
**Vitreous and porcelain enamel
finishes — Selection of test methods
for vitreous and porcelain enamelled
areas of articles**

*Finitions en émail vitrifié — Choix des méthodes d'essai applicables
aux surfaces émaillées de pièces*

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ISO 4528:2022

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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).

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).

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

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.

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*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 4258:2015), which has been technically revised.

The main changes are as follows:

- the title has been changed;
- the list of test methods and properties has been updated.

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.

Introduction

Standard test methods are required for measuring and controlling the properties and hence also the quality of vitreous and porcelain enamelled finishes.

To ensure that these finishes meet the requirements of various applications, test methods are chosen to measure the properties that are important to the function of a specific enamelled article.

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Vitreous and porcelain enamel finishes — Selection of test methods for vitreous and porcelain enamelled areas of articles

WARNING — The use of this document can involve hazardous materials, operations and equipment. It does not purport to address all of the safety or environmental problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of any other restrictions.

1 Scope

This document gives guidance on the selection of test methods for evaluating the performance of vitreous and porcelain enamelled finishes in different applications. This document references the test methods available for measuring the properties of these finishes and correlates these properties to the requirements of specific enamelled articles.

This document is limited for the most part to test methods in ISO documents or European standards but does not provide acceptance criteria or performance limits for the properties.

This document is applicable to all enamelled articles, irrespective of their basis metals.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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 Selection of test methods

The properties of enamelled surfaces are listed in [Table 1](#), along with the numbers of the ISO test methods by which they may be measured. The table identifies the tests that should be performed to assess the performance of 30 specific enamelled articles. Suitable standard test methods are selected by noting the specific tests recommended in the column for each of the enamelled articles.

Table 1 — Test methods for assessing the properties of enamelled articles

No.	Property	ISO or EN test method	Number and description of enamelled article			
			1 Cookers (top plate)	2 Cookers (baking compartment ^a , grills, burner caps, pan supports, accessories)	3 Cookers [other components (excluding cookware)]	4 Room heating equipment
Methods of assessing resistance to chemical attack in various solutions						
1	Cold citric acid	ISO 28706-1	+	+	+	+
2	Cold sulfuric acid	ISO 28706-1	-	-	+ ^b	+ ^b
3	Boiling citric acid	ISO 28706-2	-	-	-	-
4	Boiling sulfuric acid	ISO 28706-2	-	-	-	-
5	Condensing hydrochloric acid vapour	ISO 28706-2	-	-	-	-
6	Condensing products of combustion vapour	EN 1856-1:2009, Annex A	-	-	-	-
7	Hot sodium hydroxide	ISO 28706-4	-	-	-	-
8	Boiling water	ISO 28706-2:	-	-	-	-
9	Water vapour	ISO 28706-2	-	-	-	-
10	Hot standard detergent	ISO 28706-3	-	-	-	-
11	Liquid cleaners	c	+	+	+	+
12	Weathering resistance	d	-	-	-	-
13	Special corrosive substances	ISO 28706-4	-	-	-	-
14	Special corrosive substances	ISO 28706-5	-	-	-	-
15	Release of metal-ions for food contact articles	ISO 4531	-	+	-	-
16	Release of lead and cadmium	ISO 4531	-	-	-	-
Methods of assessing thickness and other properties						
17	Thickness	ISO 2178, ISO 2360	+	+	+	+
18	Reflectivity and gloss	ISO 2813	-	-	-	-
19	Waviness	c	-	-	-	-
20	Colour	ISO 105-J03/ ISO 7724 (all parts)	+	+	+	+
21	Defects (visual inspection)	c	+	+	+	+
22	Continuity and porosity (low voltage test)	ISO 8289-1	-	-	-	-
23	Continuity and porosity (low voltage test)	ISO 8289-2	-	-	-	-
24	Continuity and porosity (high voltage test)	ISO 2746	-	-	-	-
25	Resistance to thermal shock	ISO 2747	-	-	-	-
26	Resistance to thermal shock	ISO 28763:2019, Annex A	+	+	-	+
27	Resistance to thermal shock	ISO 13807	-	-	-	-
28	Resistance to heat	ISO 4530	+	+	+	+
29	Temperature class	EN 1859	-	-	-	-
30	Resistance to impact	ISO 4532	+	+	+	+
31	Adherence	EN 10209:2013, Annex C	+	+	+	+
32	Abrasion resistance	c	+	+	+	-
33	Subsurface abrasion resistance	ISO 6370-2	-	-	-	-
34	Scratch resistance	ISO 15695	-	-	-	-
35	Scratch hardness	EN 15771	-	-	-	-

