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Vitreous and porcelain enamels — Determination of the edge covering on enamelled steel plate to be used in heat exchangers

Émaux vitrifiés — Détermination du revêtement de l'arête sur une plaque en acier émaillé destinée aux échangeurs de chaleur

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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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 28723 was prepared by the European Committee for Standardization (CEN) (as EN 14863) and was adopted, under a special “fast-track procedure”, by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, in parallel with its approval by the ISO member bodies.

Vitreous and porcelain enamels — Determination of the edge covering on enamelled steel plate to be used in heat exchangers

1 Scope

This International Standard specifies a test method for the determination of the covering of the edge of enamelled steel plate to be used in heat exchangers. This method is applicable to all enamelling processes.

It is applicable to plates with a thickness between 0,5 mm and 1,5 mm.

This method is not applicable where the current flow generated in the test exceeds 3 A.

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.

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

EN 10088-1, *Stainless steels — List of stainless steels*

3 Principle

The edge of an enamelled steel plate to be tested is submerged in an electrolyte. An alternating current source and a stabilized voltage are connected to the plate. The recorded current is a measure of the covering at the edge.

4 Reagents and materials

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and distilled or de-mineralized water or water of equivalent purity.

4.1 Pickling fluid, consisting of sulfuric acid (H_2SO_4) solution, (7 ± 0,5) % by mass, with an Fe^{2+} concentration of (2 ± 1,5) g/l, at a temperature of (60 ± 2) °C.

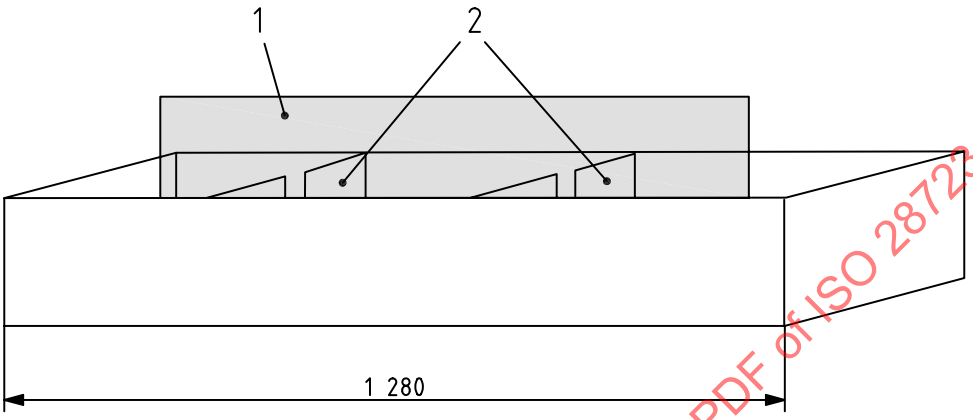
4.2 Test bath electrolyte, consisting of sodium chloride solution, 5 % NaCl by mass, made with distilled water conforming to grade 3 of ISO 3696, at a temperature of (22 ± 3) °C.

5 Apparatus

5.1 Test bath, consisting of a polypropylene container holding the electrolyte solution in which the electrodes and a test plate are placed. Polypropylene plates are used for centring and holding the test plate 10 mm from the bottom of the bath.

The arrangement of the bath and the dimensions of the components are shown in Figures 1, 2 and 3.

Dimensions in millimetres

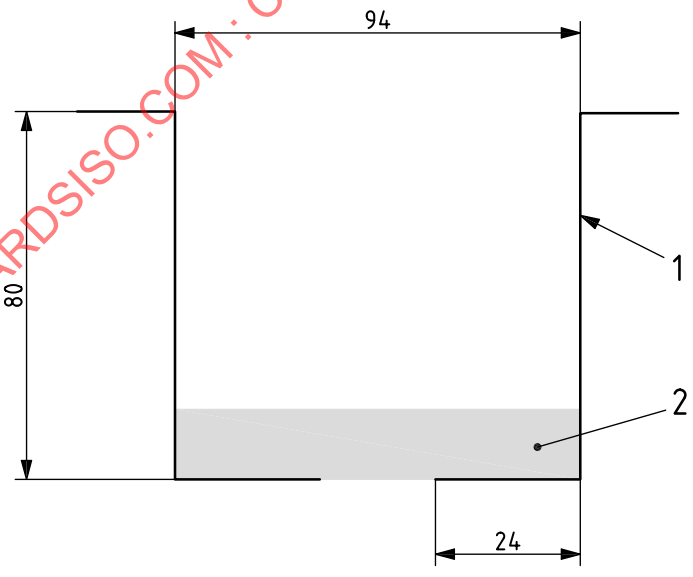


Key

1 plate to be tested
2 plates for centring and lifting the test plate from the bottom

