INTERNATIONAL STANDARD

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Vitreous and porcelain enamels — Low voltage test for detecting and locating defects

Émaux vitrifiés — Essai à basse tension pour la détection et la localisation des défauts

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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.

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

International Standard ISO 8289 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*.

This second edition cancels and replaces the first edition (ISO 8289:1986), which has been technically revised.

Vitreous and porcelain enamels — Low voltage test for detecting and locating defects

1 Scope

This International Standard specifies two low voltage tests for detecting and locating defects that extend to the basis metal in vitreous and porcelain enamel coatings.

Method A (electrical) is suitable for the rapid detection and determination of the general location of defects. Method B (optical), based on colour effects, is suitable for the more precise detection of defects and their exact locations. Method A is commonly applied to flat surfaces, whereas method B is preferred for more intricate shapes.

NOTE 1 Selection of the correct test method is critical to distinguish the areas of increased conductivity detected by method B from actual pores that extend to the basis metal, which can be detected by both methods.

NOTE 2 The low voltage test is a non-destructive method of detecting defects (see clause 3) and therefore, is completely different from the high voltage test specified in ISO 2746. The results of high and low voltage tests are not comparable and will differ.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document 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.

IEC 60086-2, *Primary batteries — Part 2: Specification sheets*.

3 Term and definition

For the purposes of this International Standard, the following term and definition applies.

3.1
defect
pore, crack or spall that penetrates or extends to the basis metal

NOTE In certain areas, defects may be unavoidable being caused during the production of the article, e.g., burnishing tool marks.

4 Principle

Defects are detected by an electrical or electroacoustical method (method A) or an optical one (method B) based on colour effects. Testing is carried out at a low voltage, contact being made with the defect by means of a conductive solution.

5 Test reagent

Dissolve 3,0 g $\pm$ 0,1 g sodium nitrite ($NaNO_2$) in 100 ml of tap water and add 2 drops of a liquid dishwashing detergent.

If the defects are to be made visible by means of colour effects (method B), add 4 ml of phenolphthalein ethanolic solution having a mass fraction of 0,5 % phenolphthalein.

WARNING — Care should be taken when using the sodium nitrite and phenolphthalein solution.

Instead of sodium nitrite, other water soluble salts may be used provided that the article shall not be re-enamelled after testing. The salt solution shall be used in such an amount that the alternative test reagent has a conductivity of 35 mS $\pm$ 3mS and a pH value of 7,5 $\pm$ 1.

6 Apparatus

6.1 Method A

6.1.1 Power source

The power source for method A shall consist of a 9 V battery device with an accuracy of $\pm$ 1V. For example, a transistor battery, 6 F 100, as specified in IEC 60086-2, is suitable.

6.1.2 Test electrode

The test electrode for method A consists of a sponge made of plastic, cellulose or similar material. For rough scanning of large enamelled surfaces, test electrodes with an area of not greater than 100 cm^2 shall be used. Any defects that are detected shall then be more precisely located using a test electrode with an area of about 1 cm^2 or by using an edge or corner of the larger electrode.

6.1.3 Measuring instrument

A sensitive microammeter or an electronic circuit that produces an acoustical signal that indicates when the electrical resistance of the vitreous enamel drops below 90 k$\Omega \pm$ 9 kΩ shall be used to detect and locate defects in the coating.

6.2 Method B

6.2.1 Power source

The power source for method B shall consist of a source of direct voltage (d.c. voltage), 24 V $\pm$ 4 V. Alternatively, a voltage divider, or three transistor radio batteries, 6 F 100, as specified in IEC 60086-2, connected in series may be employed.

6.2.2 Test electrode

Wet paper, for example, kitchen tissue, with an area of at least 500 cm^2, shall be used as the test electrode for method B.

7 Test specimen

The test specimen may be a commercial item, a part thereof or a sample plate especially prepared for this test. In any case, the test specimen shall have an uncovered (not enamelled) area of metal for contact with the negative electrode.

The test specimen shall be cleaned with a detergent solution, rinsed with tap water and dried by dabbing with a sheet of cloth or paper. When the specimen is tested within 24 h of firing, cleaning with detergent solution is not necessary. The enamel coating shall have a temperature not greater than 30 $^\circ$C.

8 Procedure

8.1 Electrical detection (method A)

Mark the area to be tested by using a felt tip marker or adhesive tape. Connect the basis metal of the test specimen to the negative pole of the power source (6.1.1). Then connect the test electrode, the sponge (6.1.2), with the positive pole of the power source (6.1.1). Soak the test electrode with the test reagent (see clause 5).

Check the electrical connection between the apparatus of 6.1.1, 6.1.2, and 6.1.3 by touching the basis metal with the test electrode. The connection is correct if the measuring instrument (6.1.3) gives an indication.

Progressively scan the total enamelled test area while moving the test electrode at a speed not greater than 0,2 m/s. Count the number of electrical signals and locate the defects.

8.2 Optical detection (method B)

Mark the test area by using a felt tip marker or adhesive tape. Connect the basis metal of the test specimen to the negative pole of the power source (6.2.1). Then connect the test electrode, the wet paper (6.2.2), with the positive pole of the power source (6.2.1). Soak the test electrode (6.2.2) with the test reagent (see clause 5) and apply it, without air inclusions, to the test area.

Switch on the power source (6.2.1) and switch it off after 2 min. Within 1 min of switching it off, count the number of defects. Each defect will be indicated by a red coloured spot visible on the test electrode (6.2.2).

9 Expression of results

Calculate the number of defects per square metre with the following equation:

$$N = \frac{S}{A}$$

where

N is the number of defects per square metre;

S is the number of detected defects;

A is the test area in square metres.

10 Test report

The test report shall contain the following information:

a) reference to this International Standard;

b) the test method used; i.e., method A or method B;

c) the identification of the article tested;

d) the number of defects per square metre;

e) if applicable, a record of the location of the defects;

f) the test reagent;

g) the date the test was made.

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