Table 1 — (continued)

No.	Property	ISO or EN test method	Number and description of enamelled article			
			5 Cookware (inside surfaces and utensils)	6 Cookware (outside surfaces)	7 Chimneys and flue pipes	8 Tableware
Methods of assessing resistance to chemical attack in various solutions						
1	Cold citric acid	ISO 28706-1	+	+	-	+
2	Cold sulfuric acid	ISO 28706-1	-	-	-	-
3	Boiling citric acid	ISO 28706-2	+	-	-	-
4	Boiling sulfuric acid	ISO 28706-2	-	-	-	-
5	Condensing hydrochloric acid vapour	ISO 28706-2	-	-	-	-
6	Condensing products of combustion vapour	EN 1856-1:2009, Annex A	-	-	(+)	-
7	Hot sodium hydroxide	ISO 28706-4	-	-	-	-
8	Boiling water	ISO 28706-2	+	-	-	-
9	Water vapour	ISO 28706-2	+	-	-	-
10	Hot standard detergent	ISO 28706-3	-	-	-	-
11	Liquid cleaners	c	+	+	-	+
12	Weathering resistance	d	-	-	-	-
13	Special corrosive substances	ISO 28706-4	+	+	-	+
14	Special corrosive substances	ISO 28706-5	-	-	-	-
15	Release of metal-ions for food contact articles	ISO 4531	+	-	-	+
16	Release of lead and cadmium	ISO 4531	-	-	-	-
Methods of assessing thickness and other properties						
17	Thickness	ISO 2178, ISO 2360	+	+	+	+
18	Reflectivity and gloss	ISO 2813	-	-	-	-
19	Waviness	c	-	-	-	-
20	Colour	ISO 105-J03/ ISO 7724 (all parts)	+	+	-	+
21	Defects (visual inspection)	c	+	+	(+)	+
22	Continuity and porosity (low voltage test)	ISO 8289-1	-	-	-	-
23	Continuity and porosity (low voltage test)	ISO 8289-2	-	-	-	-
24	Continuity and porosity (high voltage test)	ISO 2746	-	-	-	-
25	Resistance to thermal shock	ISO 2747	+	+	-	-
26	Resistance to thermal shock	ISO 28763:2019, Annex A	-	-	-	-
27	Resistance to thermal shock	ISO 13807	-	-	-	-
28	Resistance to heat	ISO 4530	-	-	-	-
29	Temperature class	EN 1859	-	-	+	-
30	Resistance to impact	ISO 4532	+	+	-	+
31	Adherence	EN 10209:2013, Annex C	+	+	(+)	+
32	Abrasion resistance	c	+	+	-	+
33	Subsurface abrasion resistance	ISO 6370-2	-	-	-	-
34	Scratch resistance	ISO 15695	-	-	-	-
35	Scratch hardness	EN 15771	-	-	-	-

Table 1 — (continued)

