BRITISH STANDARD

BS EN
14483-2:2004

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

Part 2: Determination of resistance to chemical corrosion by boiling acids, neutral liquids and/or their vapours

The European Standard EN 14483-2:2004 has the status of a British Standard

ICS 25.220.50

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BSI
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National foreword

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The UK participation in its preparation was entrusted to Technical Committee STI/36, Vitreous enamel coatings, which has the responsibility to:

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Vitreous and porcelain enamels - Determination of resistance to chemical corrosion - Part 2: Determination of resistance to chemical corrosion by boiling acids, neutral liquids and/or their vapours

Emaux vitrifiés - Détermination de la résistance à la corrosion chimique - Partie 2: Détermination de la résistance à la corrosion chimique par des acides bouillants, des liquides neutres et/ou leurs vapeurs

Emails und Emaillierungen - Bestimmung der Beständigkeit gegen chemische Korrosion - Teil 2: Bestimmung der Beständigkeit gegen chemische Korrosion durch kochende Säuren, neutrale Flussigkeiten und/oder deren Dämpfe

This European Standard was approved by CEN on 1 April 2004.

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Contents

Foreword

This document (EN 14483-2:2004) 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of an identical text or by endorsement, at the latest by December 2004, and conflicting national standards shall be withdrawn at the latest by December 2004.

This document includes a Bibliography.

This European Standard is divided into the following five parts, in accordance with the different apparatus and the different physical test conditions (temperature, pressure, stirring) that are used:

EN 14483 *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, 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*

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

Corrosion of vitreous and porcelain enamel by aqueous solutions is a dissolution process. The main component of the vitreous and porcelain enamel, SiO_2, forms a three-dimensional silica network. After hydrolysis it decomposes and forms silicic acid or silicates, respectively. These are released into the attacking medium. Other components, mainly metal oxides, are hydrolyzed as well and form the corresponding hydrated metal ions or hydroxides, respectively. 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 of the vitreous and porcelain enamel proceeds linearly during the corrosion time, for other aqueous solutions, the attack of the vitreous and porcelain enamel proceeds in a logarithmic manner during the corrosion time. Only for the first series of solutions, a scientific exact rate of loss in mass per unit area ($g/m^2.h$) can be calculated as well as a corrosion rate (mm/a).

The most important parameters influencing aqueous corrosion of vitreous and porcelain enamel are vitreous and porcelain enamel quality, temperature and pH-value. Besides, inhibition effects resulting from limited solubility of silica can 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 EN 14483-4:2004) the silica network of the vitreous and porcelain enamel is considerably attacked at 80 °C. Silicates and most of the other hydrolyzed components are soluble in the alkali. Attack proceeds linearly during regular testing times. Therefore test results are expressed in terms of a rate of loss in mass per unit area (weight 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 EN 14483-1:2004) or also in stronger acids like sulfuric acid (see clause 10 of EN 14483-1:2004), there is only minor attack on the silica network of the vitreous and porcelain enamel. Other constituents are leached to some extent from the surface. High resistant vitreous and porcelain enamels will show no visual change after exposure. On less resistant vitreous and porcelain enamels some staining or surface roughening will occur.

c) In boiling aqueous acids (see EN 14483-2) the silica network of the vitreous and porcelain enamel is being attacked, and silica as well as the other vitreous and porcelain enamel components are released into solution. However, 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, corrosion markedly drops.

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

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

   Examples for enamel corrosion proceeding in a logarithmic manner c.1) and linearly c.2) are:

   — **c.1) Boiling citric acid (see clause 10 of EN 14483-2:2004) and boiling 30 % sulfuric acid (see clause 11 of EN 14483-2:2004):**

     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 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.

   — **c.2) Boiling 20 % hydrochloric acid (see clause 12 of EN 14483-2:2004):**

     Since this is an azeotropic boiling acid, acid concentration in liquid and 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 (weight 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 EN 14483-5), aqueous acid attack is severe. To avoid inhibition testing time is restricted to 24 h and the ratio of attacking acid versus attacked vitreous and porcelain enamel surface is chosen comparatively high (similar to a chemical reaction vessel). In addition, only low silica water is taken for the preparation of test solutions. Under these provisions attack will proceed linearly with time of exposure. Therefore, test results, either with 20 % hydrochloric acid (see clause 8 of EN 14483-5:2004), artificial test solutions (see clause 9 of EN 14483-5:2004), or process fluids (see clause 10 of EN 14483-5:2004) 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 EN 14483-2:2004) the silica network is fairly stable. The vitreous and porcelain enamel surface is leached, 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 high resistant vitreous and porcelain enamels. Or, if the vitreous and porcelain enamel in test is weak, leached alkali from the vitreous and porcelain enamel can raise pH-values to alkaline levels increasing the attack by the liquid phase. Both liquid and vapour phase test can give valuable information.

