BS EN ISO 28706-5:2011

BSI Standards Publication

Vitreous and porcelain enamels — Determination of resistance to chemical corrosion

Part 5: Determination of resistance to chemical corrosion in closed systems (ISO 28706-5:2010)

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National foreword

This British Standard is the UK implementation of EN ISO 28706-5:2011. It is identical to ISO 28706-5:2010. It supersedes BS EN 14483-5:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee STI/36, Vitreous enamel coatings.

A list of organizations represented on this committee can be obtained on request to its secretary.

ISBN 978 0 580 73139 6

ICS 25.220.50

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2011.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 28706-5

July 2011

ICS 25.220.50

Supersedes EN 14483-5:2004

English Version

Vitreous and porcelain enamels - Determination of resistance to chemical corrosion - Part 5: Determination of resistance to chemical corrosion in closed systems (ISO 28706-5:2010)

Emaux vitrifiés - Détermination de la résistance à la corrosion chimique - Partie 5: Détermination de la résistance à la corrosion chimique en milieux fermés (ISO 28706-5:2010)

Emails und Emaillierungen - Bestimmung der Beständigkeit gegen chemische Korrosion - Teil 5: Bestimmung der Beständigkeit gegen chemische Korrosion in geschlossenen Systemen (ISO 28706-5:2010)

This European Standard was approved by CEN on 17 June 2011.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN ISO 28706-5:2011: E

Foreword

The text of ISO 28706-5:2010 has been prepared by Technical Committee ISO/TC 107 “Metallic and other inorganic coatings” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 28706-5:2011 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of an identical text or by endorsement, at the latest by January 2012, and conflicting national standards shall be withdrawn at the latest by January 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14483-5:2004.

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Endorsement notice

The text of ISO 28706-5:2010 has been approved by CEN as a EN ISO 28706-5:2011 without any modification.

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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 28706-5 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*.

This second edition cancels and replaces the first edition (ISO 28706-5:2008), of which it constitutes a technical revision.

ISO 28706 consists of the following parts, under the general title *Vitreous and porcelain enamels — Determination of resistance to chemical corrosion*:

- *Part 1: Determination of resistance to chemical corrosion by acids at room temperature*
- *Part 2: Determination of resistance to chemical corrosion by boiling acids, boiling neutral liquids and/or their vapours*
- *Part 3: Determination of resistance to chemical corrosion by alkaline liquids using a hexagonal vessel*
- *Part 4: Determination of resistance to chemical corrosion by alkaline liquids using a cylindrical vessel*
- *Part 5: Determination of resistance to chemical corrosion in closed systems*

Introduction

Corrosion of vitreous and porcelain enamels by aqueous solutions is a dissolution process. The main component of the enamel, silicon dioxide (SiO_2), forms a three-dimensional silica network. After hydrolysis, it decomposes and forms silicic acid or silicates. These are released into the attacking medium. Other components, mainly metal oxides, are hydrolysed as well and form the corresponding hydrated metal ions or hydroxides. All corrosion products are more or less soluble in the attacking medium. The whole process results in a loss in mass per unit area.

For some aqueous solutions, the attack on the enamel proceeds linearly during the corrosion time; for other aqueous solutions, the attack on the enamel proceeds in a logarithmic manner during the corrosion time. Only for the first series of solutions can a scientifically exact rate of loss in mass per unit area (g/m^2), as well as a corrosion rate (mm/year), be calculated.

The most important parameters influencing aqueous corrosion of the enamel are the enamel quality, the temperature and the pH value. Inhibition effects resulting from the limited solubility of silica can also contribute. The following list describes different types of enamel attack for different corrosion conditions.

a) In aqueous alkali solutions like 0,1 mol/l NaOH (see Clause 9 of ISO 28706-4:2008) the silica network of the enamel is considerably attacked at 80 °C. Silicates and most of the other hydrolysed components are soluble in the alkali. Attack proceeds linearly during regular test times. Therefore, test results are expressed in terms of a rate of loss in mass per unit area (mass loss per unit area and time) and a corrosion rate (millimetres per year).

b) At room temperature, in weak aqueous acids like citric acid (see Clause 9 of ISO 28706-1:2008) or also in stronger acids like sulfuric acid (see Clause 10 of ISO 28706-1:2008), there is only minor attack on the silica network of the enamel. Other constituents are leached to some extent from the surface. Highly resistant enamels will show no visual change after exposure. On less resistant enamels, some staining or surface roughening will occur.

c) In boiling aqueous acids (see ISO 28706-2), the silica network of the enamel is being attacked, and silica as well as the other enamel components are released into solution. However, the solubility of silica in acids is low. Soon, the attacking solutions will become saturated with dissolved silica and will then only leach the surface. The acid attack is inhibited and the rate of corrosion drops markedly.

