



A Simplified Guide to the ISO 28765:2016 - Vitreous and Porcelain Enamel Quality and Service Requirements with Comparison to European Enameling Authority (EEA) 4th Edition and AWWA D103:19

The information in this document is provided to simplify the information in and facilitate the understanding of the glass fused-to-steel (*gf2s*[™]) coating quality and service requirements defined in **ISO 28765 - Vitreous and porcelain enamels - Design of bolted steel tanks for the storage or treatment of water or municipal or industrial effluents and sludges**, and further to show how the ISO standard compares to the quality requirements of the European Enameling Authority and American Water Works Association for bolted storage tanks.

The ISO standard defines four glass quality categories. Each category has one or more application designations. We have arbitrarily named the 4 quality categories as Class AA, Class A, Class B and Class C. The table to the right shows the categories with the corresponding ISO listed tank applications.

UIG **Everstore**[®] glass fused-to-steel coatings comply with the ISO quality requirements. **Everstore**[®] meets or exceeds the Class B requirements and is used for Class B and C applications. **Everstore Plus** meets or exceeds the Class AA requirements and is used for Class AA and A applications.

UIG Glass	ISO Quality Group	ISO 28765:2016 Tank Application Categories
Everstore ^{® Plus}	Class AA	<ul style="list-style-type: none"> Thermophilic/ pasteurization digester – roof and rings exposed to gaseous zone
	Class A	<ul style="list-style-type: none"> Industrial effluent process/treatment Biogas digester for agricultural waste - roof and rings exposed to gaseous zone Thermophilic/ pasteurization digester - cylinders Municipal mesophilic digester - roof and rings exposed to gaseous zone Liquid Leachate Municipal sludge treatment - roof and rings exposed to gaseous zone Borehole/brackish/seawater
Everstore [®]	Class B	<ul style="list-style-type: none"> Municipal mesophilic digester - cylinders Municipal sludge treatment - cylinders Municipal sludge/sludge cake storage Filter tanks Storm/firewater Potable water (DWI listed Reg 31) Potable water (ANSI/NSF 61 listed)
	Class C	<ul style="list-style-type: none"> Biogas digester for agricultural waste - cylinders

The table to the right compares the glass quality requirements of ISO 28765 to the American Water Works Association (AWWA) Standard D103 *Factory-Coated Bolted Carbon Steel Tanks for Water Storage* and to the European Enamel Authority (EEA) Standards 7.20 (for industrial tanks), 7.24 (for animal feed silos) and 7.25 (for dung storage tanks) glass quality requirements. AWWA provides only a casual reference to glass quality, and while the EEA methodology is similar to ISO its requirements are less stringent.

The table on the next page shows the specific details of the property and testing requirements for each of the ISO 28765 quality classes. The simplicity of designating the quality levels as Class AA, A, B, and C allows concise and simple communication between buyer and seller with respect to the glass quality.

Relative Comparison of the Glass Quality Requirements of the Three Standards Reviewed								
	AWWA D103	EEA 7.20	EEA 7.24	EEA 7.25	ISO Class AA	ISO Class A	ISO Class B	ISO Class C
Does AWWA D103 meet or exceed the glass quality requirements of:	---	No	No	No	No	No	No	No
Does EEA 7.20 meet or exceed the glass quality requirements of:	Yes	---	Yes	Yes	No	No	No	No
Does EEA 7.24 meet or exceed the glass quality requirements of:	Yes	No	---	Yes	No	No	No	No
Does EEA 7.25 meet or exceed the glass quality requirements of:	Yes	No	No	---	No	No	No	No
Does ISO Class AA meet or exceed the glass quality requirements of:	Yes	Yes	Yes	Yes	---	Yes	Yes	Yes
Does ISO Class A meet or exceed the glass quality requirements of:	Yes	Yes	Yes	Yes	No	---	Yes	Yes
Does ISO Class B meet or exceed the glass quality requirements of:	Yes	Yes	Yes	Yes	No	No	---	Yes
Does ISO Class C meet or exceed the glass quality requirements of:	Yes	Probably	Yes	Yes	No	No	No	---

**ISO 28765:2016 - Vitreous and porcelain enamels - Design of bolted steel tanks for the storage or treatment of water or municipal or industrial effluents and sludges
Consolidation of Table 2 (Minimum quality requirements) and Table 3 (Requirements for finished vitreous enameled panels)**