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

g) For the standard detergent solution (see clause 9 of EN 14483-3:2004) it is not certain if the linear part of the corrosion curve is reached during the testing for 24 h or 168 h. Calculation of the corrosion rate is therefore not included in the test report.

h) For the undefined acids (see clause 14 of EN 14483-2:2004) and undefined alkaline solutions (see clause 10 of EN 14483-3:2004 and clause 10 of EN 14483-4:2004), it also is not known if a linear corrosion will be reached during the testing period. Calculation of the corrosion rate is therefore not included in those test reports.

For vitreous enamels fired at temperatures below 700 °C, the testing parameters (media, temperatures, and times) of this standard 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 and/or conditions” of the parts 1, 2, 3, or 4 of this standard.

EN 14483 Part 1 to Part 5 has been developed from EN ISO 4535, EN ISO 8290, ISO 2722, ISO 2733, ISO 2734, ISO 2742, ISO 2743, ISO 2745, ISO 4533 and ISO 13806.

1 Scope

This part of EN 14483 describes a test method for the determination of the resistance of flat surfaces of vitreous and porcelain enamels to boiling acids, neutral liquids, and/or their vapours.

This method allows the determination of the resistance of vitreous and porcelain enamels to the liquid and vapour phases of the corrosive medium simultaneously.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696:1987).*

ISO 48, *Rubber, vulcanized or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

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

ISO 718, *Laboratory glassware - Thermal shock and thermal shock endurance - Test methods.*

ISO 2723, *Vitreous and porcelain enamels for sheet steel — Production of specimens for testing.*

ISO 2724, *Vitreous and porcelain enamels for cast iron — Production of specimens for testing.*

ISO 3585, *Borosilicate glass 3.3 — Properties.*

ISO 4788, *Laboratory glassware - Graduated measuring cylinders.*

ISO 4799, *Laboratory glassware — Condensers.*

ISO 13804, *Vitreous and porcelain enamels for aluminium — Production of specimens for testing.*

3 Principle

A set of similarly enamelled test specimens is placed in the liquid zone and/or in the vapour zone of the testing apparatus as required and exposed to attack by a boiling acid or neutral liquid, or its vapour, under specified conditions.

The same design of test apparatus, and the same testing principle is employed for the different liquids.

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

4 Reagents

During the determination use only reagents of recognised analytical grade, unless otherwise specified.

4.1 Water, conforming to the requirements of grade 3 of EN ISO 3696, i.e. distilled water or water of equivalent purity.

4.2 Acetic acid solution, volume concentration 50 ml/l, for cleaning the testing apparatus and test specimens.

4.3 Grease solvent, such as ethanol, or water containing a few drops of liquid detergent, suitable for cleaning the testing apparatus and test specimens.

4.4 Citric acid monohydrate, ($C_6H_8O_7 \cdot H_2O$), crystalline.

4.5 Sulfuric acid, analytical grade, 30% (m/m) solution, density range 1,217 g/ml to 1,220 g/ml (measured with a hydrometer- see 5.8).

4.6 Hydrochloric acid, analytical grade, 20% (m/m) solution, density range, 1,097 g/ml to 1,099 g/ml (measured with a hydrometer – see 5.8).

5 Apparatus and materials

5.1 Test apparatus

5.1.1 General description

The testing apparatus (see Figures 1 and 2) consists of a cylinder, (see Figure 3) (5.1.2), with an adjacent support, and having a standard socket for holding a reflux condenser (5.1.3) with graduated collecting apparatus (5.1.4) on one side.