   NOTE The glass test equipment also releases silica by acid attack and contributes to the inhibition of the corrosion.

   Inhibition is effectively prevented in vapour phase tests. The condensate formed on the test specimen is free of any dissolved enamel constituents.

   Examples of enamel corrosion proceeding in a logarithmic manner [see 1)] and linearly [see 2)] are as follows.

   1) **Boiling citric acid (see Clause 10 of ISO 28706-2:2008) and boiling 30 % sulfuric acid (see Clause 11 of ISO 28706-2:2008)**

      Since only minute amounts of these acids are found in their vapours, the test is restricted to the liquid phase. The attack is influenced by inhibition effects, and corrosion depends on the time of exposure. Therefore, test results are expressed in terms of loss in mass per unit area; no rate of loss in mass per unit area is calculated.

2) **Boiling 20 % hydrochloric acid (see Clause 12 of ISO 28706-2:2008)**

   Since this is an azeotropic boiling acid, its concentration in the liquid and the vapour phase are identical, and liquid phase testing need not be performed. Vigorous boiling supplies an uninhibited condensate, and the attack proceeds linearly with time of exposure. Therefore, test results are only expressed in terms of rate of loss in mass per unit area (mass loss per unit area and time) and the corrosion rate (millimetres per year).

d) At high temperatures, with tests in the liquid phase under autoclave conditions (see ISO 28706-5), aqueous acid attack is severe. To avoid inhibition, the test time is restricted to 24 h and the ratio of attacking acid to attacked enamel surface is chosen so that it is comparatively high (similar to that in a chemical-reaction vessel). In addition, only low-silica water is used for the preparation of test solutions. Under these conditions, attack will proceed linearly with time of exposure. Therefore, test results with 20 % hydrochloric acid (see Clause 8 of ISO 28706-5:2010), simulated test solutions (see Clause 10 of ISO 28706-5:2010) or process fluids (see Clause 11 of ISO 28706-5:2010) are also expressed in terms of a rate of loss in mass per unit area (loss in mass per unit area and time).

e) In boiling water (see Clause 13 of ISO 28706-2:2008), the silica network is fairly stable. The enamel surface is leached and silica is dissolved only to a small extent. This type of attack is clearly represented by the vapour phase attack. In the liquid phase, some inhibition can be observed with highly resistant enamels. However, if the vitreous and porcelain enamel being tested is weak, leached alkali from the vitreous and porcelain enamel can raise pH values to alkaline levels, thus increasing the attack by the liquid phase. Both liquid and vapour phase testing can give valuable information.

f) Since the attack may or may not be linear, the results are expressed only in terms of loss in mass per unit area, and the test time should be indicated.

g) For standard detergent solution (see Clause 9 of ISO 28706-3:2008), it will not be certain whether the linear part of the corrosion curve will be reached during testing for 24 h or 168 h. Calculation of the corrosion rate is therefore not included in the test report.

h) For other acids (see Clause 14 of ISO 28706-2:2008) and other alkaline solutions (see Clause 10 of ISO 28706-3:2008 and Clause 10 of ISO 28706-4:2008), it will also not be known if a linear corrosion rate will be reached during the test period. Calculation of the corrosion rate is therefore not included in the test reports of those parts of this International Standard.

For vitreous enamels fired at temperatures below 700 °C, the test parameters (media, temperatures and times) of this part of ISO 28706 are not appropriate. For such enamels, for example aluminium enamels, other media, temperatures and/or times should be used. This can be done following the procedures described in the clauses for “Other test solutions” in Parts 1, 2, 3 and 4 of this International Standard.

