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Vitreous and porcelain enamels — Regenerative, enamelled and packed panels for air-gas and gas-gas heat exchangers — Specifications

Émaux vitrifiés — Échangeurs thermiques pour réchauffeurs air-gaz et gaz-gaz à empilement de panneaux émaillés remplaçables et démontables — Spécifications

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Foreword

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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*.

This second edition cancels and replaces the first edition (ISO 28763:2008), which has been technically revised. The main changes compared with previous edition are as follows:

— the normative references have been updated;

— the terms and definitions have been updated;

— references to normative documents and respective clauses have been updated;

— references and requirements for hydrogen permeability of steel have been updated in Clause 4;

— requirements for visual examinations have been amended in Clause 6.

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.

Vitreous and porcelain enamels — Regenerative, enamelled and packed panels for air-gas and gas-gas heat exchangers — Specifications

1 Scope

This document specifies the minimum requirements and the functional characteristics of enamel coatings applied by any process, such as wet dipping, wet flow-coating, wet spraying, wet electrostatic spraying, wet electrodeposition or dry-powder electrostatic spraying, to profiled steel heat exchanger panels in regenerative heat exchangers, before and after packing in baskets.

For very severe service conditions, or to obtain extended operational life, more stringent limits can be agreed between customer and supplier.

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 105-J03, *Textiles — Tests for colour fastness — Part J03: Calculation of colour differences*

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

ISO 4534, *Vitreous and porcelain enamels — Determination of fluidity behaviour — Fusion flow test*

ISO 7991, *Glass — Determination of coefficient of mean linear thermal expansion*

ISO 8289:2000, *Vitreous and porcelain enamels — Low voltage test for detecting and locating defects*

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

ISO 28706-2:2017, *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 28723, *Vitreous and porcelain enamels — Determination of the edge covering on enamelled steel plate to be used in heat exchangers*

ISO 28764, *Vitreous and porcelain enamels — Production of specimens for testing enamels on sheet steel, sheet aluminium and cast iron*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10209:2013, *Cold rolled low carbon steel flat products for vitreous enamelling — Technical delivery conditions*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
air-gas heater
heat exchanger used to heat up the air needed for combustion in the boiler, using the combustion gases from the boiler as the hot fluid

Note 1 to entry: The maximum temperature of the hot gases entering the heat exchanger is 450 °C with a normal operating temperature from 380 °C to 320 °C.

Note 2 to entry: Air-gas heat exchangers through which gases from DeNOx installations pass are considered as gas-gas heaters for the purposes of this document.

3.2
gas-gas heater
heat exchanger used in desulfuration plants to reheat the gases treated in the scrubber to obtain the proper draft in the stack

Note 1 to entry: The hot gases are the untreated gases going to the scrubber.

Note 2 to entry: The maximum temperature of the hot gases entering the heat exchanger is 200 °C with a normal operating temperature from 160 °C to 120 °C.

4 Steel substrates

4.1 Delivery

The steel for enamelling shall conform to the requirements of EN 10209 and shall be delivered with a certificate in accordance with EN 10204:2004, 3.1.

4.2 Analysis

The chemical composition shall be determined by a ladle analysis and shall conform to the requirements of EN 10209:2013, Table 2. At the request of the enameller, other elements as mentioned in EN 10209:2013, Table 2, shall be agreed with the steel manufacturer. For grades DCO3ED and DCO4ED, the carbon content of the product shall be determined and shall conform to EN 10209:2013, Table 2.

4.3 Hydrogen permeability

The hydrogen permeability shall have a minimum hydrogen permeation value (TH1) of 120, calculated in accordance with EN 10209:2013, A.1.8, Formula (A.1), or shall give the result of a minimum of 8 min in accordance with EN 10209:2013, A.1.8, Formula (A.2).

In the absence of a certificate from the steel supplier confirming the above minimum hydrogen permeability, and with prior agreement between the customer and the supplier, the fish-scale resistance shall then be determined as described in 4.4.

The hydrogen permeability method is not acceptable for the steel grades DCO6EK and DCO6ED (see EN 10209:2013, Table 2). For these grades, the fish scaling test described in 4.4 shall be used.

4.4 Fish scaling test

The fish scaling test shall be carried out in accordance with EN 10209:2013, A.2, method A.2. The test sheet (150 mm × coil width) shall be pre-treated without a nickel dip. The front and back shall be coated with enamel prepared in accordance with the supplier's milling formula and applied to produce a fired thickness of 100 µm to 130 µm. After drying, the coated test sheet shall be fired for 5 min at 820 °C. The test sheet shall then be subjected to thermal treatment at 60 °C to 80 °C for 24 h and subsequently inspected for fish scales. No fish scales are allowed.