SLOVENSKI STANDARD
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Steklasti in porcelanski emajli – Visokonapetostni preskus

Vitreous and porcelain enamels - High voltage test

Emails und Emaillierungen - Hochspannungsprüfung

Emaux vitrifiés - Essai sous haute tension

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Foreword

This document (EN 14430:2004) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2005, and conflicting national standards shall be withdrawn at the latest by March 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

There are 2 different objectives for high voltage testing of vitreous and porcelain enamels.

Test A is used to detect and locate defects, which extend down to the metal base (e.g. open pores). This is a non-destructive test usually applied to thin enamel coatings. The test serves to monitor either that the parts produced are free from defects at the chosen test voltage, or to count the number of existing defects, e.g. to determine the defect density (defects/m^2) of enamelled architecture panels.

Test B is used to detect and locate defects, which extend down to the metal base (e.g. open pores) and to detect weak spots. This is a destructive test, i.e. the test can generate open pores with an electric discharge through weak spots in the enamel coating. This test is usually applied to thick enamel coatings and serves:

a) to verify that an enamel coating is safe to be used under highly corrosive conditions, e.g. to test the enamel coating of vessels used in the chemical industry;

or

b) to verify that the enamel coating is safe to be used as a dielectric.

Test A and Test B require the same test equipment (see Clause 6) and follow the same test procedure (see Clause 9). However, for test B the applied voltage is higher than in test A (see Clause 7).

1 Scope

This document describes 2 test methods of high voltage testing:

— Test A is used to detect and locate defects in vitreous and porcelain enamels;

— Test B is used to detect and locate defects and weak spots in vitreous and porcelain enamels.

The tests are performed using DC, pulsed DC, or AC high voltage.

The tests are applicable to dry surfaces of enamel coatings. In the case of moist surfaces, care should be taken to ensure that the locating of any defects is correctly performed.

Since test voltages depend on the coating thickness, the test method, especially with test A, may not be suitable for test specimens for which the coating thickness varies to a large extent.

NOTE This document extends the range of application of the test given in ISO 2746, which is restricted to coating thicknesses of minimum 660 µm.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method (ISO 2178:1982)*

EN ISO 2360, *Non-conductive coatings on non-magnetic electrically conductive basis metals — Measurement of coating thickness —Amplitude-sensitive eddy current method (ISO 2360:2003)*

IEC/TR2 60479-1, *Effects of current on human beings and livestock — Part 1: General aspects*

3 Terms and definitions

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

3.1
defect
area of an enamel layer where an open path connects the enamel surface with the metal base

NOTE Examples of defects are cracks or pores.

3.2
weak spot
area of an enamel layer where the dielectric strength falls below the required value, as determined by the application of high voltage because of blisters, foreign body inclusions, spalling or cracks

4 Principle

A high voltage electrode is passed over the enamel surface. Defects (Test A) or defects and weak spots (Test B) are indicated by a spark and a simultaneous optical and/or acoustic signal. The applied voltage can be DC, pulsed DC or AC. The test voltage might be different in each case.

NOTE At distances smaller than 2 cm of the edges/borders of the enamelled parts, an electrical arc can occur between the test electrode and edges/borders with no or only a limited enamel coating thickness. The high voltage technique may therefore not be applicable to such border areas.

5 Apparatus

5.1 High voltage generator, as described in 5.1.1, 5.1.2 or 5.1.3.

5.1.1 Direct-current (DC) voltage generator, conforming to the requirements of IEC/TR2 60479-1, able to deliver a DC-voltage corresponding to the testing voltage, adjustable and measurable at the test probe with limiting deviations $^{+5\%}_{-10\%}$.

5.1.2 Pulsed DC-voltage generator, conforming to the requirements of IEC/TR2 60479-1, able to deliver a DC-voltage corresponding to the testing voltage. The voltage shall be adjustable and measurable at the test probe with limiting deviations $^{+20\%}_{-10\%}$ for test voltages greater than 10 kV and limiting deviations $^{+40\%}_{-10\%}$ for test voltages less than 10 kV.

5.1.3 Alternating-current (AC) voltage generator.

NOTE The output voltage of an AC-voltage generator varies, depending on the test conditions. Some generators can deliver up to 50kV. The actual voltage cannot be measured or defined.

5.2 Test electrode, made out of metal wire or conductive rubber that is unaffected by a spark discharge.

NOTE Alternative test electrodes may be used.

5.3 Indicator, able to give a clear optical and/or acoustic signal at each spark discharge.

5.4 Coating thickness measurement device, such as that described in EN ISO 2178 or EN ISO 2360.

6 Specimens

The specimens can be commercial items, parts thereof or test pieces which have been subjected to the same processing, and which for testing purposes are representative of the commercial item.

No special preparation of specimens is required.

7 Test voltage

7.1 Test A: Detection of defects (3.1) which extend down to the metal bases (e.g. open pores)

For a correct determination of these defects, the appropriate test voltage shall be used. This voltage depends on the length of the defect gap, which corresponds to the thickness of the enamel layer. Too low a voltage will not result in the determination of all defects. Too high a voltage will result in a breakdown of thin residual enamel layers (destructive testing). In order to look for defects which extend down to the metal base (e.g. open pores), the test voltage shall be as follows:

- DC voltages shall be set to the values given in Table 1.

  NOTE 1 Other voltages may be chosen by mutual agreement between interested parties.

- the voltage of pulsed DC- and AC-voltage generators shall be agreed between the interested parties.

Table 1 — Test voltage [4]

Layer thickness µm	Test voltage V
100	1 100
110	1 150
120	1 200
130	1 240
140	1 290
150	1 370
160	1 420
170	1 450
180	1 510
190	1 560
200	1 600
210	1 660
220	1 690
230	1 750
240	1 800
250	1 850
260	1 900
270	1 940
280	1 990
290	2 030
300	2 070
400	2 520
500	2 900
750	3 820
1 000	4 600
1 500	6 450
2 000	8 000