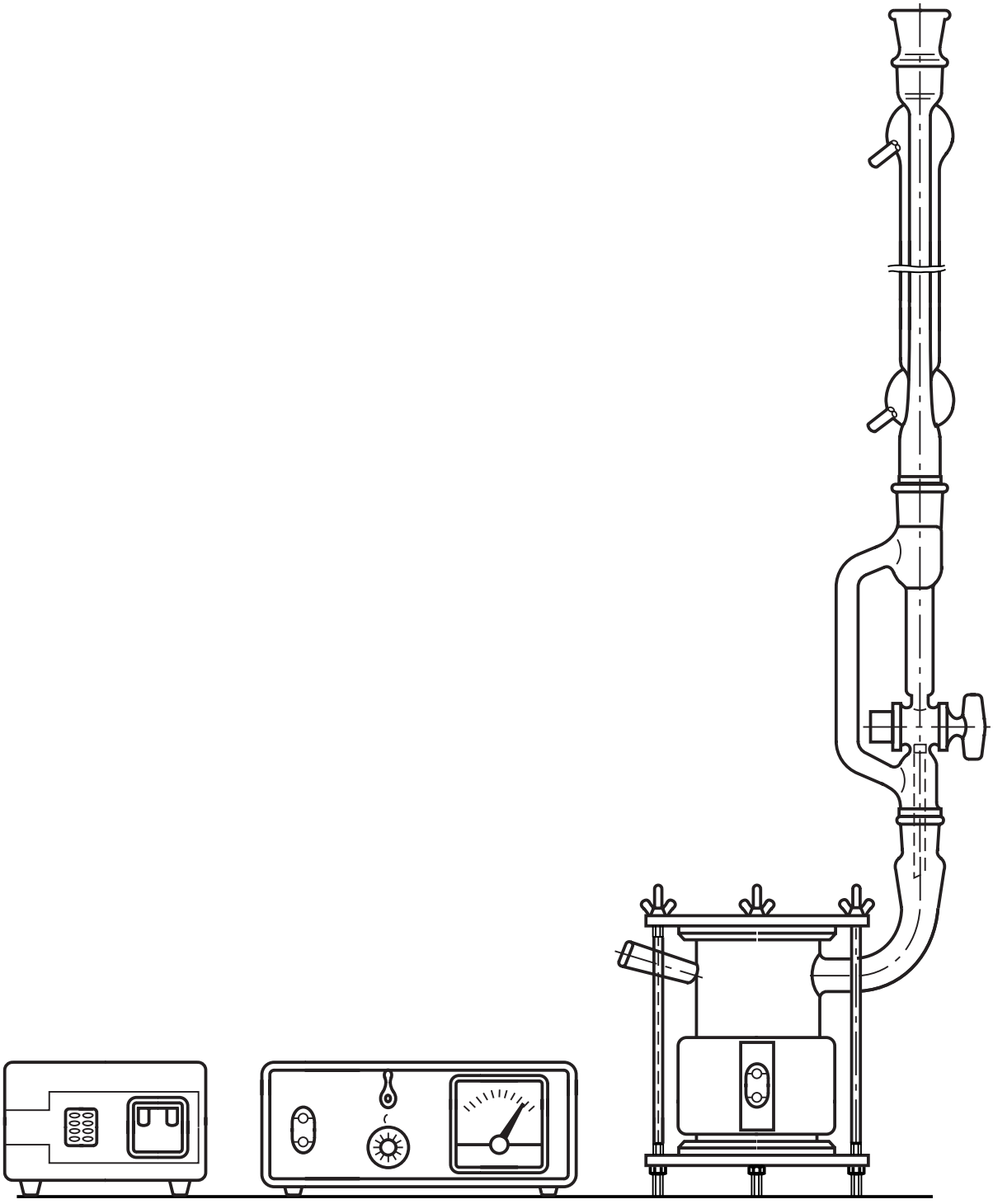
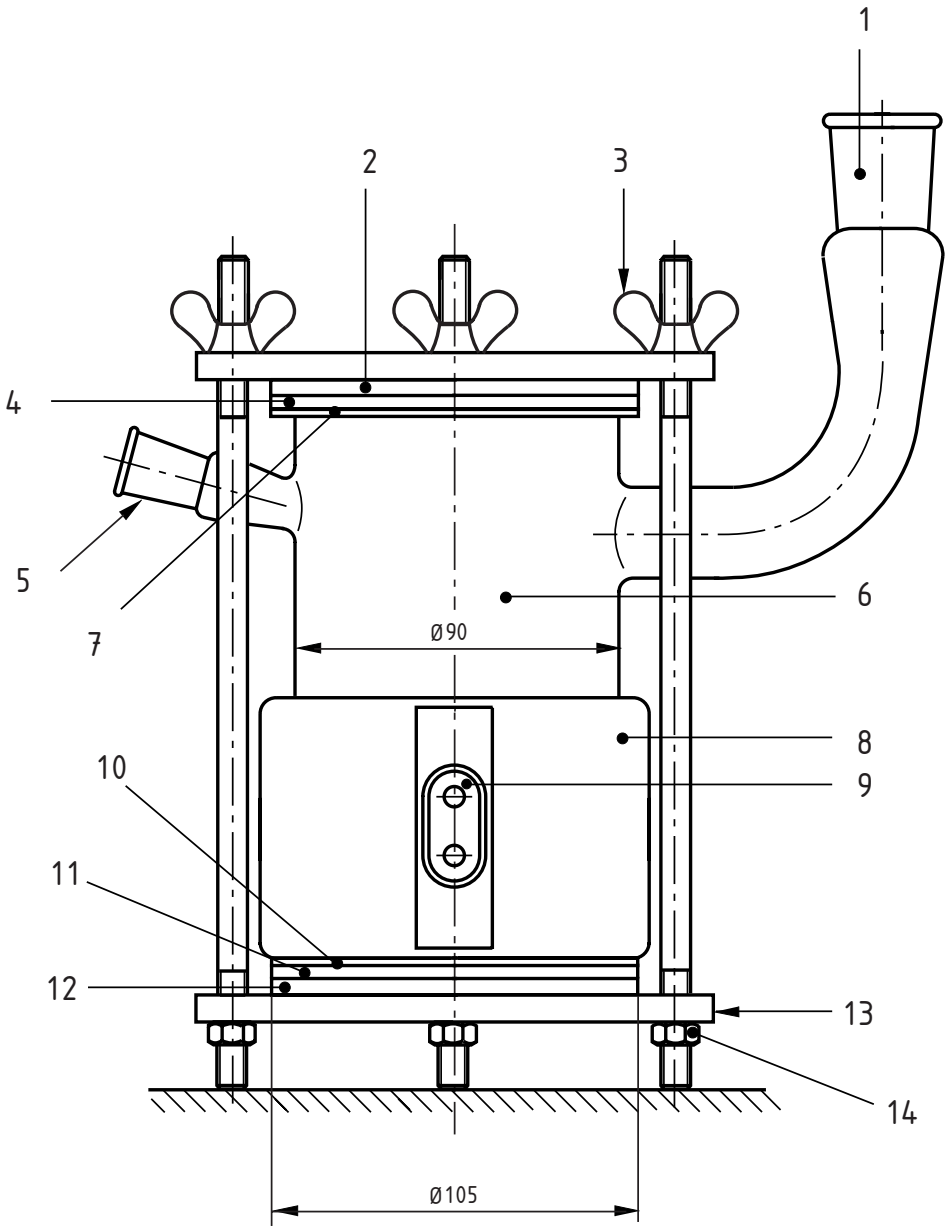


