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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 46509-2025

**Determination of the emission of volatile organic compounds in
toys**

玩具中挥发性有机化合物释放量的测定

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1 Scope

GB/T 46509-2025 is the Chinese national standard covering what a toy gives off - the emission chamber and its conditions, the sampling onto sorbent and the analysis, the compounds reported individually and as a total, and the loading factor that makes the result comparable between laboratories. First edition, under the China National Light Industry Council, already in force. Issued on 5 October 2025, it has been in force since 5 October 2025.

This document describes the determination of volatile organic compounds (VOC) emissions from toys, toy components, and toy materials, including the bag method and the climate chamber method. This document is applicable to the determination of the release of volatile organic compounds - specifically formaldehyde, benzene, toluene, ethylbenzene, and xylene - as well as total volatile organic compounds (TVOC), in toys, toy components, and toy materials.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 31107, Environmental chamber for the determination of volatile organic compounds of furniture -- General technical requirements

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 total volatile organic compounds; TVOC The sum of organic compounds - separated using a non-polar chromatographic column (with a polarity index of less than 10) and detected via gas chromatography - whose retention times fall between those of n-hexane and n-hexadecane (inclusive). [Source: GB/T 31106-2014, 3.2, modified]

3.2 volatile organic compounds; VOC Organic compounds released from the sample that can be detected in the outlet gas of the test device. NOTE. The "outlet of the test device" refers to the gas outlet of equipment used to test for the emission of volatile organic compounds (VOCs), including sampling ports designed for collecting gas samples. For example, when testing for VOC emissions using the climate chamber method, the outlet of the test device refers to the exhaust port or the sampling port of the climate chamber. [Source: GB/T 31106-2014, 3.1, modified]

3.3 area carrying capacity/volume bearing capacity The ratio of the total surface area of the sample to the volume of the air bag or climate chamber, or the ratio of the total volume of the sample to the volume of the air bag or climate chamber.

3.4 flat toys The surface area of the sample's sides constitutes less than 5% of its total surface area. Its primary characteristic is that it visually presents as a flat plane. NOTE. It typically includes various puzzles, graphic cards, stickers, drawing boards, and so on.

4 Principle

Place the samples, loaded at the specified loading rate, into a gas sampling bag or a climate chamber. Conduct the test by simulating the environmental conditions under which the samples are used. Upon the expiration of the specified duration, collect gas samples from within the bag or chamber using sorbent tubes; subsequently, determine formaldehyde concentrations using High-Performance Liquid Chromatography (HPLC), and determine volatile organic compounds (VOCs) and total volatile organic compounds (TVOCs) using Thermal Desorption-Gas Chromatography-Mass Spectrometry (TD-GC-MS).

5 Instruments and devices

5.1 Thermal Desorption-Gas Chromatography-Mass Spectrometry (TD-GC-MS).

5.2 High-Performance Liquid Chromatograph (HPLC).

5.3 Air bag. polyvinyl fluoride (PVF) film (thickness $\geq$

0.05 mm), three-way valve; specifications. 10 L~2000 L. Alternatively, other equivalent air bags may be used.

5.4 Air sampler. 200 mL/min~1000 mL/min.

5.5 Constant-temperature chamber. air-circulating type, with temperature controlled within $\pm 2^{\circ}\text{C}$.

5.6 Climate chamber. typical capacities include 60 L, 1 m³, 2 m³, etc.

5.7 High-purity nitrogen. the purity of nitrogen shall be not less than 99.999%. 5.8 2,4-Dinitrophenylhydrazine (DNPH) sampling tube. 5.9 2,6-Diphenylfuran porous polymer resin (TENAX) sampling tube.

6 Sampling steps

6.1 Sample quantity. 1 unit. In the case of product sets, the entire set is typically treated as a single sample. For samples provided with packaging, the volume is calculated based on the dimensions of the packaging. For unpackaged samples, the volume is calculated based on the actual length, width, and height. The sample surface area is calculated based on the actual exposed surface area. Following the cutting and processing of test specimens to meet load-bearing requirements and after the specimens have undergone conditioning, their edges are sealed using aluminum tape free of formaldehyde and TVOCs. NOTE. In principle, testing is conducted using a single sample. When employing the climate chamber method, an appropriately sized chamber shall be selected based on the characteristics of the sample. If the surface area-to-volume ratio of the sample is too small, such that even the smallest available climate chamber fails to meet the specified loading rate, the number of test samples shall be increased.

6.2 Sample conditioning Prior to testing, samples shall be assembled in a configuration most conducive to the emission of hazardous substances. Pre-treatment shall be conducted after the samples have been opened. The surfaces of all sample components shall be exposed to the pre-treatment environment to the greatest extent possible to facilitate gas emission. Any packaging, such as wrapping paper or plastic film, shall be removed. The pretreatment duration is (24 ± 1) h. The pretreatment environmental conditions are. - Temperature. $(23 \pm 2)^{\circ}\text{C}$; - Relative humidity. $(50 \pm 10)\%$; - The spacing between samples shall be no less than

0.5 m to facilitate air circulation; - The background levels of the pre-treatment environment shall meet the following requirements. formaldehyde content not exceeding

0.006 mg/m³, single- component VOC content not exceeding

0.005 mg/m³, and TVOC content not exceeding

0.05 mg/m³.

6.3 Bag method

6.3.1 Selection of air bags The area loading rate range for the air bag (5.3) is

0.50 m²/m³~

1.5 m²/m³; a suitable air bag shall be selected based on the principle of choosing the one with an area loading rate closest to 1 m²/m³. The volume loading rate range for the air bag is 0.075~0.30; a suitable air bag shall be selected based on the principle of choosing the one with a volume loading rate closest to 0.15. In principle, one sample is used per test. However, when the total volume of the sample is less than

0.75 L or the total surface area is less than

0.5 dm², a 10 L air bag shall be used for the test in all cases. NOTE. It is recommended that flat toys and toy materials be tested based on area load-bearing capacity, while other toys be tested based on volume load-bearing capacity.

6.3.2 Cleaning of air bags The cleaning steps for air bags (5.3) are as follows:

- a) Adjust the temperature of the constant-temperature chamber (5.5) to 80 °C. Open the chamber door and initiate gas circulation for 30 min. Close the chamber door;
- b) Open the air bag to be cleaned. Place the air bag in the test chamber with its inner surface facing outward. After heating for 10 h~12 h, reopen the chamber door to purge the internal atmosphere for 30 min;
- c) Invert the air bag, close the hatch, and continue heating for 2 h ~ 3 h;
- d) Remove the air bag. Turn the inner surface right-side out. Seal the air bag using a heat sealer or a sealing strip. Fill the bag with a specific volume of high-purity nitrogen (5.7). After 2 h, observe whether the sampling bag exhibits any noticeable shrinkage to assess its airtightness;
- e) Perform gas displacement of the air bag using high-purity nitrogen. Fill the bag with approximately 50% of its volume in high-purity nitrogen, then extract the gas. Repeat this procedure 3 times;
- f) Accurately introduce 50% high-purity nitrogen. Heat at 65°C for 120 min ± 10 min. Use a TENAX tube (5.9) to sample benzene compounds. Use a DNPH tube (5.8) to sample formaldehyde;
- g) Instrumental verification of the air bag blank is required, stipulating that the concentration of each individual substance must be less than

0.005 mg/m³.