	Property and Test or Inspection Method	Minimum Inspection Frequency	UIG Everstore® Plus		UIG Everstore®	
			Class AA	Class A	Class B	Class C
1	Resistance to chemical corrosion by citric acid at room temperature; ISO 28706-1:2008 Clause 9	Monthly or with each batch	Class AA	Class AA	Class A+	Class A
2	Resistance to chemical corrosion by sulphuric acid at room temperature; ISO 28706-1:2008 Clause 10	Monthly or with each batch	Class AA	Class A+	Test not required	Test not required
3	Resistance to chemical corrosion by hydrochloric acid at room temperature; ISO 28706-1:2008 Clause 11 (10% solution for 15 minutes)	Monthly or with each batch	Class AA	Class A+	Test not required	Test not required
4	Resistance to chemical corrosion by boiling citric acid; ISO 28706-2:2008 Clause 10 - Max mass loss after 2.5 hours	Annually	0.75 gm/m ²	1.5 gm/m ²	3.0 gm/m ²	5.0 gm/m ²
5	Resistance to chemical corrosion by boiling hydrochloric acid – Vapour phase; ISO 28706-2:2008 Clause 12 - Max mass loss after 7 days	Annually	7.0 gm/m ²	8.0 gm/m ²	Test not required	Test not required
6a	Resistance to chemical corrosion by boiling distilled or demineralized water; ISO 28706-2:2008 Clause 13 - Liquid phase - Max mass loss after 48 hours	Annually	2.5 gm/m ²	2.5 gm/m ²	5.0 gm/m ²	5.0 gm/m ²
6b	Resistance to chemical corrosion by boiling distilled or demineralized water; ISO 28706-2:2008 Clause 13 - Vapour phase - Max mass loss after 48 hours	Annually	5.0 gm/m ²	7.5 gm/m ²	Test not required	Test not required
7	Resistance to chemical corrosion by standard detergent solutions; ISO 28706-3:2008 Clause 9 - Max mass loss after 24 hours	Annually	2.5 gm/m ²	5.0 gm/m ²	Test not required	Test not required
8	Resistance to chemical corrosion by hot sodium hydroxide; ISO 28706-4:2008 Clause 9 - Max mass loss after 24 hours	Annually	6.0 gm/m ²	6.0 gm/m ²	7.0 gm/m ²	7.0 gm/m ²
9	Resistance to thermal shock; ISO 28763:2008, Annex A	Annually	No damage at 350 degrees C	No damage at 350 degrees C	Test not required	Test not required
10	Resistance to impact: Pistol test; ISO 4532 – Max damage < 2 mm in diameter after 24 hours	Monthly or with each batch	40 N force	40 N force	20 N force	20 N force
11	Determination of the resistance to abrasion; ISO 6370-2 - Max mass loss	Annually	45 gm/m ²	45 gm/m ²	Test not required	Test not required
12	Scratch hardness of surface according to Mohs; EN 15771	Monthly or with each batch	Mohs 5	Mohs 5	Mohs 5	Mohs 5
13	Adherence level; EN 10209:2013 Annex C	Monthly or with each batch	Class 2	Class 2	Class 2	Class 2
14	Enamel Thickness - Inside Surface; ISO 2178	Per ISO 2859-1:1999	300µm - 500µm	260µm - 460µm	200µm - 400µm	160µm - 360µm
15	Enamel Thickness - Outside Surface; ISO 2178	Per ISO 2859-1:1999	160µm - 500µm	160µm - 500µm	160µm - 500µm	160µm - 500µm
16	Defects – Inside Surface – No discontinuities	Every panel	ISO 2746:2015 Test A Test voltage 1500v	ISO 2746:2015 Test A Test voltage 1100v	ISO 2746:2015 Test A Test voltage 700v	ISO 8289:2000 Method A Low voltage wet sponge test
17a	Defects – Outside Surface, maximum visible defect size 1 mm	Every panel	Visual inspection (see Note 2)			
17b	Defects – Outside Surface, maximum 3 visible defects per m ² total panel area	Every panel	Visual inspection (see Note 2)			
18	Colour – Outside Surface, Colour and colour tolerances shall be agreed between interested parties	Per ISO 2859-1:1999	Inspection using a colour comparator approved prior to production by the vitreous enameller			

Notes:

1. Consult with supplier for suitability for specific applications. All applications subject to concentration and temperature considerations of the stored liquid.
2. It is permissible, when agreed between the contracting parties, to rectify defects with a material approved by the vitreous enameller for the purpose, applied according to the rectification material manufacturer's instructions.