Figure 1 — View of assembled testing equipment

Two test specimens shall form the top and bottom of the cylinder. One of them may be replaced by a glass plate (5.1.14) if required. The cylinder with the specimens, shall be supported between two plates (see Figure 2) locked at the corner by screw bolts (5.1.8), wing nuts (5.1.7), and hexagonal nuts (5.1.6). A synthetic fibre washer (5.1.9) is fixed between the plates (5.1.5) and each specimen. The specimens are sealed against the ground edges of the cylinder with the packing rings (5.1.10), the material of which is dependent on the type of test solution. Any uncoated area of the test specimen shall be protected from exposure to the attacking medium.

When testing specimens cut from an enamelled article, the packing rings (5.1.10) are replaced by protective envelopes (see Figure 5) in which the specimens are placed.

Dimensions in millimetres



Key

1 For reflux condenser
2 Synthetic fibre washer
3 Wing nut
4 Specimen
5 For thermometer
6 Cylinder
7 Packing
8 Heater
9 Electric plug
10 Packing
11 Specimen
12 Synthetic fibre washer
13 Triangular plate
14 Hexagonal nut

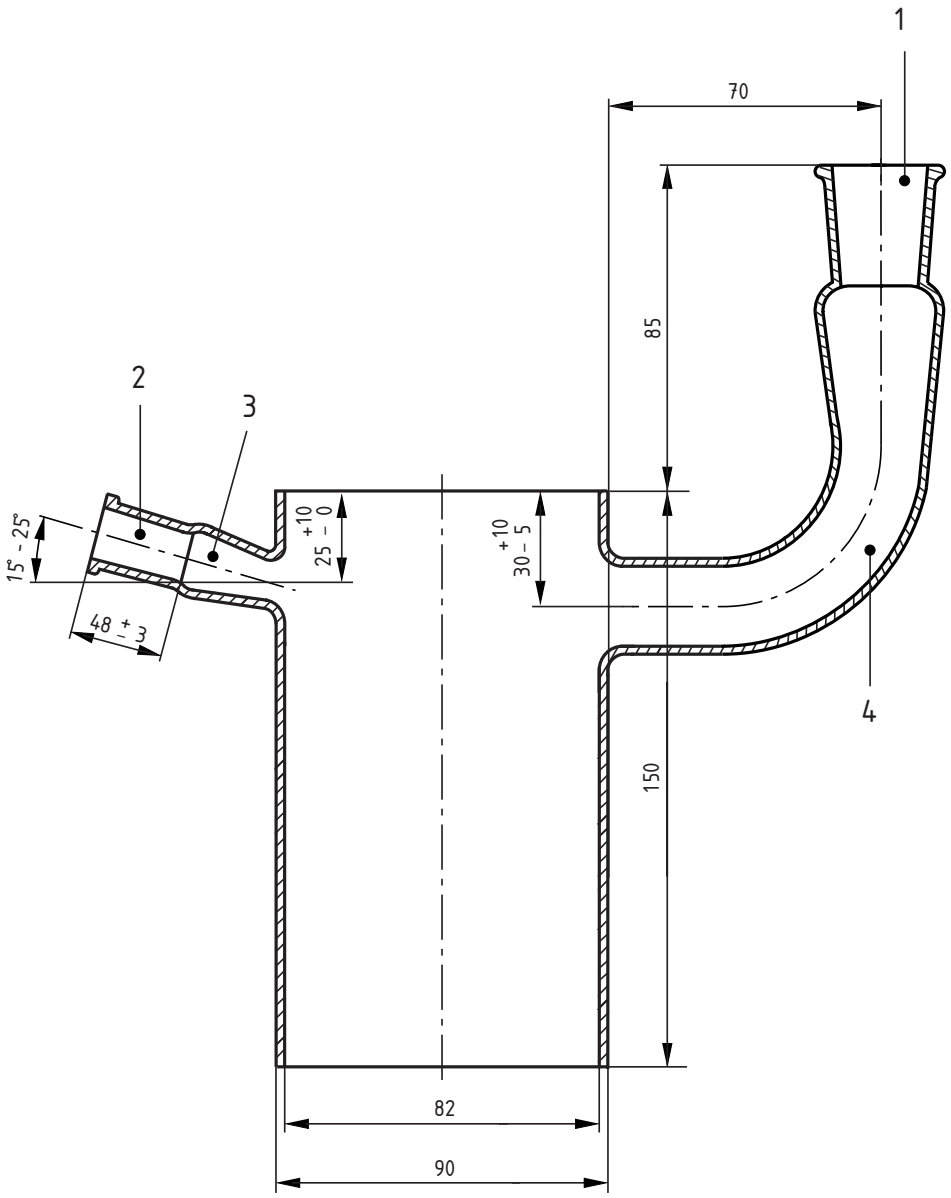
Figure 2 — Testing apparatus

The apparatus is heated externally by a heater (5.1.11), placed on the lower half of the cylinder (5.1.2) such that the lower edge is maximum 3 mm above the sealing ring. The testing apparatus is composed of the following parts:

5.1.2 Cylinder, made of borosilicate glass 3,3 conforming to the requirements of ISO 3585. In case of testing the cylinder according to ISO 718, it shall pass the test without breaking at a difference in temperature of at least 120 °C.

