



**International  
Standard**

**ISO 28721-2**

**Vitreous and porcelain enamels —  
Glass-lined apparatus for process  
plants —**

**Part 2:**

**Designation and specification of  
resistance to chemical attack and  
thermal shock**

*Émaux vitrifiés — Appareils émaillés pour les installations  
industrielles —*

*Partie 2: Désignation et spécifications de la résistance à l'attaque  
chimique et au choc thermique*

**Third edition  
2025-02**

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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 document 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)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 262, *Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 28721-2:2015), which has been technically revised.

The main changes are as follows:

- The normative references have been updated.
- Terms and definitions have been added.
- The crack formation temperature determination has been updated.

A list of all parts in the ISO 28721 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The performance of an enamelled article can be influenced by both the chemical composition of a vitreous enamel and the specific enamelling process. In order to ascribe measurable attributes to enamel besides its general designation, the manufacturer conducts standardized tests. The enamel is categorized in terms of the resulting resistance to corrosion and thermal shock.

The quality requirements specified in this document represent the minimum requirements a chemical enamel is expected to meet based on the current state of the art.

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# Vitreous and porcelain enamels — Glass-lined apparatus for process plants —

## Part 2:

# Designation and specification of resistance to chemical attack and thermal shock

**WARNING** — This document calls for the use of either substances or procedures, or both, that can be injurious to health if adequate safety measures are not taken. This document does not address any health hazards, safety or environmental matters associated with its use. It is the responsibility of the user of this document to establish appropriate health, safety and environment practices and determine the applicability of regulatory limitations prior to use.

## 1 Scope

This document specifies requirements for the resistance of chemical enamels to chemical attack and thermal shock, as well as their designation, for ordering purposes.

It is applicable to enamels used in glass-lined apparatus, piping and other components, primarily used in process equipment in chemical plants, which are applied on to low-alloy carbon steels substrates.

**NOTE** The main criteria for assessing enamel quality are its resistance to chemical attack and thermal shock, and the structure of the cover coat enamel.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 13807, *Vitreous and porcelain enamels — Determination of crack formation temperature in the thermal shock testing of enamels for the chemical industry*

ISO 19496-1, *Vitreous and porcelain enamels — Terminology — Part 1: Terms and definitions*

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, alkaline liquids and/or their vapours*

ISO 28706-4, *Vitreous and porcelain enamels — Determination of resistance to chemical corrosion — Part 4: Determination of resistance to chemical corrosion by alkaline liquids using a cylindrical vessel*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19496-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

## 4 Designation

The enamel quality shall be determined by the following:

- the rate of corrosion in hydrochloric acid, determined in accordance with ISO 28706-2;
- the rate of corrosion in sodium hydroxide solution, determined in accordance with ISO 28706-4;
- the crack formation temperature, determined in accordance with ISO 13807;
- the structure of the cover coat enamel, e.g. all-vitreous, all-semicrystalline, vitreous on a semicrystalline intermediate layer and semicrystalline on a vitreous intermediate layer;
- the colour of the enamel.

The designation of data on quality requirements in accordance with this document shall be as follows:

- Enamel quality requirements in accordance with ISO 28721-2.

## 5 Quality requirements

### 5.1 Rate of corrosion in hydrochloric acid

The resistance to condensing hydrochloric acid vapour shall be equal to or less than 0,08 mm/year.

### 5.2 Rate of corrosion in sodium hydroxide solution

The rate of corrosion in 0,1 mol/l sodium hydroxide solution, tested at 80 °C for 24 h, shall be equal to or less than 0,40 mm/year. The volume surface ratio shall be 20 cm<sup>3</sup>:1 cm<sup>2</sup> in accordance with ISO 28706-4.

### 5.3 Crack formation temperature

The crack formation temperature shall be equal to or greater than 190 °C.

For enamels used on accessories such as agitators, baffles, thermometer wells, immersion tubes, intermediate rings, sensors and perforated plates, as well as for piping accessories and pumps, a crack formation temperature of at least 170 °C may be permissible.

The crack formation temperature determined in accordance with ISO 13807 only represents a characteristic of the specimens tested and not the glass-lined apparatus, piping and other components.

The temperature limits for thermal shock and for heating and cooling of glass-lined apparatus are given in ISO 28721-3.

NOTE The drying oven temperature has a minimum of 210 °C subtracting 20 °C for the quenching water temperature.