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**Vitreous and porcelain enamels —  
Inside and outside enamelled  
valves and pressure pipe fittings for  
untreated and potable water supply —  
Quality requirements and testing**

*Émaux vitrifiés — Robinetterie émaillée à l'intérieur et à l'extérieur  
et raccords de tuyauterie pour conduites forcées destinées à  
l'alimentation en eau non traitée et en eau potable — Exigences de  
qualité et essais*



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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.

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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

ISO 11177 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 262, *Metallic and other inorganic coatings*, in collaboration with Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

## Introduction

The requirements defined in this International Standard regarding the product quality of enamelled valves and pressure pipe fittings for untreated and potable water supply take into account the real stress conditions to which a component can be subjected in the course of its operating life. Typical types of stress are:

- during storage: climate, UV radiation, mechanical stress;
- during transportation: mechanical stress e.g. at certain points (impact), laterally (friction);
- during preparation for installation: cleaning agents, mechanical stress e.g. at certain points (impact), laterally (friction);
- during installation: mechanical stress;
- during operation: abrasion caused by the carried medium, corrosion from surrounding medium, mechanical stress from shifting ground loads, UV radiation with valves built in above ground.



# Vitreous and porcelain enamels — Inside and outside enamelled valves and pressure pipe fittings for untreated and potable water supply — Quality requirements and testing

## 1 Scope

This International Standard specifies the requirements for product quality and product testing of enamelled valves and pressure pipe fittings for untreated and potable water supply. It is not applicable for chemical service glass-enamel and apparatus enamel.

## 2 Normative references

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

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 6370-1, *Vitreous and porcelain enamels — Determination of the resistance to abrasion — Part 1: Abrasion testing apparatus*

ISO 6370-2, *Vitreous and porcelain enamels — Determination of the resistance to abrasion — Part 2: Loss in mass after sub-surface abrasion*

ISO 16474-1, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 16474-2, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 13807, *Vitreous and porcelain enamels — Determination of crack formation temperature in the thermal shock testing of enamels for the chemical industry*

ISO 15695, *Vitreous and porcelain enamels — Determination of scratch resistance of enamel finishes*

ISO 28706-2, *Vitreous and porcelain enamels — Determination of resistance to chemical corrosion — Part 2: Determination of resistance to chemical corrosion by boiling acids, boiling neutral liquids and/or their vapours*

EN 15771, *Vitreous and porcelain enamels — Determination of surface scratch hardness according to the Mohs scale*

DIN 50929-3, *Corrosion of metals — Probability of corrosion of metallic materials when subject to corrosion from the outside — Buried and underwater pipelines and structural components*

## 3 Terms and definitions

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

### 3.1

#### **pore**

defect in the enamel coat passed through from the base material

### 3.2

#### **corrosion**

reaction of a material with its environment causing a measurable change in the material which can lead to impaired function of a component or a complete system

### 3.3

#### **sub-surface migration**

type of corrosion whereby the attack progresses underneath the protective layer parallel to the surface which can lead to separation of the protective layer from the base material

## 4 Sampling

Sampling shall be agreed between contractual partners.

## 5 Quality requirements and testing procedures

### 5.1 Enamelling surface quality

The enamelling shall be uniform and smooth and carried out in such a way on the sealing surfaces that the seal effect is not impaired.

Slight variations in colour on edges and ridge areas do not impair product quality and are acceptable.

Isolated pores are acceptable provided the dimension of an individual pore does not exceed 1 mm and that no more than 7 pores are visible on a surface segment with a diameter of approximately 35 mm.

### 5.2 Coat thickness

The measurement of coat thickness shall be carried out using a calibrated test system in accordance with ISO 2178.

On flat surfaces, coat thickness shall lie between 200 µm and 600 µm. In edge, undercut and ridge areas etc., the coat thickness shall be at least 150 µm.

### 5.3 Hardness

Surface hardness shall be determined as surface scratch hardness in accordance with the Mohs scale in accordance with EN 15771. The surface scratch hardness shall be  $\geq 4$ .

### 5.4 Resistance to thermal shock

Testing resistance to thermal shock shall be carried out in accordance with ISO 13807 on enamelled cast-iron samples, however a temperature difference of 200 K and cooling (off) in water at room temperature shall be adopted.

After the testing, the enamelling shall not exhibit any visible defects.

### 5.5 Corrosion resistance to water and steam

The testing shall be carried out in accordance with ISO 28706-2.

Afterwards the dried surface shall be visually checked.

A significant change to the surface quality caused by blistering, partial delamination or pitting due to exposure to water or steam is not permitted. A loss of shine is insignificant.



