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

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

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Foreword

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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 8290 was prepared by Technical Committee ISO/TC 107, *Metal and other inorganic coatings*, subcommittee SC 6, *Vitreous and porcelain enamels*.

This second edition cancels and replaces the first edition (ISO 8290:1987) 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 sulfuric acid at room temperature

1 Scope

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

It is particularly intended for the testing of vitreous and porcelain enamelled articles that come into contact with products of combustion containing sulfuric acid.

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

NOTES

- 1 For testing the resistance to citric acid of vitreous and porcelain enamels at room temperature, see ISO 2722.
- 2 For testing the resistance to boiling citric acid, see ISO 2742.
- 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.

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 1042:—¹⁾, *Laboratory glassware — One-mark volumetric flasks.*

ISO 2723:1995, *Vitreous and porcelain enamels for sheet steel — Production of specimens for testing.*

ISO 2724:1973, *Vitreous and porcelain enamels for cast iron — Production of specimens for testing.*

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

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

ISO 9180:1988, *Black leads for wood-cased pencils — Classification and diameters.*

1) To be published. (Revision of ISO 1042:1983)

3 Principle

A part of the surface of a test specimen is exposed under defined conditions to sulfuric acid solution.

The resistance of the enamelled surface is assessed using methods based on appearance and cleanability.

4 Reagents

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 ISO 3696).

4.1 Sulfuric acid (H₂SO₄) solution, 20 g/l: measure 41 ml of sulfuric acid ($c(\text{H}_2\text{SO}_4) = 0,5 \text{ mol/l}$) in the graduated measuring cylinder (5.1), transfer to the volumetric flask (5.2) and dilute to the mark with water.

4.2 Cleaning medium, for example ethanol, C₂H₅OH, or water containing a few drops of liquid detergent, for cleaning and degreasing the test specimen.

4.3 Titanium dioxide, pigment grade.

5 Apparatus

5.1 Graduated measuring cylinder, capacity 50 ml, complying with ISO 4788.

5.2 One-mark volumetric flask, capacity 100 ml, complying with ISO 1042.

5.3 Pipette, complying with ISO 648.

5.4 Towel, of white cotton or flax.

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

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

5.7 Filter paper, free from fluoride.

5.8 Pencil, HB hardness, complying with ISO 9180.

5.9 Caps, for example watch-glasses, made of polyethylene or glass, external diameter approximately 30 mm.

6 Test specimens

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

Prepare the test specimens for testing vitreous and porcelain enamels for sheet steel and for cast iron in accordance with ISO 2723 and ISO 2724, respectively.

Clean each test specimen with the cleaning medium (4.2), then rinse it in hot water until the water spreads evenly on the surface and finally dry it by dabbing (not rubbing) with the clean towel (5.4).

7 Procedure

7.1 Contact with the testing solution

Using the pipette (5.3), place a few drops of the sulfuric acid solution (4.1) on each test specimen. Maintain the test specimen 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, of diameter less than that of the cap (5.9). Cover the treatment area with the cap immediately after placing the acid on the test specimen.

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 sulfuric 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), if any, wash the test specimen with either water as specified in clause 4 or tap water, then dry it by dabbing (not wiping) with filter paper (5.7).

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

7.2 Determination

7.2.1 General

Examine each test specimen within 2 h of the completion of the test period (see 7.1).

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

The evaluation is based on the examinations specified in 7.2.2 to 7.2.4, which shall be in accordance with the test scheme and classification given in Figure 1 and in Table 1.

7.2.2 Visual examination

View, using normal or corrected vision, the different areas at varying angles, at a distance of about 250 mm from the test specimen, without a magnifying glass, in order to ascertain whether the treated area differs from the non-treated area (for example 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 that the latter is uniform and strong enough.

If the treated area differs in any respect from the non-treated area, the test specimen shall be deemed to have failed the visual examination.

7.2.3 Rubbing test (dry)

Draw, using the pencil (5.8), a few 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 the 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.

7.2.4 Rubbing test (moist)

Carry out the test specified in 7.2.3, but use 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.

