

INTERNATIONAL
STANDARD

ISO
2722

Second edition
1997-02-15

**Vitreous and porcelain enamels —
Determination of resistance to citric acid
at room temperature**

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*Émaux vitrifiés — Détermination de la résistance à l'acide citrique
à température ambiante*

ISO 2722:1997

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Reference number
ISO 2722:1997(E)

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.

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.

International Standard ISO 2722 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings* Subcommittee SC 6, *Vitreous and porcelain enamels*.

This second edition cancels and replaces the first edition (ISO 2722:1973) which has been technically revised.

Annex A of this International Standard is for information only.

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Vitreous and porcelain enamels — Determination of resistance to citric acid at room temperature

1 Scope

This International Standard specifies a method of test for the determination of resistance to citric acid, at room temperature, of vitreous and porcelain enamelled articles, and also specifies a method for classifying the results.

It is not applicable to vitreous and porcelain enamels that come into contact with hot and strong acids or to vitreous and porcelain enamelled articles for use in the chemical industry.

NOTES

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- 1 For testing the resistance to boiling citric acid, see ISO 2742^[3].
- 2 For testing the resistance to sulfuric acid of vitreous and porcelain enamels at room temperature, see ISO 8290^[5].
- 3 For testing the resistance to condensing hydrochloric acid vapour of vitreous and porcelain enamelled surfaces of containers and equipment used in the chemical industry, see ISO 2743^[4].

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

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

ISO 4788:1980, *Laboratory glassware — Graduated measuring cylinders*.

3 Principle

Exposure, under defined conditions, of a part of the surface of a test specimen to attack by citric acid solution.

Assessment of resistance by methods based on the appearance and cleanability of the enamelled surface.

4 Reagents and materials

During the determination, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water, or water of equivalent purity (grade 3 water complying with the requirements of ISO 3696).

4.1 Citric acid solution, 100 g/l.

Dissolve 10 g of pure crystalline citric acid ($C_6H_8O_7 \cdot H_2O$) in water and then add water to the 100 ml mark.

A fresh solution, prepared the same day, is required for each test.

4.2 Degreasing medium, for example a detergent containing water or ethanol, C_2H_5OH , for cleaning and degreasing of the test specimens.

4.3 Titanium dioxide, pigment grade.

5 Apparatus

5.1 Graduated measuring cylinder, capacity 100 ml, complying with the requirements of ISO 4788.

5.2 Balance, accurate to 0,1 g.

5.3 Pipette, complying with the requirements of ISO 648.

5.4 Towel, of white cotton or flax.

5.5 Filter paper, free from fluoride, thickness less than 0,18 mm, approximately 30 mm in diameter (only to be used for testing of curved surfaces).

5.6 Filter paper, free from fluoride, thickness greater than 0,38 mm, approximately 25 mm in diameter (only to be used for testing of curved surfaces).

5.7 Filter paper, free from fluoride.

5.8 Pencil, HB hardness (or equivalent).

5.9 Caps (e.g. curved glasses), made of polyethylene or glass, external approximately 30 mm in diameter.

6 Test specimens

6.1 The test specimens may be commercial items, parts thereof, or test pieces especially prepared in accordance with the International Standard for the appropriate base metal.

NOTE — The production of test specimens for testing vitreous and porcelain enamels for sheet steel, cast iron and aluminium is specified in ISO 2723^[1], ISO 2724^[2] and ISO 13804^[6], respectively.

6.2 Each test specimen shall be cleaned with the degreasing medium (4.2), then rinsed with hot water until the water spreads evenly on the surface and then finally dried by dabbing (not rubbing) with the clean towel (5.4).

Alternatively, the test specimen may be rinsed with ethanol and allowed to air-dry after rinsing with hot water.

7 Procedure

7.1 Attack by the testing solution

Using the pipette (5.3), place a few drops of the citric acid solution (4.1) on each specimen and keep at a temperature of $23\text{ °C} \pm 3\text{ °C}$ during the whole period of the test, ensuring that there is a continuous treatment area the diameter of which shall be less than that of the cap (5.9). Cover the treatment area immediately with the cap.