Vitreous and porcelain enamels — Determination of resistance to chemical corrosion —

Part 5:
Determination of resistance to chemical corrosion in closed systems

WARNING — This part of ISO 28706 calls for the use of substances and/or procedures that may be injurious to health if adequate safety measures are not taken. This part of ISO 28706 does not address any health hazards, safety or environmental matters associated with its use. It is the responsibility of the user of this part of ISO 28706 to establish appropriate health, safety and environmentally acceptable practices and take suitable actions for any national and international regulations. Compliance with this part of ISO 28706 does not in itself confer immunity from legal obligations.

1 Scope

This part of ISO 28706 specifies a test method for the determination of the resistance of vitreous- and porcelain-enamelled articles to attack in closed systems by acid, neutral and alkaline liquids, as well as by actual process mixes.

It applies primarily to the testing of enamels designed for use in chemical processes.

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 649-1, *Laboratory glassware — Density hydrometers for general purposes — Part 1: Specification*

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

3 Principle

Enamelled test specimens are exposed to attack by a liquid corrosive at temperatures above the normal boiling point, under defined autoclave conditions.

The loss in mass is determined and used to calculate the rate of loss in mass per unit area.

4 Apparatus

4.1 Test vessel.

4.1.1 Design

The ratio between the volume, V, of the test solution, in cubic centimetres, at 20 °C, and the exposed area of enamel, A, in square centimetres, shall be $V/A = (40 \pm 2)$ cm. The vessel shall be filled to a level such that, when closed and given an ambient temperature of 18 °C to 28 °C, at least 20 % of its volume remains available as a vapour headspace. To ensure that this requirement is met, the size of the test apparatus shall be selected to suit that of the specimen.

NOTE Several enamelled specimens can be placed in the same test vessel and tested simultaneously.

WARNING — The test vessel may be a pressure vessel. It is the responsibility of the user of this International Standard to establish appropriate health, safety and environmentally acceptable practices and take suitable actions for any national and international regulations concerning the safe use of pressure vessels.

4.1.2 Material

The test vessel shall be made of a material resistant to the test solution and not releasing any substances that might influence the corrosion of the enamel. In particular, glass or ceramic flasks and fittings or coatings made of fluorinated plastics shall be avoided. Used as a component of seals, PTFE (polytetrafluorethylene) is the only fluorinated plastic suitable for tests with mineral acids, e.g. sulfuric acid and hydrochloric acid.

NOTE Vessels with tantalum fittings or with electrolytically deposited tantalum coatings and vessels made of solid tantalum meet these requirements for acid and neutral solutions over a wide range of applications. For tests with alkaline liquids, both vessels made of plastic materials, e.g. polypropylene bottles, and vessels made of high-alloy austenitic steel are suitable.

4.1.3 Fittings in the test vessel

Fittings in the test vessel are optional, e.g. the test vessel can be equipped with a protective rod for the temperature probe, a specimen holder and other fittings (e.g. agitator and gas supply hose).

4.1.4 Heating device

The type of heating device and its power rating, especially in the case of tests with pressure vessels and temperatures above the boiling point, shall be selected such that the test temperature is reached within 1 h and controllable to within 1 °C, where the test temperature is defined as the temperature of the test solution at the interface with the enamel surface.

The temperature of the test solution is assumed to be locally constant during the exposure period, if the test is carried out in the liquid phase.

At test temperatures lower than 100 °C, and especially when using test vessels made of plastic material (for example polypropylene bottles), a thermostatically controlled bath filled with demineralized or distilled water and fitted with an agitator or circulation pump shall be used. This may hold one or more test vessels. The bath shall be covered to avoid loss of liquid by evaporation and shall be capable of maintaining the temperature constant to within 0,1 °C up to 100 °C.

4.2 Analytical balance, capable of weighing to ±0,02 mg.

4.3 Oven, capable of maintaining a temperature of at least 120 °C.

4.4 Desiccator, capable of holding the test specimens.

4.5 Sponge or **cotton wool**, for cleaning the test specimens.

4.6 Graduated hydrometer, conforming to the requirements of ISO 649-1.

5 Test specimens

5.1 Shape and preparation

The enamel coating on the test specimens shall cover them completely and be free from pinholes. The basis metal and the process used to shape the test specimens shall be selected such that there is no risk of localized corrosion occurring as a result of edge spalling or burn marks.

The composition of the enamel on the test specimens and the process by which it is applied shall be the same as in the production process for which testing is being carried out.

