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**Ceramic ware, glass-ceramic ware and  
glass dinnerware in contact with food —  
Release of lead and cadmium —**

**Part 2:  
Permissible limits**

*Articles en céramique, vaisselle en vitro-céramique et vaisselle plate en  
verre en contact avec les aliments — Émission de plomb et de cadmium —*

*Partie 2: Limites admissibles*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 6486 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 6486-2 was prepared by Technical Committee ISO/TC 166, *Ceramic ware, glassware and glass ceramic ware in contact with food*.

This second edition cancels and replaces the first edition (ISO 6486-2:1981) which has been technically revised.

ISO 6486 consists of the following parts, under the general title *Ceramic ware, glass-ceramic ware and glass dinnerware in contact with food — Release of lead and cadmium*:

- *Part 1: Test method*
- *Part 2: Permissible limits*

## Introduction

Lead- and cadmium-release from ceramic and glassware surfaces is an issue which requires effective means of control to ensure the protection of the population against possible hazards arising from the use of improperly formulated and/or processed ceramic, glass-ceramic and glass dinnerware used for the preparation, serving and storage of food and beverages. As a secondary consideration, different requirements from country to country for the control of the release of toxic materials from the surfaces of ceramic ware present non-tariff barriers to international trade in these commodities. Accordingly, there is a need to maintain internationally accepted methods of testing ware for lead- and cadmium-release, and to define permissible limits for the release of these toxic heavy metals.

The limits for lead and cadmium release specified in this part of ISO 6486 are not intended to be regarded as the maximum amount of these metals to which exposure can be considered safe. They are levels which are consistent with good manufacturing practice in the respective industries, harmonize regulatory levels in principal world markets and reflect a general objective of reducing overall exposure to these metals.



# Ceramic ware, glass-ceramic ware and glass dinnerware in contact with food — Release of lead and cadmium —

## Part 2: Permissible limits

### 1 Scope

This part of ISO 6486 specifies permissible limits for the release of lead and cadmium from ceramic ware, glass-ceramic ware and glass dinnerware intended to be used in contact with food, but excluding porcelain enamel articles.

This part of ISO 6486 is applicable to ceramic ware, glass-ceramic ware and glass dinnerware which is intended to be used for the preparation, cooking, serving and storage of food and beverages, excluding articles used in food manufacturing industries or those in which food is sold.

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 6486. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 6486 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 385-2:1984, *Laboratory glassware — Burettes — Part 2: Burettes for which no waiting time is specified.*

ISO 648:1977, *Laboratory glassware — One-mark pipettes.*

ISO 1042:1998, *Laboratory glassware — One-mark volumetric flasks.*

ISO 3585:1998, *Borosilicate glass 3.3 — Properties.*

ISO 3696:1987, *Water for analytical laboratory use — Specifications and test methods.*

### 3 Terms and definitions

For the purposes of this part of ISO 6486, the following terms and definitions apply.

#### 3.1

##### **atomic absorption spectrometry (AAS)**

spectroanalytical method for qualitative determination and quantitative evaluation of element concentrations wherein the technique determines these concentrations by measuring the atomic absorption of free atoms

**3.2**

**atomic absorption**

absorption of electromagnetic radiation by free atoms in the gas phase wherein a line spectrum is obtained which is specific for the absorbing atoms

**3.3**

**bracketing technique**

analytical method consisting of bracketing the measured absorption or machine reading of the sample between two measurements made on calibration solutions of neighbouring concentrations within the optimum working range

**3.4**

**calibration function**

function relating atomic absorption instrument readings, either in absorption or in other machine units, to the concentration of lead or cadmium which generated the instrument reading

**3.5**

**ceramic ware**

ceramic articles which are intended to be used in contact with foodstuffs, e.g. foodware made of china, porcelain and earthenware, whether glazed or not

**3.6**

**cooking ware**

foodware, specifically intended to be heated in the course of preparation of food and drinks by conventional thermal methods and by microwaves

**3.7**

**dinnerware**

articles specially intended for the serving of food on the table, including plates, dishes and salad bowls, but excluding volumetric ware typically used for beverages, such as goblets and decanters

**3.8**

**direct method of determination**

analytical method consisting of inserting the measured absorption or machine reading into the calibration function and deducing the concentration of the analyte

**3.9**

**drinking rim**

20 mm wide section of the external surface of a drinking vessel, measured downwards from the upper edge along the wall of the vessel

**3.10**

**extraction solution**

acetic acid, 4 % (V/V), recovered after the extraction test and which is analysed for lead and cadmium concentration

**3.11**

**flame atomic absorption spectrometry (FAAS)**

atomic absorption spectrometry that uses a flame to create free atoms of the analyte in the gas phase

**3.12**

**flatware**

ceramic or glassware having an internal depth not exceeding 25 mm, measured from the lowest point to the horizontal plane passing through the point of overflow

**3.13**

**foodware**

articles which are intended to be used for the preparation, cooking, serving and storage of food or drinks

**3.14****glass ceramic**

inorganic material produced by the complete fusion of raw materials at high temperatures into a homogeneous liquid which is then cooled to a rigid condition and temperature treated in such a way as to produce a mostly micro-crystalline body

**3.15****glass**

inorganic material produced by the complete fusion of raw materials at high temperature into a homogeneous liquid which is then cooled to a rigid condition, essentially without crystallization

NOTE The material may be clear, coloured, or opaque, depending on the level of colouring and opacifying agents used.

