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Vitreous and porcelain enamels — Determination of resistance to boiling hydrochloric acid

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FOREWORD

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It has been approved by the Member Bodies of the following countries :

Australia	Israel	South Africa, Rep. of
Chile	Italy	Spain
Egypt, Arab Rep. of	Japan	Sweden
France	Netherlands	Switzerland
Germany	New Zealand	United Kingdom
Hungary	Poland	U.S.S.R.
India	Portugal	
Ireland	Romania	

No Member Body expressed disapproval of the document.

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Vitreous and porcelain enamels — Determination of resistance to boiling hydrochloric acid

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method of test for determining the resistance of flat surfaces of vitreous and porcelain enamels for containers and chemical apparatus to boiling hydrochloric acid.

NOTE — This method of test is also suitable for determining the chemical resistance of enamels to other highly corrosive acid chemicals.

The method allows determination of the resistance of enamels to the liquid and vapour phases of the corrosive medium.

2 REFERENCES

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 2733, *Vitreous and porcelain enamels — Apparatus for testing with acid and neutral liquids and their vapours.*

3 PRINCIPLE

Each set of similarly enamelled specimens is exposed to attack by a boiling 20 % (*m/m*) solution of hydrochloric acid for 48 h (2 days) or 336 h (14 days), the specimens being placed in the liquid chamber and in the vapour chamber of the testing apparatus as required.

The loss in mass is determined and the corrosion speed calculated therefrom.

The lower the corrosion speed, the higher is the resistance of the vitreous and porcelain enamel to boiling hydrochloric acid.

4 REAGENTS

4.1 Hydrochloric acid, 20 % (*m/m*) solution, analytically pure, ρ_{20} 1,098 g/ml.

A fresh solution is required for each test.

4.2 Distilled or demineralized water, for cleaning the testing apparatus and specimens.

5 APPARATUS

5.1 Testing apparatus and packing A, both in accordance with ISO 2733.

5.2 Hot-air oven capable of maintaining a temperature of at least 130 °C.

5.3 Desiccator, for example with an internal diameter of 200 mm.

5.4 Graduated measuring cylinder, capacity 500 ml.

5.5 Beakers.

5.6 Balance, accurate to ± 0,2 mg.

5.7 Sponge, soft.

6 TEST SPECIMENS

6.1 The specimens to be used shall be specially prepared in accordance with the International Standards for the appropriate basis metal.

NOTE — Specimens for testing vitreous and porcelain enamels

- for sheet steel, see ISO 2723;
- for cast iron, see ISO 2724.

6.2 For each determination, two tests with each set of specimens shall be carried out.

6.3 Each specimen shall be rinsed with distilled or demineralized water and dried for 2 h in the hot-air oven (5.2) at 110 ± 5 °C, then cooled for at least 2 h in the desiccator (5.3) and weighed to the nearest 0,2 mg (starting mass).

7 PROCEDURE

7.1 Fix the specimens in the testing apparatus (5.1) so that the cover coat sides of the specimens are facing the interior of the cylinder.

Screw down the three wing nuts evenly to make the testing apparatus watertight.

7.2 Run 350 ml of the test solution (4.1) into the socket for the return flow cooler, replace the latter and switch on the heater.

As soon as the test solution begins to boil (two to four bubbles per second), lower the current by the rheostat control so that the test solution simmers during the remainder of the test.

Record the temperature during the simmering.

7.3 The simmering time shall be 48 h (2 days). If the loss in mass of a specimen after this time is less than 5 mg, carry out the test with new specimens and a simmering time of 336 h (14 days).

If the test is confined exclusively or mainly to attack by one phase only (liquid or vapour) this determines the testing time (2 or 14 days respectively).

7.4 After simmering for 48 h (or 336 h) empty the cylinder and, after cooling, rinse with distilled or demineralized water.

Take the specimens from the testing apparatus and wipe them three times with the wet sponge (5.7) and water.

After carefully removing any packing residues from the edges of the specimens, dry them for 2 h in the hot-air oven (5.2) at 110 ± 5 °C. After a further 2 h in the desiccator (5.3), weigh them again to the nearest 0,2 mg (final mass).

8 EXPRESSION OF RESULTS

8.1 The area exposed to the attack of acid or acid vapour is assumed to be 50 cm^2. If the loss in mass Δm (starting mass − final mass) is stated in milligrams, for a testing time of 48 h (2 days) the corrosion speed $v_{K(2)}$ is calculated in grams per square metre per day according to the equation :

$$v_{K(2)} = \frac{\Delta m}{10} = 0{,}1\ \Delta m \qquad \ldots (1)$$

For a testing time of 336 h (14 days) the corrosion speed $v_{K(14)}$ is calculated in grams per square metre per day according to the equation :

$$v_{K(14)} = \frac{\Delta m}{70} = 0{,}014\ 28\ \Delta m \qquad \ldots (2)$$

8.2 The results obtained for the specimens placed in the liquid chamber and in the vapour chamber of the testing apparatus are calculated separately. Since the determination consists of two parallel tests, two values are given for the attack in the liquid phase and two for the vapour phase, which are then averaged.

The difference between the minimum and maximum individual values of the corrosion speed shall be less than 30 %; the 30 % are calculated from the arithmetic mean of the individual values. If not, a further test shall be carried out, the results of which shall be taken into account in calculating a new arithmetic mean.

For the evaluation, the results of the specimens which show defects such as pinholes down to the metal, chipped edges or edge corrosion, are omitted. The corresponding number of new specimens shall be tested.

9 TEST REPORT

The test report shall include the following particulars :

a) testing temperature, in degrees Celsius;

b) simmering time, in days;

c) corrosion speed $v_{K(2)}$ or $v_{K(14)}$, in grams per square metre per day, rounded to the nearest 0,01 g/(m^2.d), separated according to vapour and liquid phases, giving the arithmetic means and the number of single values.