The total mass of each test specimen shall not exceed 160 g. The ratio between the area of the exposed surface, A, in square centimetres, and the mass, m, in grams, of the test specimen shall be greater than 0,1 cm^2/g.

5.2 Number of test specimens

At least two test specimens shall be tested; the actual number of test specimens depends on the number of individual values required to calculate the arithmetic mean (see 7.2).

5.3 Cleaning, conditioning and weighing of test specimens

Degrease the test specimens, rinse them with demineralized water and then dry them in the oven (4.3) for at least 2 h at 110 °C ± 5 °C. Once the test specimens are dry, cool them in the desiccator (4.4) for at least 2 h and weigh them to the nearest 0,02 mg immediately after removal from the desiccator.

6 Procedure

6.1 General procedure

Pour the test solution (see Clauses 8, 10 and 11) into the test vessel so as to immerse completely the surface of the test specimens to be exposed. For safety reasons, the vapour headspace requirements given in 4.1.1 shall be respected.

After closing the test vessel, heat within 1 h to the test temperature (see 8.3, 10.3 and 11.3).

Start the exposure period of 24 h ± 5 min as soon as the test temperature is reached.

At the end of the exposure period, switch off the heating device and allow the test vessel to cool in air.

This procedure may be used both with vessels in which the test specimens are kept under pressure and with vessels in which the test specimens are at atmospheric pressure.

6.2 Special procedure for plastic bottles

If the test solution is alkaline (see Clause 9) or if the test temperature does not exceed 100 °C or is always below the boiling point of the test solution, tests may be carried out using plastic bottles. Adjust the thermostat of the thermostatically controlled bath to the required test temperature. In the case of hot sodium hydroxide solution, perform all tests as specified in Clause 9.

Fill the thermostatically controlled bath with sufficient water to cover the bottles up to the screw thread. Fill each bottle with test solution to the required depth (see 4.1), close the bottles tightly and place them in the bath set at the test temperature (see 9.3, 10.3 and 11.3). When the test temperature is reached, place each specimen in its bottle. Close the bottle and start the test.

Remove the bottle from the bath after 24 h ± 5 min.

6.3 Washing, drying and weighing of exposed test specimens

Remove the test specimens from their test vessels and wash them with a sponge or with cotton wool (4.5) and demineralized water. Remove any reaction products still adhering with mild, non-abrasive cleaning agents.

Care shall be taken to ensure that the cleaning procedure does not damage the enamel, e.g. by scratching it.

Dry the test specimens for 2 h in the oven (4.3) at 110 °C ± 5 °C. Allow them to cool for a further 2 h in the desiccator (4.4). Remove and weigh them immediately to the nearest 0,02 mg.

Reject all test specimens which have lost mass for reasons not due to corrosion, e.g. because of chipping or scratches. Test a corresponding number of new test specimens.

Determine the exposed area of enamel and the loss in mass, Δm, of each test specimen in such a way that, for a rate of loss in mass per unit area, v, of $\pm 0{,}028\,5$ g/m²·h, the sum of the maximum relative errors of measurement is not greater than 10 % (see also Annex A).

7 Expression of results

7.1 Rate of loss in mass per unit area

For each test specimen, calculate the rate of loss in mass per unit area, v, using Equation (1):

$$v = \left| \Delta m \right| / (A \times t) \tag{1}$$

where

A is the exposed area of enamel, in square metres (m^2);

Δm is the loss in mass, in grams (g);

t is the exposure time, in hours (h);

v is the rate of loss in mass per unit area, in grams per square metre per hour ($g/m^2 \cdot h$).

7.2 Calculation of mean values

7.2.1 Rate of loss in mass per unit area

Calculate the arithmetic mean of the rate of loss in mass per unit area, v, from the individual values obtained in 7.1, provided that the range of values (i.e. the difference between the maximum and minimum values) is not greater than the permitted difference.

The permitted range, which depends on the number of individual values, shall be in accordance with Table 1.

Table 1 — Permitted range as a function of the number of individual values

Number of individual values	**Permitted range** (expressed as a percentage of the lowest value) %
2	30
3	37
4	42

If the permitted range for two individual values is less than or equal to 30 %, stop the test after testing two test specimens.

If the permitted range is greater than 30 % but less than or equal to 37 % or 42 %, test one or two additional test specimens, respectively. Then calculate the arithmetic mean from all three or four individual values. Otherwise, repeat the test with new test specimens.

