

QUALITY STANDARD FOR TRIFUSION[®] PLUS GLASS COATINGS FOR USE IN INDUSTRIAL LIQUID STORAGE TANKS

1. SCOPE

This Standard specifies the quality requirements for the TRIFUSION[®] PLUS process for glass coating by vitreous enameling of panels intended for use in the construction of storage tanks for uses such as the storage or treatment of industrial effluent, where a wider variability of liquor concentrations exists and the more aggressive environment demands a superior quality.

This Standard applies to the enameling elements of the TRIFUSION[®] PLUS process, however, the quality criteria in Section 5.2 should apply to the tank as built. The TRIFUSION[®] PLUS glass coating has been developed with reference to International Standard specifications for glass coatings on bolted steel panels and conforms to ISO 28765⁽¹⁾.

2. DEFINITIONS

For the purposes of this Standard, the following definitions shall apply.

Glass coating: Any coating, commonly also referred to as vitreous enamel, based on silica Glass-Fused-to-Steel sheets by the TRIFUSION[®] PLUS process at temperatures sufficient to cause glass melting and chemical bonding to the steel substrate so as to form a composite glass/steel panel.

Supplier: Any company supplying Fusion Tanks and Silos with any materials for use in the TRIFUSION[®] PLUS process.

Defect: Any void, break, crack, thin spot, blister, foreign inclusion or contamination of the glass coating.

Discontinuity: Any defect which allows an electric current to pass through the glass coating when testing using the specified instrument operated in accordance with Section 5.2.2 of this Standard.

3. GENERAL

The inspection procedures specified in this Standard and the TRIFUSION[®] PLUS enameling process shall be carried out under quality management systems accredited to ISO 9001⁽²⁾.

4. RAW MATERIALS

4.1 The steel used shall have a specification as agreed between Fusion Tanks and Silos and the steel supplier having due regard to the requirements of the enameling process.

4.2 All other raw materials used in the production of the glass coated panels shall be inspected on receipt at Fusion Tanks and Silos' premises to ensure that they meet Fusion Tanks and Silo's specifications.

4.3 Where Fusion Tanks and Silos is not able to inspect raw material against any aspect of Fusion Tanks and Silos' specification or the specification according to Clause 5.1.1 (for example, chemical composition of steels, flow bead tests of glass etc.), Fusion Tanks and Silos shall require the supplier to carry out such inspections at the supplier's premises and provide Fusion Tanks and Silos with authorized copies of certificates for such inspections and record conformity of the raw materials in accordance with the Quality Specification, and make certified copies of those records available.

5. QUALITY

5.1 Glass Coating

Glass coated test samples shall be regularly tested to ensure that the properties of the glass coating meet the requirements of this Standard and Fusion Tanks and Silos' specification.

5.1.1 Quality Specification

Tests shall be carried out to ensure that the glass coating on the contact enamel surface meets the chemical resistance and physical properties specifications set out in Table 1.

TABLE 1 – CHEMICAL RESISTANCE AND PHYSICAL PROPERTIES

	TEST STANDARD	QUALITY SPECIFICATION	MINIMUM TEST FREQUENCY
CHEMICAL RESISTANCE (Inside Surface)			
Citric acid at room temperature	EN 14483-1:2004 ⁽³⁾ Clause 9	Class AA	Monthly
Boiling citric acid	EN 14483-2:2004 ⁽⁴⁾ Clause 10	Maximum weight loss 0.75g/m ² after 2½ hours	Annually
Boiling distilled or demineralized water Liquid phase - Vapor phase -	EN 14483-2:2004 Clause 13	Maximum weight loss 1.5g/ m ² after 48 hours 5g/m ² after 48 hours	Annually
Hot sodium hydroxide	EN 14483-4:2004 ⁽⁵⁾ Clause 9	Maximum weight loss 6g/ m ² after 24 hours	Annually
Sulphuric acid at room temperature	EN 14483-1:2004 Clause 10	Class AA	Monthly
Hydrochloric acid at room temperature	EN 14483-1:2004 Clause 11	Class AA	Monthly
Boiling hydrochloric acid Vapor phase	EN 14483-2:2004 Clause 12	Maximum weight loss 7g/m ² after 7 days	Annually
Standard detergent solutions	EN 14483-3:2004 ⁽⁶⁾ Clause 9	Maximum weight loss 2.5g/m ² in 24 hours	Annually
PHYSICAL PROPERTIES (Inside Surface)			
Impact	ISO 4532 ⁽⁷⁾ , 40N force.	Maximum cracking 2mm after 24 hours	Monthly
Adherence level	EN 10209: Annex D ⁽⁸⁾	Class 2	Monthly
Resistance to abrasion	ISO 6370-2 ⁽⁹⁾	Maximum weight loss 45g/m ²	Annually
Resistance to thermal shock	ISO 2747 ⁽¹⁰⁾	300°C	Annually
Scratch hardness	EN 101 ⁽¹¹⁾	Mohs 5	Monthly

5.2 Finished Panels

Finished panels shall be inspected following the enameling process, prior to packing and dispatch from Fusion Tanks and Silos' premises. Fusion Tanks and Silos shall carry out inspections on both the inside and the outside surfaces. In cases where both the inside and the outside surfaces of the panel are in contact with the stored liquid both surfaces shall be treated as inside surfaces for the purposes of this Standard.