**3.16****hollowware**

ceramic ware having an internal depth greater than 25 mm, measured from the lowest point to the horizontal plane passing through the point of overflow. Hollowware is subdivided into three categories based on volume:

- small: hollowware with a capacity < 1,1 l;
- large: hollowware with a capacity of  $\geq 1,1$  l;
- storage: hollowware with a capacity of  $\geq 3$  l;
- cups and mugs: small ceramic hollowware commonly used for consumption of beverages, e.g., coffee or tea at elevated temperature.

NOTE Cups and mugs are vessels of approximately 240 ml capacity with a handle. Cups typically have curved sides whereas mugs have cylindrical sides.

**3.17****optimum working range**

range of concentrations of an analyte over which the relationship between absorption and concentration is practically linear

**3.18****reference surface area**

the area that is intended to come into contact with foodstuffs in normal use

**3.19****test solution**

the solvent used in the test to extract lead and cadmium from the article [acetic acid, 4 % (V/V)]

**3.20****vitreous enameled ware**

metallic articles coated with a vitreous inorganic coating bonded by fusion at temperatures above 500 °C

**4 Permissible limits**

The permissible limits for lead- and cadmium-release are given in Table 1.

**Table 1 — Permissible limits for lead- and cadmium-release**

Type of Ware	<i>n</i> <sup>a</sup>	Permissible limit criterion	Unit of measure	Lead limit	Cadmium limit
Flatware	4	mean ≤ limit	mg/dm <sup>2</sup>	0,8	0,07
Small Hollowware	4	all specimens ≤ limit	mg/l	2	0,5
Large Hollowware	4	all specimens ≤ limit	mg/l	1	0,25
Storage Hollowware	4	all specimens ≤ limit	mg/l	0,5	0,25
Cups and Mugs	4	all specimens ≤ limit	mg/l	0,5	0,25
Cooking Ware	4	all specimens ≤ limit	mg/l	0,5	0,05

<sup>a</sup> *n* is the number of specimens in the sample under test.

**5 Reproducibility and variability**

**5.1 General**

Lead- and cadmium-release measurements from ceramic foodware are subject to analytical reproducibility errors and sampling variability. The material presented in this section is of scientific and technological interest but is not of normative or statutory value in the context of this part of ISO 6486.

**5.2 Reproducibility**

Three types of determination errors occur in the analytical measurement of lead and cadmium concentrations. Each is listed in Table 2 with an approximate value for the standard deviation of each [4].

**Table 2 — Sources of Variation in analytical determination of Pb and Cd**

1	Source of Variation	Standard deviation, Pb determination mg/l	Standard deviation, Cd determination mg/l
2	Analysis, within laboratory	0,04	0,004
3	Analysis, between laboratories	0,06	0,007
4	Laboratory × sample Interaction	0,06	0,01
5	Reproducibility	0,094	0,012

The statistical interaction term, row 4 in Table 2, reflects the failure of the differences in sample analyses to be the same from laboratory to laboratory. A detailed discussion may be found in elementary statistical texts that address Analysis of Variance (ANOVA) methods. The reproducibility is the square root of the sum of the squares of the standard deviations from the three sources of variation.

### 5.3 Variability

Analytical reproducibility is quite good compared to the intrinsic variability of the extraction behavior of glass and ceramic surfaces. This variability, termed sampling variability, is by far the greatest source of experimental error. Moore <sup>[5]</sup> has shown that the coefficient of variability for lead and cadmium release for large samples is typically 60%. Thus, the true average lead release value for a large population must be approximately 0,58 mg/l in order to avoid one of four test specimens from exceeding a 2 mg/l limit 1 in 10 000 times. Table 3 illustrates the effect of population mean and standard deviation values on the probability that 1 in 4 or 1 in 6 specimens will exceed a 2 mg/l limit value.

**Table 3 — Probabilities of exceeding 2 mg/l limit**

Population mean	Population standard deviation	Probability of 1 in 4 > 2 mg/l	Probability of 1 in 6 > 2 mg/l
0,4	0,24	< 0,000 01	< 0,000 01
0,8	0,48	0,138 26	0,200 05
1,2	0,72	0,758 36	0,881 22
0,4	0,12	< 0,000 01	< 0,000 01
0,8	0,24	0,000 02	0,000 04
1,2	0,36	0,325 68	0,446 27

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1) To be published.



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