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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

Reference number
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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8290 was prepared by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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

1 Scope and field of application

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 testing of vitreous and porcelain enamelled articles that come in contact with products of combustion containing sulfuric acid.

It is not applicable to matt vitreous and porcelain enamels, to vitreous and porcelain enamels that come in 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, *Vitreous and porcelain enamels — Determination of resistance to citric acid at room temperature.*

2 For testing the resistance to boiling citric acid, see ISO 2742, *Vitreous and porcelain enamels — Determination of resistance to boiling citric acid.*

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, *Vitreous and porcelain enamels — Determination of resistance to condensing hydrochloric acid vapour.*

2 References

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

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

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

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

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

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

3 Principle

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

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

4 Reagents and material

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 Sulfuric acid (H_2SO_4), solution, 20 g/l.

Measure 41 ml of sulfuric acid [$c(H_2SO_4)$ = 0,5 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 Degreasing solvent, such as trichloroethylene or acetone, suitable for cleaning the test specimen.

4.3 Titanium dioxide, pigment grade.

5 Apparatus

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

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

5.3 Pipette, complying with the requirements of ISO 648.

5.4 Towel, of white cotton or flax.

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

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

5.7 Filter paper.

5.8 Pencil, HB hardness (or equivalent).

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

5.10 Electric lamp, fitted with a 40 W pearl bulb (for example siliconized).

6 Test specimens

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

NOTE — The production of test specimens for testing vitreous and porcelain enamels for sheet steel and for cast iron is specified in ISO 2723 and ISO 2724 respectively.

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

7 Procedure

7.1 Attack by the testing solution

Using the pipette (5.3), place a few drops of the sulfuric acid solution (4.1) on each test specimen and keep at a temperature of 23 ± 3 °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 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 ± 3 °C.

After 15 min ± 30 s, remove the cap (5.9) and filter papers (5.5 and 5.6) if any, wash the test specimen with either water (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 may be affected.

7.2 Determination

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

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

The evaluation is based on the examinations specified in 7.2.1 to 7.2.4, which shall be in accordance with the scheme and classification given in the figure and in the table.

7.2.1 Visual examination

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 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 the latter is uniform and strong enough. 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. If, on rubbing the test specimen with the dry towel (5.4), 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 Reflection test

7.2.3.1 Set the test specimen in such a way that the image of the bulb of the electric lamp (5.10), located 350 ± 100 mm away from the specimen, reflects on the non-treated area with an angle of incidence of 45 °. Then watch the image of the bulb on the non-treated area while the test specimen is slowly moved, so that the image moves into the treated area. If no blurring of the image is observed while it passes from one area to the other, the test specimen passes the reflection test.

7.2.3.2 If the test specimen fails the reflection test (7.2.3.1), it is then necessary to distinguish, in the passage from one area to the other, whether there is a blurring or a complete disappearance of the image.

7.2.4 Rubbing test (moist)

Carry out the test specified in 7.2.2, 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.

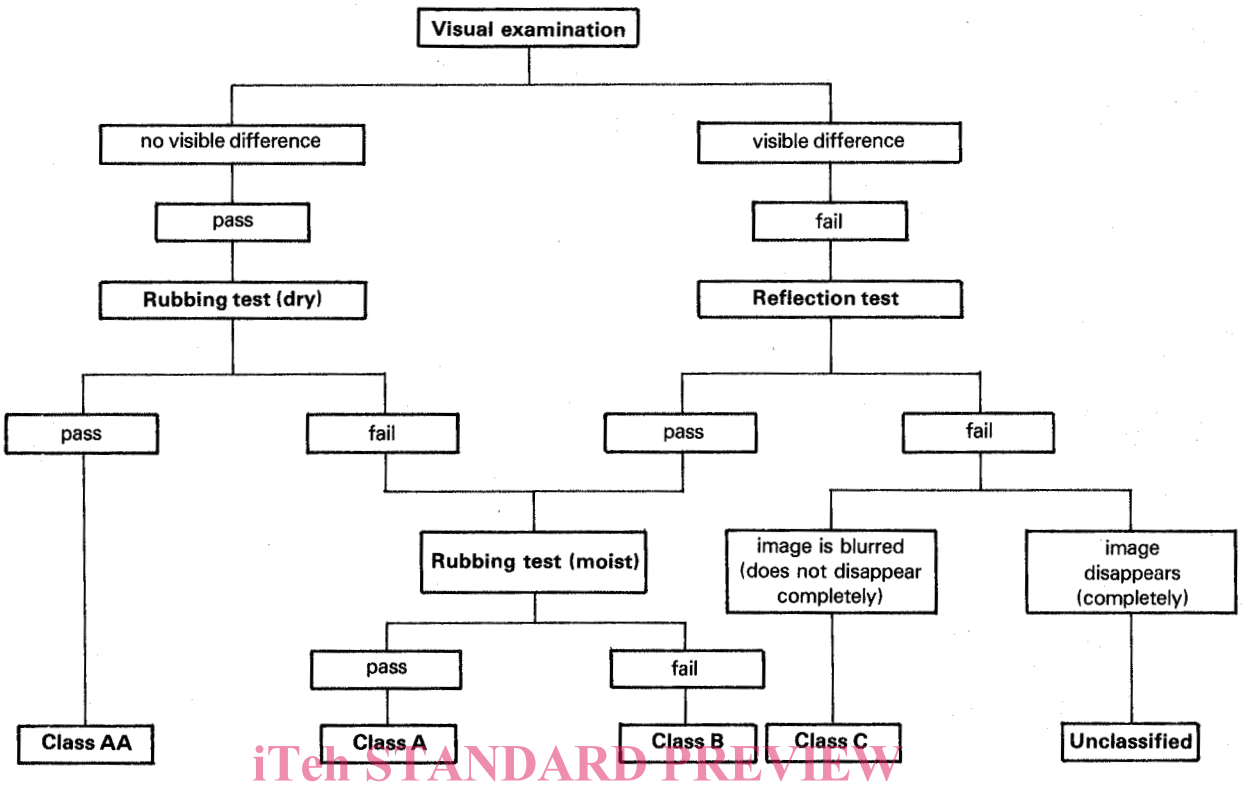

Figure — Test scheme

8 Classification of results

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

In the case of a failed visual examination (7.2.1) and a totally failed reflection test (7.2.3.2), the enamel cannot be evaluated by this International Standard.

9 Test report

The test report shall contain the following information:

a) a reference to this International Standard;

b) a description of the test specimen;

c) the results of the tests specified in clause 7;

d) the classification of the vitreous and porcelain enamel according to clause 8.

Table — Classification

Class	Visual examination	Reflection test	Rubbing test	
			Dry	Moist
AA	pass	—	pass	—
A	pass	—	fail	pass
A	fail	pass	—	pass
B	pass	—	fail	fail
B	fail	pass	—	fail
C	fail	partly fail	—	—
Unclassified (not resistant to sulfuric acid)	fail	totally fail	—	—

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Descriptors : coatings, non metallic coatings, vitreous enamels, porcelain enamels, tests, acid resistance tests, sulfuric acid.

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