NOTE Cylinders having two sockets can also be used if the smaller socket is closed by a stopper which is resistant to the boiling solution.

Dimensions in millimetres



Key

1 Ground glass socket for condenser
2 Ground glass socket for thermometer
3 Connecting piece
4 Connecting piece

Figure 3 — Cylinder

5.1.3 A Liebig-West reflux condenser, or equivalent reflux condenser conforming to ISO 4799 in which there is no volume change during the test, with a nominal jacket length of 400 mm and standard ground joint of borosilicate glass 3,3 conforming to the requirements of ISO 3585.

5.1.4 Graduated collector, with standard ground joint of borosilicate glass 3,3 conforming to the requirements of ISO 3585, (see Figure 4), and arranged in the apparatus to collect the condensate produced in the reflux condenser. The graduation interval shall be 0,1 ml.

Dimensions in millimetres

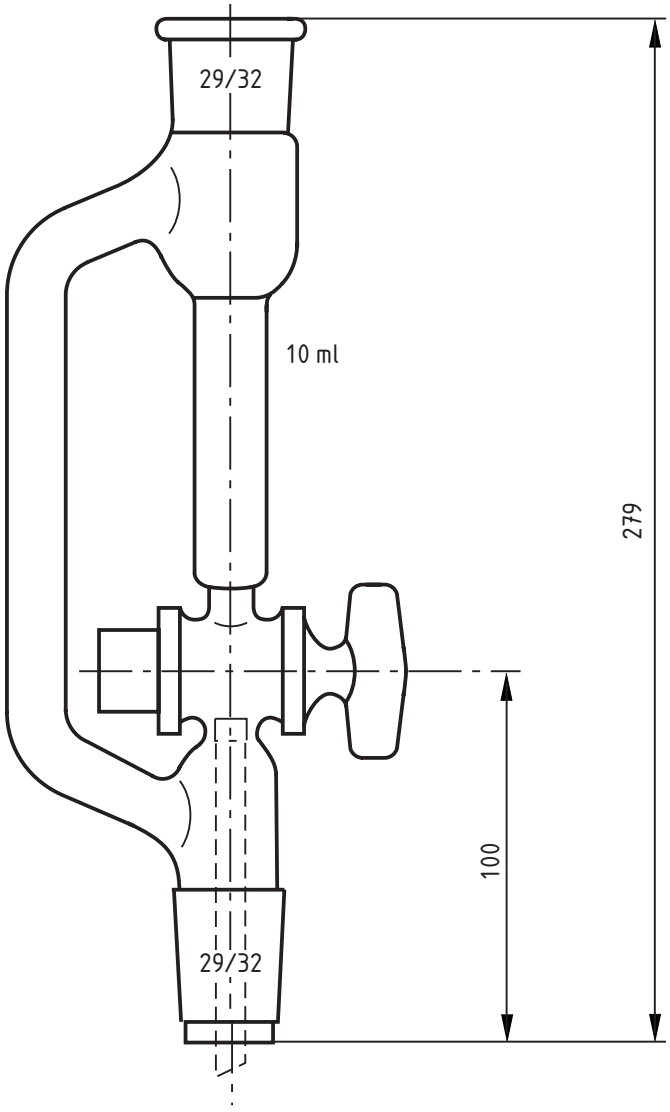


Figure 4 — Graduated collector

Dimensions in millimetres

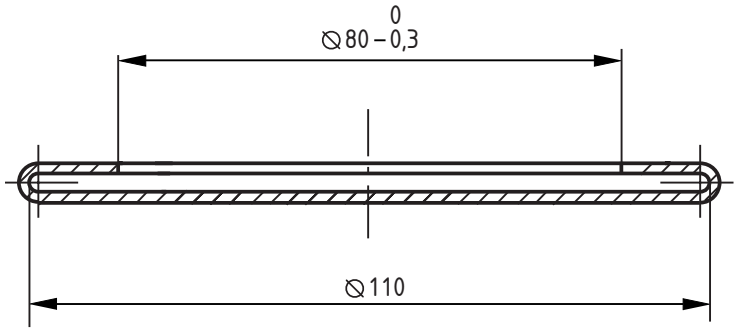


Figure 5 — Protective envelope

5.1.5 Two plates of surface protected steel

5.1.6 Hexagonal nuts, with a thread fitting the screw bolts.

5.1.7 Wing nuts, with a thread fitting the screw bolts.

5.1.8 Screw bolts, of corrosion resistant steel.

5.1.9 Synthetic fibre washers, resistant to acid and water at 140 °C.

NOTE PTFE is the only suitable fluorinated plastic material for tests with mineral acids (e.g. H_2SO_4, HCl)