5.2.1 Inspection of the Outside Surface

The outside surface of all panels shall be inspected visually under good daylight or equivalent lighting for defects in the glass coating. Any panel having visible defects larger than 0.04" shall be rejected. Any panel having more than three visible defects per m² of the total panel area shall be rejected. All visible defects on the outside surface of accepted panels shall be repaired using a repair material approved by Fusion Tanks and Silos for this purpose and applied according to the repair material manufacturer's instructions.

5.2.2 Inspection of the Inside Surface

The inside panel surface shall be inspected using a high voltage tester approved by Fusion Tanks and Silos for this purpose and used in accordance with Test A of EN 14430⁽¹²⁾ and Clause 5.2.2.1. Inspection shall be carried out on every panel and any panel having any discontinuities shall be rejected.

5.2.2.1 The tester shall have an accuracy of $\pm 1\%$ and a test voltage of 1500 volts shall be used. The tester shall have a valid calibration record.

5.2.3 Inspection of the Glass Thickness

The thickness of the glass shall be measured using an approved instrument suitable for a measurement range of 0-19.7 mils and used in accordance with EN ISO 2178⁽¹³⁾. Inspection shall be carried out using a sampling procedure complying with ISO 2859: Part 1⁽¹⁴⁾.

The thickness of the glass on the inside surface of every panel shall be maintained in the range from 13.4 mils to 19.7 mils. The thickness of the glass on the outside surface of every panel shall be maintained in the range from 9.8 mils to 19.7 mils. Panels having a glass

thickness outside these ranges shall be rejected.

5.2.4 Inspection of Glass Color

The outside panel surface shall be inspected using a color comparator instrument and the color checked against standard limits set by Fusion Tanks and Silos. Inspection shall be carried out using a sampling procedure complying with ISO 2859: Part 1. Panels of a color outside these limits shall be rejected.

6. HANDLING AND PACKING

Prior to storage or packing panel edges shall be protected using a material approved by Fusion Tanks and Silos for this purpose and applied according to the edge protection material manufacturer's instructions. All panels shall be packed using a suitable membrane between the panels.

7. GUIDANCE NOTES FOR INSTALLATION AND USE

7.1 Care in Handling

Recommendations for the correct methods of handling outside the enameling premises are given in the *Fusion Tanks and Silos Construction Guide*.

7.2 Inspection at the Construction Site

During tank installation, the use of an approved low voltage wet swab tester on the inside panel surface is recommended. Fusion Tanks and Silos can advise on the use of the low voltage wet swab test equipment. Guidance is also given in the *Fusion Tanks and Silos Construction Guide*.

7.3 Change of Use

Owners and users of industrial storage tanks should be aware that changes in the use or structure of a tank can result in dramatic changes to the operating environment and affect the coating and design limitations of the tank. Fusion Tanks and Silos will offer advice on request.

8. REFERENCES

1. ISO 28765:2008

Vitreous and porcelain enamels – Design of vitreous enamel coated bolted steel tanks for the storage or treatment of water or municipal or industrial effluents and sludges.

2. ISO 9001:2000

Quality management systems - Requirements for design, manufacture and installation of vitreous enameled tanks and silos for storage and processing of liquid and dry product and associated equipment.

3. EN 14483-1:2004

Vitreous and porcelain enamels – Determination of resistance to chemical corrosion – Part 1: Determination of resistance to chemical corrosion by acids at room temperature.

4. 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 vapors.

5. EN 14483-4:2004

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.

6. EN 14483-3:2004

Vitreous and porcelain enamels – Determination of resistance to chemical corrosion – Part 3: Determination of resistance to chemical corrosion by alkaline liquids using a hexagonal vessel.

7. ISO 4532:1991

Determination of the resistance of enameled articles to impact: Pistol test.

8. EN 10209:1996

Annex D: Cold-rolled low carbon steel flat products for vitreous enameling.

9. ISO 6370-2:1991

Vitreous and porcelain enamels – Determination of resistance to abrasion – Part 2: Loss in mass after sub-surface abrasion.

10. ISO 2747:1998

Vitreous and porcelain enamels - Enameled cooking utensils - Determination of resistance to thermal shock.

11. EN 101:1991

Ceramic floor and wall tiles - Method for determination of scratch hardness of surface according to Mohs.

12. EN 14430:2004

Vitreous and porcelain enamels – High voltage test.

13. EN ISO 2178:1995

Non-magnetic coatings on magnetic substrates – Measurement of coating thickness – Magnetic method.

14. ISO 2859:1999

Sampling procedure for inspection by attributes - Part 1: Sampling schemes indexed by Acceptance quality limits (AQL) for lot-by-lot inspection.