

Specification for

**Limits of metal release
from ceramic ware,
glassware, glass
ceramic ware and
vitreous enamel ware**

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Furniture and Household Equipment Standards Committee (FHM/-) to Technical Committee FHM/29, upon which the following bodies were represented:

- Association of Metropolitan Authorities
- Association of Public Analysts
- British Ceramic Gift and Tableware Manufacturers Association
- British Ceramic Manufacturers Federation
- British Ceramic Research Ltd.
- British Glass Industry Research Association
- British Vitrified Hotelware Association
- Consumer Standards Advisory Committee of BSI
- Department of Health and Social Security
- Department of Trade and Industry (Consumer Safety Unit, CS Division)
- Department of Trade and Industry (Laboratory of the Government Chemist)
- Glass Manufacturers' Federation
- Institute of Trading Standards Administration
- Institute of Vitreous Enamellers
- Society of Glass Technology
- Stoneware Potters' Association
- Vitreous Enamel Development Council

This British Standard, having been prepared under the direction of the Furniture and Household Equipment Standards Committee, was published under the authority of the Board of BSI on 29 August 1986. It comes into effect on a date to be announced (see foreword).

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The following BSI references relate to the work on this standard:
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Foreword

This British Standard has been prepared under the direction of the Furniture and Household Equipment Standards Committee and is a combined revision of BS 4860, BS 5103 and BS 5180.

The need for revision of BS 4860 has been created by the publication of EEC Directive 84/500/EEC which the UK is required to implement and the opportunity has been taken to incorporate the closely related requirements of BS 5103 and BS 5180 into the revision to avoid proliferation of requirements and test methods in the field of metal release from ceramics, glass, glass ceramics and vitreous enamels in contact with food.

This standard will form the basis of regulations to be made under the Consumer Safety Act 1978, replacing the Glazed Ceramic Ware (Safety) Regulations SI 1975 No. 1241. It will become effective only when these Regulations are revoked and replaced by the new Regulations; withdrawal of BS 4860:1972 will be announced at the appropriate time. The remade regulations will be based upon this standard and will be consistent with it.

This standard specifies limits for metal release from vitreous enamel ware which differ from those required by the Vitreous Enamel-ware (Safety) Regulations SI 1976 No. 454 in which BS 5180:1974 is called up. In the interests of uniformity it is recommended that the limits specified in this standard be adopted for those vitreous enamel products equivalent in form and usage to the categories identified in the standard, although the Regulations will not be correspondingly amended and BS 5180:1974 will not therefore be withdrawn on publication of this standard. However, no regulations exist, or are currently envisaged, for glass and glass ceramic articles and the adoption of the limits specified in this standard should be considered as a contribution to the reduction of exposure to lead and cadmium in the environment. Accordingly BS 5103 is withdrawn.

The limits for lead and cadmium release specified in this standard are not intended to be regarded as the maximum amounts of these metals to which exposure can be considered safe, they are the lowest levels achievable by the industries concerned with the object of reducing overall exposure to these metals.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations. In particular, reliance on this standard may not in all cases meet the requirements of the Vitreous Enamel-ware Regulations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies limits for lead and cadmium, expressed as a concentration of the elements, released from ceramic, glass, glass ceramic and vitreous enamel articles intended for use in contact with foodstuffs, when the article is subjected to a specified method of test.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1

ceramic ware

articles manufactured from a mixture of inorganic materials with a generally high argillaceous or silicate content to which small quantities of organic materials may have been added. These articles are first shaped and the shape thus obtained is permanently fixed by firing. They may be glazed, enamelled and/or decorated

2.2

glassware

articles manufactured from soda-lime-silica, borosilicate or lead crystal glass, or from glass ceramic

2.3

vitreous enamel ware

articles manufactured with a glazed surface finish produced by the application of a powdered inorganic glass, dry or suspended in water, to metal parts and its subsequent fusion

2.4

surface area

the surface area of an article (in category 1), which can be filled, is the area of the surface of the meniscus formed by the free liquid surface when the article is filled to within 1 mm of the overflow point, measured from the upper rim of the article. For articles with a flat or slightly sloping rim this distance is within 6 mm of the extreme edge of the rim

in all other cases the surface area is that calculated from the area(s) of the article's surface which will come into contact with foodstuffs in normal use

2.5

volume

the volume of an article (in categories 2 and 3) is the capacity obtained when the article is filled to within 1 mm of the overflow point

3 Classification

Three categories of article are specified, determined by the size, shape and/or purpose of the article with the intention of defining the maximum levels of metal release from the article's surface.