## 5.6 Corrosion resistance to citric acid

The enamelling shall be resistant to citric acid in accordance with ISO 28706-2.

## 5.7 Corrosion and chemical resistance to acid soil

Requirements for corrosion resistance of the exterior coating (sheathing) to very aggressive soils with a soil assessment value  $B_0$  or  $B_1$ , less than  $-10$ , in accordance with DIN 50929-3 (equivalent to soil Class III in accordance with DIN 50929-3) shall be met.

The testing shall be carried out in a watery solution equivalent to soil Class III in accordance with DIN 50929-3 (pH = 4, 400 mmol/kg sodium chloride, 400 mmol/kg sodium sulfate) at room temperature over a period of six months.

A further test shall to be carried out in very aggressive moist soil (less than 20 % water by weight) in accordance with DIN 50929-3 over a period of six months outdoors. The soil shall be composed of the following:

- 80 % topsoil;
- 10 % peat;
- 40,6 mmol/kg Epsom salt;
- 10 % water by weight;
- citric acid to adjust the pH value of the soil to 3,5.

The dried surface shall be checked visually for loss of shine and corrosion. There shall not be any visible defects.

## 5.8 Corrosion and chemical resistance to sub-surface migration of enamel after impact test

The sample shall be deliberately damaged by means of an impact test (test with a falling weight).

The following test conditions shall be adhered to:

- drop height of falling weight  $\geq 300$  mm;
- mass of falling weight 0,2 kg;
- material of falling weight e.g. tool steel 1.2210;
- hardness of falling weight 60 HRC;
- point of falling weight  $60^\circ$ , point radius 1 mm.

Subsequent to the impact test, the sample shall be placed in deionized water at a temperature of  $80^\circ\text{C}$  for three days.

The damaged section shall not show any visible defects (crack extension, further flaking) for 24 h after the test.

If there is no visible damage after the vertical shock test, the drop height shall be increased until such damage occurs.

## 5.9 Corrosion resistance after scratch damage

The sample (flat plate or component measuring  $100\text{ mm} \times 100\text{ mm}$ ) shall be used in accordance with ISO 15695 with a force of 10 N in 5 rotations and a radius of 40 mm.

Subsequent to the test, the sample shall be placed in deionized water at a temperature of 80 °C for three days.

The damaged section shall not show any defects on visual inspection.

### **5.10 Corrosion resistance after abrasion damage**

The test shall be carried out in accordance with ISO 6370-1 and ISO 6370-2 on a flat sample (plate or component).

The following test conditions shall be adhered to:

- test force of 100 N;
- linear relative movement of 60 mm;
- sample size of 100 mm × 100 mm.

Subsequent to the test the sample shall be placed in deionized water at a temperature of 80 °C for three days.

The damaged section shall not show any defects on visual inspection.

### **5.11 Resistance to climatic exposure and ultraviolet radiation**

Exposure tests shall be carried out on a sample plate in accordance with ISO 16474-1 and ISO 16474-2.

The following test conditions for the exposure tests shall be adhered to:

- temperature: 12 h, 10 °C up to 50 °C;
- relative humidity: 30 % up to 75 %;
- UV radiation by means of a lamp<sup>1)</sup> with 300 W power, distance of lamp from sample surface 500 mm, length of exposure 168 h.

Afterwards the sample shall be placed in deionized water at a temperature of 80 °C for three days.

On visual inspection there shall not be any sign of corrosion or optical changes visible (e.g. loss of shine, fading).

Additionally, structural components installed above ground shall permanently be made resistant to climatic exposure and UV rays. Neither fading nor compromising of the corrosion resistance are permitted.

### **5.12 Physiological harmlessness**

With regard to the hygienic fitness of materials in contact with drinking water, attention is drawn to regulation at national level, where a European and/or international regulation does not exist.

## **6 Test report**

The test report shall include the following information as a minimum:

- a) name of the test laboratory;
- b) reference to this International Standard i.e. ISO 11177;
- c) batch size and number of non-conforming parts;

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1) Ultra Vitalux lamp is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

- d) tests carried out;
- e) test results;
- f) deviations from this International Standard, if applicable;
- g) date of testing.

## Bibliography

- [1] Federal Environment Agency — Guidance on the hygienic assessment of organic materials in contact with potable water (KTW Guidance). Federal Health Pamphlet, Health Research. Health Protection. 2005, **48** pp. 1409–1415
- [2] EN 12873-1, *Influence of materials on water intended for human consumption — Influence due to migration — Part 1: Test method for factory-made products made from or incorporating organic or glassy (porcelain/vitreous enamel) materials*