5.1.10 Packing rings (see clause 6).

5.1.11 Heater, with an output of 400 W to 500 W, constructed in heat-conducting alloy covered with heat-insulating material, having dimensions such that the lower edge of the heater is maximum 3 mm above the sealing rings, and is not in contact with the packing.

5.1.12 Heat controlling device, for example thermostat, variable transformer, electronic control equipment.

5.1.13 Voltage stabilizer, to avoid variation in heating due to fluctuation in power supply.

5.1.14 Glass plate, of borosilicate glass 3,3 conforming to the requirements of ISO 3585, having a diameter of 105 mm, as cover or bottom of the cylinder, if required.

5.1.15 Simmering aid, such as floatable particles resistant to the boiling solution.

NOTE 1 PTFE is the only suitable fluorinated plastic material for tests with mineral acids (e.g. H_2SO_4, HCl)

NOTE 2 When boiling with sulfuric acid, the boiling retardation is best avoided by using of capillary tubes of borosilicate.

5.2 Drying oven, capable of maintaining temperatures of at least 130 °C.

5.3 Desiccator, for example with an internal diameter of 200 mm**.**

5.4 Graduated measuring cylinder, capacity 500 ml, conforming to the requirements of ISO 4788.

5.5 Beakers.

5.6 Balance, capable of weighing to the nearest to 0,2 10^{-3} g.

5.7 Sponge, soft.

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

6 Packing rings

6.1 General

The method of packing the specimens towards the ground edges of the cylinder depends on the type of specimen and the type of test solution. Either of the following shall be used:

6.2 Packing A

Compressed fibre washers having a 100 mm external diameter, 80 mm ± 1 mm internal diameter, 2 mm thick, covered with a plastic material resistant to hydrochloric acid at 140 °C (for example polytetrafluorethene).

6.3 Packing B

Packing ring having a 100 mm internal diameter, 80 ± 0,3 mm internal diameter, 2 mm or 3 mm thick, consisting of rubber, with hardness 70 IRHD as defined in ISO 48, resistant to citric acid and water at 140 °C (for example chloroprene or ethylene-propylene).

7 Test specimens

Prepare the test specimens in accordance with ISO 2723, ISO 2724 or ISO 13804 as appropriate for the base material.

Rinse each test specimen with water (4.1). If necessary, use a suitable grease solvent (4.3). Dry each specimen for 2 h in the drying oven (5.2) maintained at 110 °C ± 5 °C. Allow the specimen to stand for at least 2 h in the desiccator (5.3) and finally weigh it to the nearest 0,2 mg. Record the starting mass, m_s.

8 Procedure

Carry out two determinations with new test specimens for each test, in vapour and/or liquid.

Fix the test specimens in the testing apparatus (5.1) so that the cover coat sides of the test specimens are facing the interior of the cylinder. Protect any uncoated areas of the test specimen from exposure to the attacking medium. If only the liquid phase is to be tested, use a glass plate of borosilicate glass 3.3 (ISO 3585) as cover for the apparatus; if only the vapour phase is to be tested, use a glass plate of borosilicate 3.3 (ISO 3585) as the bottom of the apparatus.

Screw down the wing nuts evenly to ensure that the testing apparatus is tight to liquids.

Run 450 ml of the test solution (see clauses 10 to 13), into the socket of the graduated collector, replace the latter and the reflux condenser. Switch the heater on, and bring the test solution to boiling point within 15 min of switching the power on. The measured test period starts with the commencement of boiling. As soon as the solution is boiling vigorously, use the heat controlling device to maintain the amount of condensate discharged from the reflux condenser and measured in the graduated collector by adjusting its rate of boiling within the range 8 ml ± 2 ml per 3 min, for the duration of the test.

The duration of the test depends on the test solution (see clauses 10 to 13).

After controlled heating for the described period (see clauses 10 to 13) , empty the cylinder, cool it and rinse it with water (4.1).

Take the specimens from the testing apparatus and wipe them three times with the sponge (5.7) which has been soaked in acetic acid (4.2) at room temperature, then rinse with water (4.1).

After carefully removing any packing residues from the edges of the specimen, dry it for 2 h in the hot air oven (5.2) at 110 °C ± 5 °C. After a further 2 h in the desiccator (5.3), weigh it again to the nearest 0,2 mg and record the final mass, m_f. The total time for removal of specimen from desiccator until completion of weighing shall not exceed 2 min.