In the case of curved surfaces, place the thin filter paper (5.5) on the area to be treated. On top of this put the thicker filter paper (5.6). Apply drops of the citric acid solution (4.1) to the top filter paper (5.6) until both filter papers are saturated. Cover the filter papers to prevent evaporation, for example with a cap (5.9), and keep the specimen at a temperature of $23\text{ °C} \pm 3\text{ °C}$.

After $15\text{ min} \pm 30\text{ s}$, remove the cap (5.9) and filter papers (5.5 and 5.6), wash the test specimen with either distilled or equivalent purity water or tap water, then dry it by dabbing (not rubbing) with filter paper (5.7).

When using tap water, ensure that a residual film is not allowed to form; otherwise the classification may be affected.

7.2 Determination

Examine each test specimen within 2 h of the completion of the attack by the testing solution (see 7.1).

For the evaluation, only that part of the surface of the test specimen which has been subjected to exposure to acid shall be considered as a treatment area.

The evaluation is based on the examinations specified in 7.2.1 and 7.2.2, which shall be in accordance with the scheme and classification given in figure 1 and table 1.

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7.2.1 Visual examination

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View, using normal or corrected vision, the different areas at varying angles, at a distance of 250 mm from the test specimen, without a magnifying glass, in order to ascertain the treated area differs from the non-treated area (e.g. if the brightness or the colour has changed, or if some spots have appeared). Carry out the examination in daylight, avoiding direct sunlight. The test specimen may also be examined in artificial light provided the latter be uniform and sufficiently intense. If the treated area differs in any respect from the non-treated area, the test specimen fails the visual examination.

7.2.2 Rubbing test (dry)

Draw, using the pencil (5.8), some approximately parallel lines across both the treated and non-treated areas. For black and dark coloured enamels, rub the titanium dioxide (4.3) on to the two areas instead of using a pencil. Then rub the test specimen with a dry towel (5.4). If the markings on the treated area are more difficult to remove than those on the non-treated area, the test specimen fails the dry rubbing test.

7.2.3 Rubbing test (moist)

Draw, using the pencil (5.8), some approximately parallel lines across both the treated and non-treated areas. For black and dark coloured enamels, rub the titanium dioxide (4.3) on to the two areas instead of using a pencil. Then rub the test specimen with a towel (5.4) which has been moistened with water and thoroughly wrung out (do not use any soap or detergent). If the markings on the treated area are more difficult to remove than those on the non-treated area, the test specimen fails the moist rubbing test.