Category 1. Articles which cannot be filled and articles which can be filled, the internal depth of which, measured from the lowest point to the horizontal plane passing through the upper rim, does not exceed 25 mm. This includes those articles known as flatware.

Category 2. Articles, not in categories 1 or 3, which can be filled. This includes those articles known as holloware.

Category 3. Packaging and storage vessels having a capacity of more than 3 L and cooking ware, i.e. items designed and sold for use in the hot preparation of food or beverages. In a set of articles termed "oven-to-tableware" there will be items which are not intended for use in the actual cooking process; such items are of category 1 or 2, as defined therein.

4 Lead and cadmium release

4.1 General

When tested in accordance with the method given in Appendix A any article of ceramic ware, glassware, glass ceramic ware or vitreous enamel ware shall not release into the extracting solution a quantity of lead or cadmium, calculated as the element, exceeding that given in 4.2 for the appropriate category of article.

Where an article is fitted with a lid of the same material, the vessel and lid shall be tested separately and the quantities of lead and cadmium obtained summed to provide the values for compliance with 4.2. For the purposes of this requirement the summed values shall be considered as applying to the surface area or volume of the vessel only.

4.2 Limits

The maximum limits of lead (Pb) and cadmium (Cd) release shall be as follows.

Category 1 articles: 0.8 mg of Pb/0.07 mg of Cd, per square decimetre of surface area;

Category 2 articles: 4.0 mg of Pb/0.3 mg of Cd, per litre of volume;

Category 3 articles: 1.5 mg of Pb/0.1 mg of Cd, per litre of volume.

4.3 Sampling provision

Where an article of ceramic ware, glassware, glass ceramic ware or vitreous enamel ware releases a quantity of lead and/or cadmium into the extracting solution at a level exceeding that given in **4.2**, by not more than 50 %, at least three further articles shall be tested and the average quantity of lead and/or cadmium per article determined.

The average quantity so determined shall not exceed that given in **4.2** for a single article and no one sample shall exceed the value by more than 50%.

Appendix A Method for determination of metal release

A.1 Reagents

A.1.1 General. All reagents shall be of recognized analytical quality.

A.1.2 Water, complying with the requirements of BS 3978.

A.1.3 Acetic acid (CH_3COOH), glacial.

A.1.4 Acetic acid solution (4 % V/V). To 500 mL of water (A.1.2) add 40 mL of glacial acetic acid (A.1.3) and make up to 1 L. Freshly prepare the solution prior to use in sufficient quantity to enable the whole of any group of tests and analyses to be completed.

A.1.5 Standard metal solutions

A.1.5.1 $1\,000 \pm 1$ mg Pb in 1 L of 4 % V/V acetic acid (A.1.4).

A.1.5.2 500 ± 0.5 mg Cd in 1 L of 4 % V/V acetic acid (A.1.4).

NOTE Commercially available standard solutions for atomic absorption spectroscopy may be used provided that the concentrations of such solutions are known to an equivalent accuracy.

A.2 Apparatus

A.2.1 Atomic absorption spectrophotometer, with a detection limit equal to or better than 0.2 mg/L Pb (in 4 % V/V acetic acid) and 0.02 mg/L Cd (in 4 % V/V acetic acid).

NOTE The detection limit is the concentration of the element which gives a signal equal to four times the standard deviation of the background noise level of the instrument.

A.2.2 Laboratory glassware. Volumetric glassware of class B, or better, accuracy as specified in BS 700, BS 846 or BS 1792, as appropriate. General laboratory glassware of borosilicate glass incapable of releasing detectable levels of lead or cadmium into 4 % acetic acid during the test procedure.

A.3 Preparation of samples

Wash the sample in an aqueous solution at 40 ± 5 °C containing 1 mL/L of domestic liquid detergent. Rinse the sample thoroughly with water (A.1.2) and allow to drain, then wipe dry with clean filter paper. Do not use any sample which shows residual staining.

If the sample possesses an area of its surface, which is not intended to come into contact with foodstuffs in normal use, other than the interior of any lid, cover this area after the initial washing and drying with a protective coating which will withstand the effect of 4 % V/V acetic acid and which will not release any detectable levels of Pb or Cd into 4 % V/V acetic acid during the test procedure.

NOTE High melting point paraffin wax is a suitable coating.

Do not handle the surface to be tested after it has been prepared.

A.4 Procedure

A.4.1 Condition the sample to 22 ± 2 °C. For category 1 articles, determine and record the surface area of the article.