Test specimens which show defects such as pinholes down to the metal, chipped edges or edge corrosion shall be disregarded, and a corresponding number of new specimens shall be tested.

Measure the diameter of the area exposed to attack. The mean value of 3 measurements of the diameter of the area exposed to attack shall fall within ± 1 mm of 80 mm. Calculate the exposed area to attack, A, using this mean value of the diameter.

9 Expression of results

9.1 Total loss in mass per unit area

For each test, calculate the total loss in mass per unit area, $\Delta\rho_A$, in g/m² for the total duration of the test from the equation:

$$\Delta\rho_A = \frac{(m_s - m_f)}{A} \quad (1)$$

where

m_s is the starting mass, in g;

m_f is the final mass, in g;

and

A is the exposed area to attack, in m^2.

In order to distinguish between the testing results of different testing periods, the number of testing hours shall be stated as a subscript to the symbol; for example;

for 2,5 h testing time, $\Delta\rho_{A2,5}$

for 48 h testing time, $\Delta\rho_{A48}$

For the evaluation, the results of the specimens which show defects such as pinholes down to the metal, chipped edges, or edge corrosion, shall be omitted. The corresponding number of new specimens shall be tested.

Express the result as the arithmetic mean of the individual values to the nearest 0,1g/m^2. The individual values shall not differ from the mean value more than 20%.

9.2 Corrosion rate

For the hydrochloric acid test (see clause 12) the corrosion of the enamel proceeds linear with corrosion time. Calculate the corrosion rate, v, as the rate of loss in grams per unit area, gm^{-2}h^{-1}, using the equation:

$$v = \frac{\Delta \rho_A}{t} \tag{2}$$

where t is the testing time, in h.

Calculate the corrosion rate, w, in mm per year from the equation:

$$w = 3{,}504\ v \tag{3}$$

NOTE For the equation (3), it is assumed that enamel is a homogeneous material (without gas bubbles) with a density of 2,5 g/cm³.

Express the result as the arithmetic mean of the individual values in millimetres per year, to the nearest 0,01 mm/a.

10 Boiling citric acid

10.1 General

Carry out this test using the procedure described in clause 8.

10.2 Citric acid test solution

Dissolve 32 g of pure crystalline monohydrate citric acid ($C_6H_8O_7 \cdot H_2O$) in 500 ml of water (4.1). A fresh solution, prepared the same day, is required for each test.

Only the resistance to chemical corrosion by the liquid phase shall be tested.

10.3 Duration of the test

The controlled heating time, with the amount of condensate maintained within the range 8 ml ± 2 ml per 3 min, shall be 2,5 h (150 min).

If the loss in mass of a specimen after this time is less than 8 mg, the result of the test is “<1,6 g/m²”.

If a more precise result is required, carry out another test using new specimens and another test solution and/or another test duration after testing with other test solutions and/or conditions as described in clause 14.

10.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the vitreous and porcelain enamel tested;

b) a reference to clause 10 of this European Standard, EN 14483-2:2004 e.g. "Tested in accordance with clause 10 of EN 14483-2:2004 – boiling citric acid ";

c) the duration of the test: 2,5 h;

d) the result(s), including the results of the individual determinations, giving the loss in mass per unit area as calculated for the time period over which testing was conducted (9.1), in grams per square metre, rounded to the nearest 0,1g/m^2, giving the arithmetic mean and the number of single values;

e) any deviations from the procedure specified;

f) any unusual features observed during the test;

g) the date of the test.

11 Boiling sulfuric acid

11.1 General

Carry out this test following the procedure described in clause 8.

11.2 Test solution

Sulfuric acid, analytical grade, 30% (m/m) solution, density range 1,217 g/ml to 1,220 g/ml (measured with a hydrometer- see 5.8). A fresh solution is required for each test.

Only the resistance to chemical corrosion by the liquid phase shall be tested.

11.3 Duration of the test

The controlled heating time, with the amount of condensate maintained within the range 8 ml ± 2 ml per 3 min, shall be 18 h.

If the loss in mass of a specimen after this time is less than 8 mg, the result of the test is “<1,6 g/m²”.

If a more precise result is required, carry out another test using new specimens and another test solution and/or another test duration after testing with other test solutions and/or conditions as described in clause 14.

11.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the vitreous and porcelain enamel sample tested;

b) a reference to clause 11 of this European Standard, EN 14483-2:2004 e.g. "Tested in accordance with clause 11 of EN 14483-2:2004 – boiling sulfuric acid";

c) the duration of the test: 18 h;

d) the result(s), including the results of the individual determinations, giving the loss in mass per unit area as calculated for the time period over which testing was conducted (9.1), in grams per square metre, rounded to the nearest 0,1 g/m^2, giving the arithmetic mean and the number of single values;

e) any deviations from the procedure specified;

f) any unusual features observed during the test;

g) the date of the test.

12 Boiling hydrochloric acid

12.1 General

Carry out this test using the procedure described in clause 8.