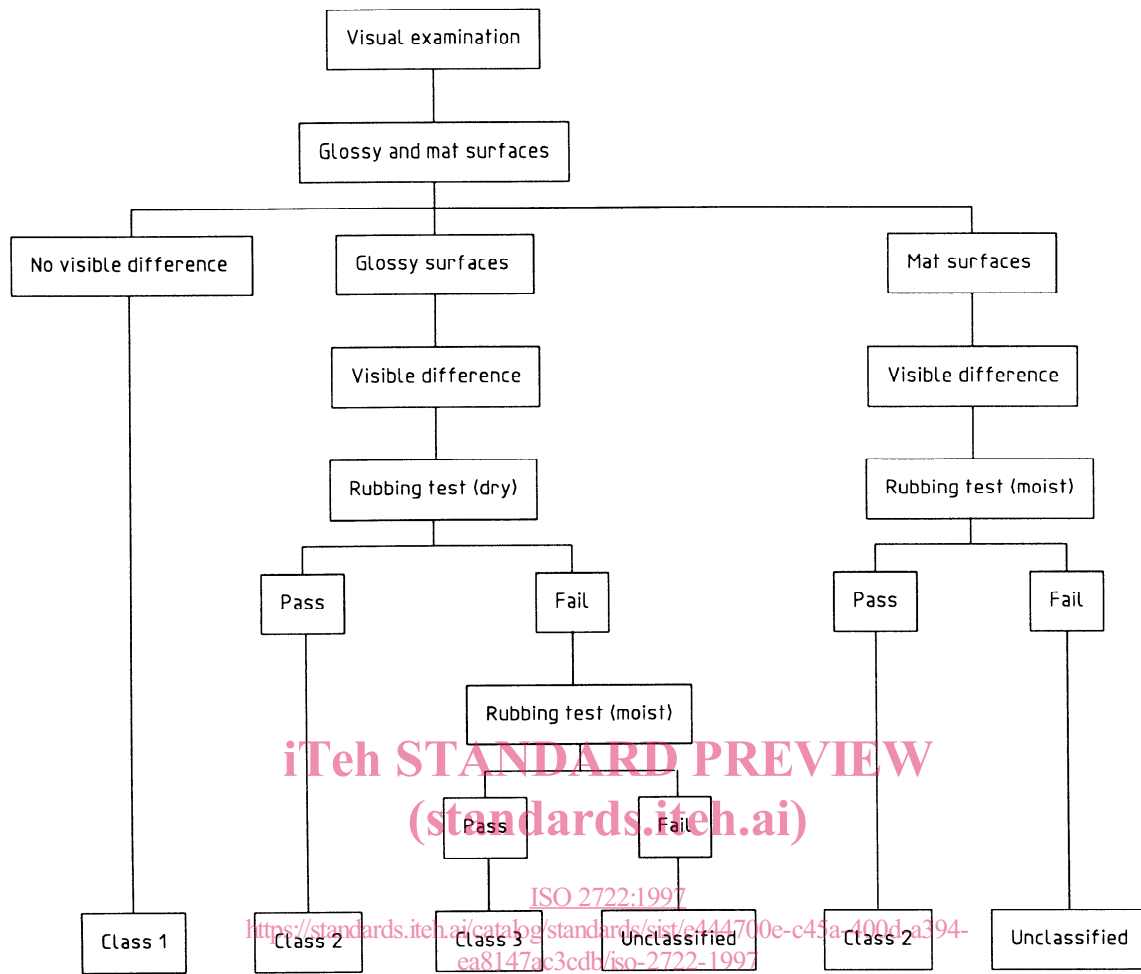


Figure 1 — Test scheme

Table 1 — Classification

Type of examination	Class	
	Glossy surface	Mat surface
Visual examination — passed	1	1
Rubbing test (dry) — passed	2	—
Rubbing test (moist) — passed	3	2
Rubbing test (moist) — failed	Unclassified	Unclassified

8 Classification of results

Dependent on the results of the determinations which have been performed in accordance with 7.2, the vitreous and porcelain enamels are conveniently classified as shown in table 1.

In the case of a failed visual examination (7.2.1), a failed dry rubbing test (7.2.2) and a failed moist rubbing test (7.2.3) for glossy surfaces and a failed visual examination (7.2.1), and a failed moist rubbing test (7.2.3) for mat surfaces, the vitreous and porcelain enamel concerned shall not be evaluated by this International Standard.

9 Test report

The test report shall contain the following information:

- a) reference to this International Standard;
- b) description of the test specimen;
- c) results of the test specified in clause 7;
- d) classification of the vitreous and porcelain enamel according to clause 8.

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Annex A (informative)

Bibliography

- [1] ISO 2723:1995, *Vitreous and porcelain enamels for sheet steel — Production of specimens for testing.*
- [2] ISO 2724:1973, *Vitreous and porcelain enamels for cast iron — Production of specimens for testing.*
- [3] ISO 2742:1983¹⁾, *Vitreous and porcelain enamels — Determination of resistance to boiling citric acid.*
- [4] ISO 2743:1986, *Vitreous and porcelain enamels — Determination of resistance to condensing hydrochloric acid vapour.*
- [5] ISO 8290:1987¹⁾, *Vitreous and porcelain enamels — Determination of resistance to sulfuric acid at room temperature.*
- [6] ISO 13804:—²⁾, *Vitreous and porcelain enamels for aluminium — Production of specimens for testing.*

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1) Under revision.

2) To be published.

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