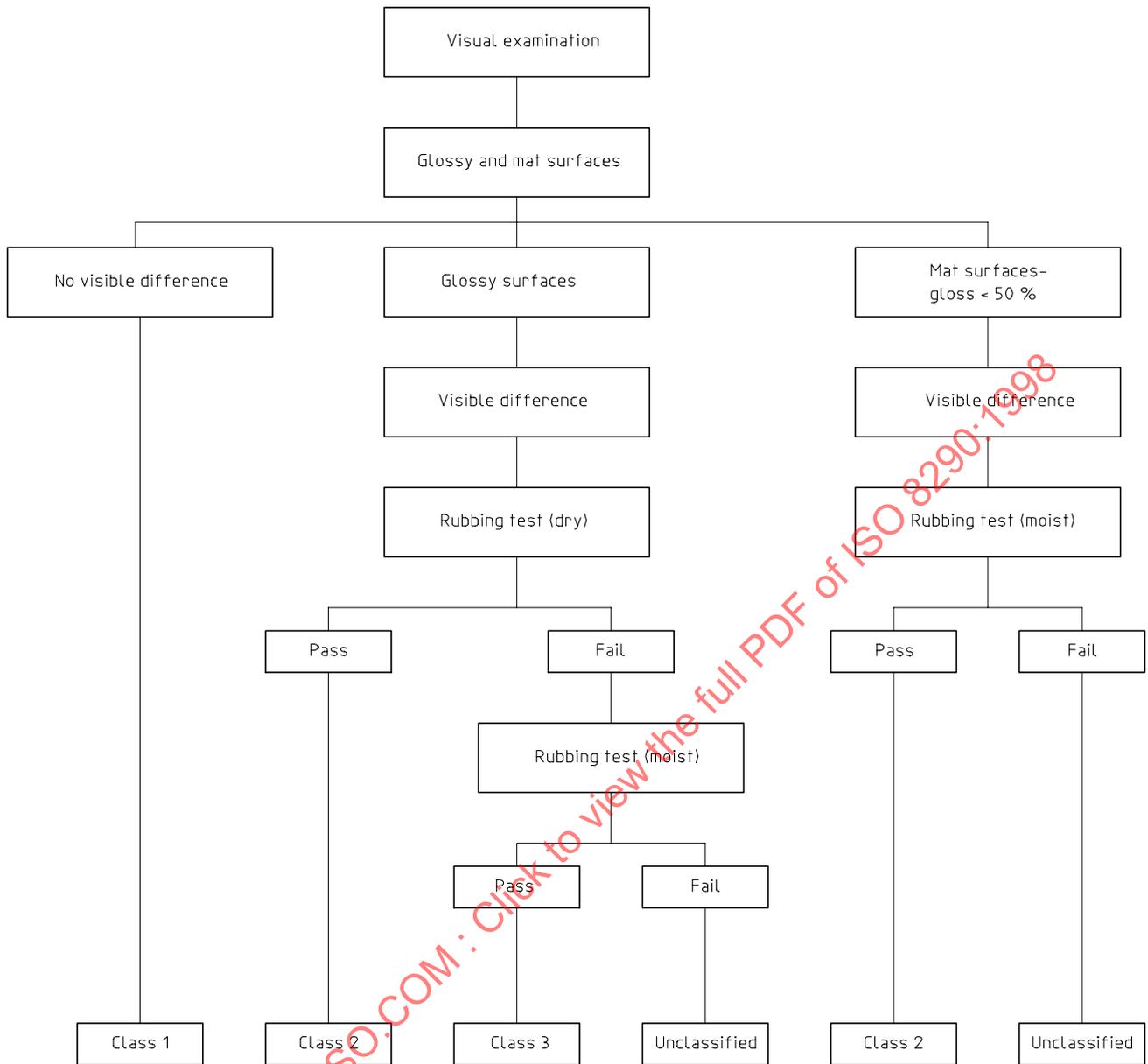


Figure 1 — Test scheme

8 Classification of results

Dependent on the results of the determinations which have been performed in accordance with 7.2, classify the vitreous and porcelain enamels as shown in Table 1.

In the case of a failed visual examination (see 7.2.2), a failed dry rubbing test (see 7.2.3) and a failed moist rubbing test (see 7.2.4) for glossy surfaces and a failed visual examination (see 7.2.2), and a failed moist rubbing test (see 7.2.4) for mat surfaces, the vitreous and porcelain enamel concerned may not be evaluated by this International Standard.

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

9 Test report

The test report shall contain the following information:

- a) reference to this International Standard, i.e. ISO 8290:1998;
- b) a description of the test specimen;
- c) the result of the test specified in clause 7;
- d) the classification of the vitreous and porcelain enamel according to clause 8.

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Annex A (informative)

Bibliography

- [1] ISO 2722:1997, *Vitreous and porcelain enamels — Determination of resistance to citric acid at room temperature.*
- [2] ISO 2742:1998, *Vitreous and porcelain enamels — Determination of resistance to boiling citric acid.*
- [3] ISO 2743:1986, *Vitreous and porcelain enamels — Determination of resistance to condensing hydrochloric acid vapour.*

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