12.2 Test solution

Hydrochloric acid, analytical grade, 20% (m/m) solution, density range, 1,097 g/ml to 1,099 g/ml (measured with a hydrometer – see 5.8). A fresh solution is required for each test.

Only the resistance to chemical corrosion by the vapour phase shall be tested.

12.3 Duration of the test

The controlled heating time, with the amount of condensate maintained within the range 8 ml ± 2 ml per 3 min, shall be 7 days.

If the loss in mass of a specimen after this time is less than 8 mg, carry out the test with new specimens and a controlled heating time of 14 days. If the loss in mass is still less than 8 mg, the result of the test is “<1,6 g/m²”.

If a more precise result is required, carry out another test using new specimens and another test solution and/or another test duration after testing with other test solutions and/or conditions as described in clause 14.

12.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the vitreous and porcelain enamel sample tested;

b) a reference to clause 12 of this European Standard, EN 14483-2:2004 e.g. "Tested in accordance with clause 12 of EN 14483-2:2004 – boiling hydrochloric acid";

c) the duration of the test: 7d or 14 d;

d) the result(s), including the results of the individual determinations, giving

— the loss in mass per unit area as calculated for the time period over which testing was conducted (9.1) , in grams per square metre, rounded to the nearest 0,1g/m^2 , giving the arithmetic mean and the number of single values;

— the rate of loss in mass per unit area (9.2), in grams per square metres per hour, rounded to the nearest 1,10^{-3} g/m²h, giving the arithmetic mean and the number of single values;

— the corrosion rate (9.2) in millimetres per year, rounded to 0,01 mm/a;

e) any deviations from the procedure specified;

f) any unusual features observed during the test;

g) the date of the test.

13 Boiling distilled or demineralized water

13.1 General

Carry out this test following the procedure described in clause 8.

13.2 Test solution

The test solution shall be water (4.1) with a maximum electrical conductivity of 50 µS/cm. A fresh supply of water is required for each test.

The resistance to chemical corrosion by at least one of both phases (the liquid phase or the vapour phase) shall be tested.

13.3 Duration of the test

The controlled heating time, with the amount of condensate maintained within the range 8 ml ± 2 ml per 3 min, shall be 48 h (2 days).

If the loss in mass of a specimen after this time is less than 8 mg, carry out the test with new specimens and a controlled heating time of 336 h (14 days). If the loss in mass after this time is still less than 8 mg, the result of the test is "<1,6 g/m²".

If a more precise result is required, carry out another test using new specimens and another test solution and/or another test duration after testing with other test solutions and/or conditions as described in clause 14.

13.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the vitreous and porcelain enamel sample tested;

b) a reference to clause 13 of this European Standard, EN 14483-2:2004 e.g. "Tested in accordance with clause 13 of EN 14483-2:2004 – boiling distilled or demineralized water";

c) the duration of the test: 48 h or 14 d;

d) the result(s), including the results of the individual determinations, giving

— the loss in mass per unit area for the liquid phase test as calculated for the time period over which testing was conducted (9.1), in grams per square metre, rounded to the nearest 0,1g/m^2, giving the arithmetic mean and the number of single values;

— the loss in mass per unit area for the vapour phase test as calculated for the time period over which testing was conducted (9.1), in grams per square metre, rounded to the nearest 0,1g/m^2, giving the arithmetic mean and the number of single values;

e) any deviations from the procedure specified;

f) any unusual features observed during the test;

g) the date of the test.

14 Other test solutions and/or conditions

14.1 General

Carry out this test following the procedure described in clause 8.

14.2 Test solution

An agreed test solution shall be and made up using of water (4.1) and reagents of analytical grade. No test solutions may be used that could damage the apparatus (for example F-containing solutions).

The test report shall indicate whether the resistance to chemical corrosion by both phases was tested or only one phase (the liquid phase or the vapour phase).

14.3 Duration of the test

The controlled heating time, with the amount of condensate maintained within the range 8 ml ± 2 ml per 3 min, shall be included in the test report.

If the loss in mass of a specimen after this time is less than 8 mg, the result of the test is “<1,6 g/m²”.

If a more precise result is required, carry out another test using new specimens and another test solution and/or another test duration.

14.4 Test report

The test report shall include the following information:

a) all information necessary for the identification of the vitreous and porcelain enamel sample tested;

b) a reference to clause 14 of this European Standard, EN 14483-2:2004 e.g. "Tested in accordance with clause 14 of EN 14483-2:2004 – other test solution vapour and/ or liquid phase test";

c) a description of the test solution;

d) the duration of the test;

e) the result(s), including the results of the individual determinations, giving the loss in mass per unit area for the phases(liquid/vapour) that have been tested as calculated for the time period over which testing was conducted (9.1), in grams per square metre, rounded to the nearest 0,1g/m^2, and if necessary, the rate of loss in mass per unit area and the corrosion rate (9.2), giving always the arithmetic mean and the number of single values;

f) any deviations from the procedure specified;

g) any unusual features observed during the test;

h) the date of the test.

Bibliography

ISO 1629, *Rubbers and latices – Nomenclature.*

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