7.2.2 Corrosion rate

Calculate the mean corrosion rate, w, from the arithmetic mean of the rate of loss in mass per unit area, v, obtained in 7.2.1:

$$w = 3{,}504v \qquad (2)$$

where w is the mean corrosion rate, in millimetres per year (mm/year).

NOTE In Equation (2), it is assumed that the enamel is a homogeneous material with a density of 2,5 g/cm^3.

8 Autoclave test with hydrochloric acid

8.1 General

Carry out this test using the procedure described in 6.1.

8.2 Test solution

Hydrochloric acid, analytical grade, 20 % (by mass) solution, density range 1,097 g/ml to 1,099 g/ml (measured with a hydrometer — see 4.6). A fresh solution shall be used for each test.

The solution shall be prepared using water conforming to grade 2 of ISO 3696 and shall have a silicon dioxide (SiO_2) concentration of not more than ($0{,}1 \times 10^{-3}$) g/l.

8.3 Test temperature

The test temperature shall be (140 ± 1) °C.

8.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the sample tested;

b) a reference to Clause 8, e.g.:

  “Tested in accordance with Clause 8 of ISO 28706-5:2010 — Autoclave test with hydrochloric acid”;

c) the number of test specimens tested;

d) the number of test specimens placed in the same test vessel and tested simultaneously;

e) the results obtained for:

  — the rate of loss in mass per unit area, in grams per square metre per hour, giving the individual values and the arithmetic mean;

  — the mean corrosion rate, in millimetres per year;

f) any deviations from the procedure specified;

g) any unusual features observed during the test;

h) the date of the test.

9 Test with hot sodium hydroxide solution

9.1 General

Carry out this test in plastic bottles heated in the thermostatically controlled water bath, as described in 6.2.

9.2 Test solution

Use sodium hydroxide solution, $c(\mathrm{NaOH}) = 1$ mol/l, prepared by dissolving 40 g of NaOH, analytical grade, in water conforming to grade 2 of ISO 3696, and making up to 1 l.

Carry out each test with a freshly prepared solution. Keep the test solution in a closed vessel when it is not actually being used.

The use of commercially available standard ampoules containing 40 g of NaOH is recommended for preparation of the test solution.

9.3 Test temperature

The test temperature shall be (80 ± 0,1) °C.

9.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the sample tested;

b) a reference to Clause 9, e.g.:

“Tested in accordance with Clause 9 of ISO 28706-5:2010 — Test with hot sodium hydroxide solution”;

c) the number of test specimens tested;

d) the results obtained, in one of the two following ways:

- the calculated rate of loss in mass per unit area, in grams per square metre per hour, giving the individual values (see 7.1) and the arithmetic mean;
- the rate of loss in mass per unit area, in grams per square metre per hour, rounded to the nearest 1×10^{-4} g/m^2·h, giving the individual values and the arithmetic mean [if the rate of loss in mass per unit area is $< 0{,}005$ g/m^2·h, quote “below detection sensitivity” and give the mean corrosion rate (see 7.2.2), in millimetres per year, rounded to the nearest 0,01 mm/year];

e) any deviations from the procedure specified;

f) any unusual features observed during the test;

g) the date of the test.

10 Tests with simulated solutions

10.1 General

Carry out these tests using the procedure described in 6.1 or 6.2.

10.2 Test solution

An agreed test solution shall be made up using demineralized water with an SiO_2 concentration of not more than $0{,}1 \times 10^{-3}$ g/l and reagents of analytical grade.

10.3 Test temperature

The test temperature shall be agreed in advance and shall be recorded in the test report.

10.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the sample tested;

b) a reference to Clause 10, e.g.:

"Tested in accordance with Clause 10 of ISO 28706-5:2010 — Tests with simulated solutions";

c) a description of the test solution used;

d) the test temperature;

e) the number of test specimens tested;

f) the number of test specimens placed in the same test vessel and tested simultaneously;

g) the results obtained, as follows:

- the rate of loss in mass per unit area, in grams per square metre per hour, giving the individual values and the arithmetic mean;
- the mean corrosion rate, in millimetres per year;

h) any deviations from the procedure specified;

i) any unusual features observed during the test;

j) the date of the test.

11 Tests with process fluids

11.1 General

Carry out these tests using the procedure described in 6.1 or 6.2.

