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

Part 1: Swab test for non-profiled surfaces

Émaux vitrifiés — Essai à basse tension pour la détection et la localisation des défauts —
Partie 1: Essai avec tampon pour les surfaces non profilées

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by ISO/TC 107, *Metallic and other inorganic coatings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 262, *Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces ISO 8289:2000, which has been technically revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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

Part 1:
Swab test for non-profiled surfaces

1 Scope

This document 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 applicable to the rapid detection and determination of the general location of defects. Method B (optical), based on colour effects, is applicable to the more precise detection of defects and their exact locations. Both methods are commonly applied to flat surfaces. For more intricate shapes, such as undulated and/or corrugated surfaces, ISO 8289-2 is applicable.

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 and, therefore, is completely different from the high voltage test specified in ISO 2746. The results of the high and low voltage tests are not comparable and will differ.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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

Note 1 to entry: In certain areas, defects can 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 ± 0,1 g sodium nitrite ($NaNO_2$) in 100 ml of tap water and add two 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 is not 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 ± 3 mS and a pH value of 7,5 ± 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 ±1 V. 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 restance of the vitreous enamel drops below 90 kΩ ± 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 (DC voltage), 24 V ± 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 °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 of 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 using Formula (1):

$$N = \frac{S}{A} \tag{1}$$

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 document, i.e. ISO 8289-1;

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.

Bibliography

[1] ISO 2746, *Vitreous and porcelain enamels — High voltage test*

[2] ISO 8289-2, *Vitreous and porcelain enamels — Low-voltage test for detecting and locating defects — Part 2: Slurry test for profiled surfaces*

[3] IEC 60086-2, *Primary batteries — Part 2: Physical and electrical specifications*