Figure 1 — Dimensions of the test bath

Dimensions in millimetres



Key

1 electrode (1 264 mm long)
2 NaCl solution

Figure 2 — Dimensions of the two stainless-steel electrodes (EN 10088-1 grade 1.4301)

Dimensions in millimetres

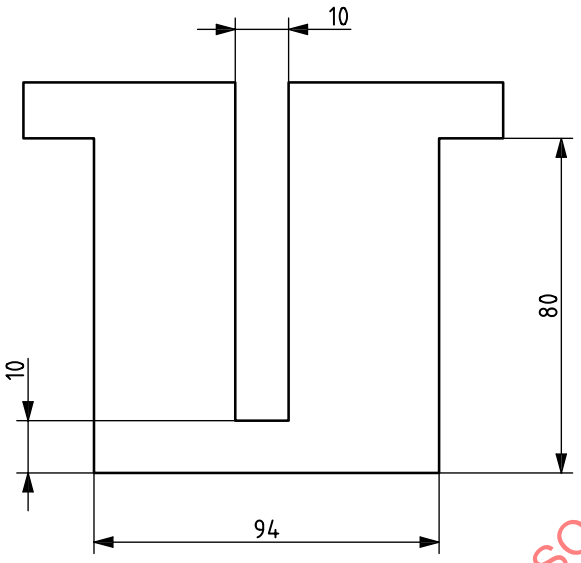


Figure 3 — Dimensions of the two polypropylene centring plates

5.2 Voltage source, consisting of a stabilized alternating source of (10,0 ± 0,05) V. The electrical diagram is shown in Figure 4.

The voltage source shall be able to maintain these voltage limits throughout the test.

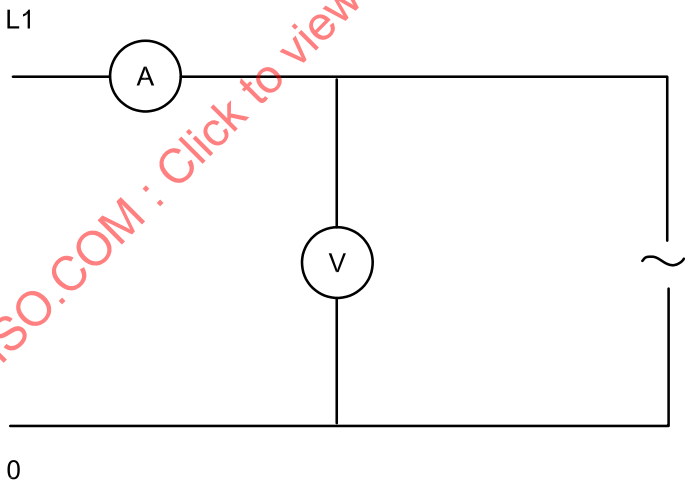


Figure 4 — Electrical diagram

5.3 Ammeter, capable of reading to the nearest 0,01 A.

6 Test specimens

Select at least one pair of plates, one corrugated and one undulated, of the same length. The minimum length of the edge to be used for the test is 300 mm.

Immerse the plates in the pickling solution (4.1) in a suitable container for a period of 10 min ± 10 s. Rinse the plates well with water and dry them.

7 Procedure

Using the design drawing, determine, to the nearest 1 mm, the total (i.e. stretched) length of the edge of the corrugated or undulated test specimen.

NOTE The stretched edge length is the length taking into account the profiling of the corrugation and undulation of the test specimen.

Determine the un-enamelled thickness of the test specimen to the nearest 0,1 mm.

Position the plate in the bath (5.1) in such a way that a maximum of 10 mm of the edge to be measured (one of the edges in the flue gas direction) is immersed in the electrolyte solution (4.2). Do this within one hour after rinsing off the sulfuric acid.

Connect the voltage source (5.2) between the bath electrodes and electrode L1 to the test specimen and, using the ammeter (5.3), record the current automatically (3 ± 0,5) s after switching on the test voltage.

Repeat the test for the other edge of the test specimen and for the second test specimen.

8 Calculation and expression of results

For each edge, calculate the uncoated surface area, a, in mm^2, using the equation:

$$a = 1{,}222I^2 + 12{,}903I \quad (1)$$

where I is the measured current, in A.

Calculate the percentage free surface area, S, using the equation:

$$S = \frac{a}{b \times c} 100 \quad (2)$$

where

a is the uncoated surface area, in mm^2, calculated from Equation (1);

b is the stretched length of the edge of the plate, in mm;

c is the thickness of the un-enamelled plate, in mm.

Calculate the percentage edge covering, E, using the equation:

$$E = 100 - S \quad (3)$$

Express the percentage edge covering as the mean of all the determinations, rounded to the nearest 0,1 %.

Calculate the uncoated surface area, U, in mm^2/m, using the equation:

$$U = \frac{a}{b} 1000 \quad (4)$$

Express the uncoated surface area per metre length as the mean of all the determinations, rounded to the nearest 10 mm^2/m.