11.2 Test solution

The composition of the test solution shall be defined in advance and shall be recorded in the test report.

NOTE When carrying out the test using process fluids, even small quantities of certain constituents can inhibit or accelerate the rate of loss in mass. The inhibitory effect of silicon dioxide and materials releasing silicon dioxide is one well-known example.

11.3 Test temperature

The test temperature shall be defined in advance and shall be recorded in the test report.

11.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the sample tested;

b) a reference to Clause 11, e.g.:

“Tested in accordance with Clause 11 of ISO 28706-5:2010 — Tests with process fluids”;

c) a description of the process fluid used;

d) the test temperature;

e) the number of test specimens tested;

f) the number of test specimens placed in the same test vessel and tested simultaneously;

g) the results obtained, as follows:

  - the rate of loss in mass per unit area, in grams per square metre per hour, giving the individual values and the arithmetic mean;
  - the mean corrosion rate, in millimetres per year;

h) any deviations from the procedure specified;

i) any unusual features observed during the test;

j) the date of the test.

Annex A
(informative)

Explanatory notes

This part of ISO 28706 does not specify test equipment in detail but permits the user to design test vessels in such a way that they meet the particular requirements of a specific product (test solution) or particular operational process. Examples of test vessels and test specimens are given in the literature (see References [1], [2] and [3]).

In order to ensure the reproducibility of results obtained with different test vessels, the maximum permissible error of measurement in the test method should be restricted to less than the likely maximum relative deviation of the measured value from the true value. Expressed in simplified terms, for the test parameters given in this part of ISO 28706, the maximum error of measurement is determined solely by the permissible deviation of the test temperature from the specified value. Other influencing properties, such as the volume/surface ratio and the pressure, have a relatively small effect on the result if the tolerance limits specified in this part of ISO 28706 are respected (see References [1], [2] and [3]).

The temperature dependency of the corrosion rate can be described by a simple analytical relationship established by Arrhenius (see Reference [1]). This shows that, for a maximum temperature deviation of 1 °C from the specified value in the temperature range from 100 °C to 180 °C, there is a maximum relative deviation of 10 %. The relative error of measurement decreases in inverse proportion to the test temperature. Therefore, the technically important corrosion rate value of 0,1 mm/year, representing the resistance limit, should be determined to the nearest 0,01 mm/year.

The precision of the test method is defined by the maximum error of measurement resulting from the maximum errors of measurement for the individual parameters measured (i.e. loss in mass, exposure period and area of enamel exposed). This can be calculated directly from the maximum relative errors of measurement in accordance with the law of error propagation:

$$\frac{\Delta v}{v} = \frac{\Delta A}{A} + \frac{\Delta t}{t} \tag{A.1}$$

where A, t and v are as defined in 7.1.

The maximum relative error of measurement for the exposure period specified in this part of ISO 28706 is 0,35 %. Thus the total of the maximum errors of measurement from loss in mass and area of enamel exposed should not be greater than 9,65 %.

The maximum error of measurement is 2,1 cm^2 for the area of a cylindrical test rod enamelled on all sides with a specified surface area of 25 cm^2 (see Reference [2]), resulting from the measurement uncertainty for determining the loss in mass by weighing as specified in 5.3 and 6.3. If a surface area of only 11 cm^2 is specified (see Reference [2]), the area should be determined to within 0,8 cm^2. Where an approximately flat area described by a 40 mm diameter circle is exposed to the test solution, the area should be determined to within 0,9 cm^2, i.e. the diameter should be determined to within 0,7 mm.

A distinction should be made between liquid and vapour phase exposure in the case of enamel corrosion occurring in chemical engineering processes. Under given process conditions, the maximum corrodibility in the liquid phase can be determined using the test methods specified in this part of ISO 28706. The corrosion rates thus obtained are representative of enamelled containers and vessels used in chemical engineering processes, with a volume to exposed enamel area ratio not greater than 40 cm and a volume not greater than 6 m^3.

The experimental determination of the maximum corrodibility in the vapour phase still presents problems, mainly due to the difficulties involved in measuring the test temperature and the mass of condensate. If the composition of the condensate is known, the maximum corrodibility can be determined approximately by preparing a solution, using reagents of analytical grade, corresponding to the composition of the condensate and using it as the liquid phase.

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