A.4.2 Fill the conditioned sample with 4 % V/V acetic acid solution (A.1.4) at 22 ± 2 °C to a level no more than 1 mm from the overflow point, measured from the upper rim of the sample, and to no more than 6 mm from the extreme edge of a sample with a flat or sloping rim. Samples which cannot be filled should be completely immersed in the minimum amount of 4 % V/V acetic acid.

Record the quantity of 4 % V/V acetic acid required or used to an accuracy of ± 2 %. Record the quantities separately where an item with a lid is tested.

A.4.3 Where tests are for both cadmium and lead, cover the sample and ensure that throughout the test procedure the surface under test is kept in complete darkness.

NOTE 1 If lead only is to be determined the test may be conducted in normal lighting.

Maintain the filled, or immersed, samples at 22 ± 2 °C for 24 ± 0.5 h under conditions which preclude evaporative losses.

NOTE 2 Plastic trays with close fitting lids are suitable containers to prevent evaporative losses from the test vessels.

A.4.4 Homogenize the extract solution, by stirring or other method, without loss of solution or abrasion of the surface being tested and withdraw a portion for the determination of lead and/or cadmium.

NOTE A method of homogenizing the extraction solution is to remove a quantity by pipette and allow it to run back into, or onto, the sample several times, avoiding dilution or evaporation loss in the process.

A.5 Analysis

A.5.1 Set up the atomic absorption spectrophotometer having regard to the manufacturer's instructions using wavelengths of 217.0 nm for lead determination and 228.8 nm for cadmium determination with appropriate correction for background absorption effects.

NOTE Where appropriate, a wavelength of 283 nm may be used for the analytical confirmation of lead.

A.5.2 Aspirate water (A.1.2) and adjust the zero. Aspirate a range of dilute standard metal solutions prepared by dilution of the standard metal solutions (A.1.5) with 4 % V/V acetic acid solution. Aspirate water (A.1.2) after each standard metal solution (A.1.5) and record the absorbance values obtained.

A.5.3 Aspirate water (A.1.2) and then 4 % V/V acetic acid (A.1.4) and measure the absorbance value. Aspirate the sample extracts (see A.4.4), accurately diluted where appropriate, interspersed with water (A.1.2). Measure the absorbance values of the sample extracts or accurately diluted sample extracts.

A.5.4 To check for instrument drift, aspirate dilute standard metal solutions interspersed with sample extracts and with water (A.1.2).

Provided that the absorbance values of the dilute standard metal solutions and of the 4 % V/V acetic acid solution (A.1.4) indicate minimal drift, the results may be calculated by the bracketing technique (see A.6), from a manually prepared calibration curve or by using the calibration facilities of the instrument.

A.6 Calculation of results by the bracketing technique

The lead or cadmium content, C_0 , expressed in mg/L of the extraction solution, is given by the equation:

$$C_0 = \left[\left\{ \left(\frac{A_0 - A_1}{A_2 - A_1} \right) (C_2 - C_1) \right\} + C_1 \right] d$$

where

- A_0 is the absorbance of the lead or cadmium in the sample extract;
- A_1 is the absorbance of the lead or cadmium in the lower bracketing solution;
- A_2 is the absorbance of the lead or cadmium in the upper bracketing solution;
- C_1 is the lead or cadmium content of the lower bracketing solution (in mg/L);
- C_2 is the lead or cadmium content of the upper bracketing solution (in mg/L);
- d is the factor by which the sample was diluted.

NOTE The lower and upper bracketing solutions should be chosen to have absorbance values close to that of the sample extract or diluted sample extract.

Relate the values so determined to the total quantity(ies) of solution recorded in A.4.2 and, for category 1 articles, to the surface area of the article.

A.7 Test report

The test report shall contain:

- a) the nature of the article under test;
- b) the surface area or volume, as appropriate, of the article;
- c) the amount of lead and/or cadmium in the total quantity(ies) of extracting solution(s) expressed as milligrams of Pb or Cd per square decimetre of surface area for category 1 articles or milligrams of Pb or Cd per litre of volume for category 2 and 3 articles.

Publications referred to

BS 700, *Graduated pipettes*.

BS 846, *Specification for burettes*.

BS 1792, *Specification for one-mark volumetric flasks*.

BS 3978, *Water for laboratory use*.

BS 4860, *Permissible limits of metal release from glazed ceramic ware*¹⁾.

BS 5180, *Permissible limits of metal release from vitreous enamel-ware*¹⁾.

¹⁾ Referred to in the foreword only.

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