteristic X-ray fluorescence specific to each element. An energy-dispersive detector resolves the characteristic X-ray fluorescence from different elements and measures their intensities; after theoretical calculation using the fundamental parameter method, these intensities are found to be directly proportional to the mass fractions of the elements within the sample. Calibration curves are established using either standard samples/reference materials or calibration samples prepared via the standard addition method, thereby enabling the determination of the mass fractions of the target elements within the sample.

5 Reagents and Materials

5.1 Mixed standard solution of lead, cadmium, chromium, mercury, arsenic, selenium, and antimony. Use elemental standard stock solutions that have been nationally certified and issued a standard sample/reference material certificate. The mass concentration shall be 1 000 mg/L or higher, and the matrix shall be water-based, a 5% (or lower) hydrochloric acid (or nitric acid) matrix, or an organic matrix.

5.2 Barium standard solution. Use an elemental standard stock solution that has been nationally certified and issued a standard sample/reference material certificate. The mass

concentration shall be 10 000 mg/L, and the matrix shall be a 5% (or lower) nitric acid matrix or an organic matrix.

5.3 Blank paint. Water-based wood paint, acrylic-based wood paint, or other paints commonly used for wooden furniture, wherein the content of each of the eight elements under analysis is less than

0.5 mg/kg.

5.4 Wooden materials or metal substrates. Preferably use wooden materials or metal substrates commonly used in furniture manufacturing.

5.5 Glass plate or polytetrafluoroethylene (PTFE) plate. The surface must be flat, and the material must be resistant to solvent corrosion.

6 Instruments and Equipment

6.1 X-ray fluorescence spectrometer. A benchtop or handheld energy-dispersive X-ray fluorescence spectrometer complying with the provisions of JB/T 12962.1 or GB/T 16597.The detector resolution shall be less than 135eV@Mn.Ka; the accompanying software shall feature quantitative analysis capabilities based on the fundamental parameter method and allow for the customization of multi-layer sample structures.

6.2 Manual coater. An adjustable doctor blade-type or fixed-gap-type coater with a flat surface. The material shall be resistant to solvent corrosion, non-reactive with paint, and designed to prevent contamination.

6.3 Cutter. An electric saw or other tool suitable for cutting wooden materials and metallic materials.

6.4 Ultrasonic thickness gauge. An instrument with an accuracy of no less than 1 μm and a maximum measurement range of no less than 500 μm.

7 Preparation of Test Specimens

When using a benchtop X-ray fluorescence spectrometer, use the cutter (6.3) to cut the furniture sample into dimensions that match the sample aperture of the instrument. When using a handheld X-ray fluorescence spectrometer, cutting of the furniture sample is not required; tests may be performed directly on a flat surface of the furniture.

8.1 Preparation of Paint Coating Calibration Samples

8.1.1 Dilute the mixed standard solution of lead, cadmium, chromium, mercury, arsenic, selenium, and antimony (5.1)-selecting an aqueous solvent, organic solvent, or amphiphilic solvent based on the specific medium-to concentrations of 10 mg/L, 25 mg/L, 50 mg/L, 100 mg/L, 200 mg/L, and 500 mg/L. Subsequently, mix these solutions with the blank paint (5.3)

at a mass ratio of

1.1 to prepare spiked paint samples with varying concentrations.

8.1.2 Dilute the barium standard solution (5.2)-selecting an aqueous solvent, organic solvent, or amphiphilic solvent based on the specific medium-to concentrations of 25 mg/L, 100 mg/L, 200 mg/L, 500 mg/L, and 1 000 mg/L. Subsequently, mix these solutions with the blank paint (5.3) at a mass ratio of

1.1 to prepare spiked paint samples with varying concentrations.

8.1.3 Apply the spiked paint samples with varying concentrations prepared in steps

8.1.2 onto wooden materials or metal substrates (5.4) using a manual coater (6.2). Place the coated samples inside a dust cover to prevent dust accumulation, and allow them to dry into a film at room temperature; the selected film thickness for the manual coater (6.2) shall range from 20 μm to 200 μm.

8.1.4 Following the procedure specified in step 8.1.3, apply the spiked paint samples with varying concentrations prepared in steps

8.1.2 onto glass plates or polytetrafluoroethylene (PTFE) plates (5.5) using the same manual coater (6.2). Place the coated samples inside a dust cover to prevent dust accumulation, and allow them to dry into a film at room temperature.

8.1.5 Determine the content of each target element in the paint film (8.1.4) using chemical analysis methods (see Appendix A). The values shall be expressed in milligrams per kilogram (mg/kg), and the determined results shall serve as standard values for the construction of the standard curve for X-ray fluorescence spectrometry. If applicable standard paint film samples/reference materials are available, the preparation steps specified in

8.1.5 may be omitted.

8.2 Measurement Conditions for the X-ray Fluorescence Spectrometer Refer to the instrument's operating manual to select appropriate measurement conditions for testing, or directly select a built-in instrument method. Appendix B provides reference test conditions for the instrument.

8.3 Construction of the Standard Curve Based on the furniture substrate type (wooden material or metal substrate), define the sample structure within the instrument software. For the series of paint coating calibration samples (8.1.3), an ultrasonic thickness gauge (6.4) shall be used to measure the film thickness in accordance with the method specified in GB/T 37361.This measured thickness shall be input into the fundamental parameter method as a calculation parameter. Tests shall be performed using the instrumental