No.	Property	ISO or EN test method	Number and description of enamelled article			
			9 Sinks	10 Refrigerators (inside surfaces)	11 Refrigerators (outside surfaces)	12 Washing machines (drum)
Methods of assessing resistance to chemical attack in various solutions						
1	Cold citric acid	ISO 28706-1	+	+	+	+
2	Cold sulfuric acid	ISO 28706-1	+	-	-	-
3	Boiling citric acid	ISO 28706-2	+	-	-	-
4	Boiling sulfuric acid	ISO 28706-2	-	-	-	-
5	Condensing hydrochloric acid vapour	ISO 28706-2	-	-	-	-
6	Condensing products of combustion vapour	EN 1856-1:2009, Annex A	-	-	-	-
7	Hot sodium hydroxide	ISO 28706-4	-	-	-	-
8	Boiling water	ISO 28706-2	+	-	-	+
9	Water vapour	ISO 28706-2	-	-	-	+
10	Hot detergent	ISO 28706-3	+	-	-	+
11	Liquid cleaners	c	+	+	+	-
12	Weathering resistance	d	-	-	-	-
13	Special corrosive substances	ISO 28706-4	-	-	-	-
14	Special corrosive substances	ISO 28706-5	-	-	-	-
15	Release of metal-ions for food contact articles	ISO 4531	-	-	-	-
16	Release of lead and cadmium	ISO 4531	-	-	-	-
Methods of assessing thickness and other properties						
17	Thickness	ISO 2178, ISO 2360	+	+	+	+
18	Reflectivity and gloss	ISO 2813	+	-	-	-
19	Waviness	c	-	-	-	-
20	Colour	ISO 105-J03/ ISO 7724 (all parts)	+	+	+	-
21	Defects (visual inspection)	c	+	+	+	+
22	Continuity and porosity (low voltage test)	ISO 8289-1	-	-	-	+
23	Continuity and porosity (low voltage test)	ISO 8289-2	-	-	-	-
24	Continuity and porosity (high voltage test)	ISO 2746	+	-	-	-
25	Resistance to thermal shock	ISO 2747	-	-	-	-
26	Resistance to thermal shock	ISO 28763:2019, Annex A	-	-	-	-
27	Resistance to thermal shock	ISO 13807	-	-	-	-
28	Resistance to heat	ISO 4530	-	-	-	-
29	Temperature class	EN 1859	-	-	-	-
30	Resistance to impact	ISO 4532	+	+	+	+
31	Adherence	EN 10209:2013, Annex C	+	+	+	+
32	Abrasion resistance	c	+	-	-	+
33	Subsurface abrasion resistance	ISO 6370-2	-	-	-	-
34	Scratch resistance	ISO 15695	+	-	-	-
35	Scratch hardness	EN 15771	+	-	-	-

Table 1 — (continued)

No.	Property	ISO or EN test method	Number and description of enamelled article			
			13 Washing machines [box (outside)]	14 Dishwasher [rinsing container (inside)]	15 Dishwasher [box (outside)]	16 Bathtubs and articles for sanitary use (households)
Methods of assessing resistance to chemical attack in various solutions						
1	Cold citric acid	ISO 28706-1	+	+	+	+
2	Cold sulfuric acid	ISO 28706-1	-	-	-	+
3	Boiling citric acid	ISO 28706-2	-	-	-	+
4	Boiling sulfuric acid	ISO 28706-2	-	-	-	-
5	Condensing hydrochloric acid vapour	ISO 28706-2	-	-	-	-
6	Condensing products of combustion vapour	EN 1856-1:2009, Annex A	-	-	-	-
7	Hot sodium hydroxide	ISO 28706-4	-	+	-	-
8	Boiling water	ISO 28706-2	-	+	-	(+)
9	Water vapour	ISO 28706-2	-	+	-	-
10	Hot standard detergent	ISO 28706-3	+	+	-	(+)
11	Liquid cleaners	c	+	-	+	+
12	Weathering resistance	d	-	-	-	-
13	Special corrosive substances	ISO 28706-4	-	+	-	+
14	Special corrosive substances	ISO 28706-5	-	-	-	-
15	Release of metal-ions for food contact articles	ISO 4531	-	-	-	-
16	Release of lead and cadmium	ISO 4531	-	-	-	-
Methods of assessing thickness and other properties						
17	Thickness	ISO 2178, ISO 2360	+	+	+	+
18	Reflectivity and gloss	ISO 2813	-	-	-	-
19	Waviness	c	-	-	-	-
20	Colour	ISO 105-J03/ ISO 7724 (all parts)	+	-	+	+
21	Defects (visual inspection)	c	+	+	+	+
22	Continuity and porosity (low voltage test)	ISO 8289-1	-	+	-	+
23	Continuity and porosity (low voltage test)	ISO 8289-2	-	-	-	-
24	Continuity and porosity (high voltage test)	ISO 2746	-	-	-	+
25	Resistance to thermal shock	ISO 2747	-	-	-	-
26	Resistance to thermal shock	ISO 28763:2019, Annex A	-	-	-	-
27	Resistance to thermal shock	ISO 13807	-	-	-	-
28	Resistance to heat	ISO 4530	-	-	-	-
29	Temperature class	EN 1859	-	-	-	-
30	Resistance to impact	ISO 4532	+	+	+	(+)
31	Adherence	EN 10209:2013, Annex C	+	+	+	+
32	Abrasion resistance	c	-	-	-	+
33	Subsurface abrasion resistance	ISO 6370-2	-	-	-	-
34	Scratch resistance	ISO 15695	-	-	-	-
35	Scratch hardness	EN 15771	-	-	-	+