

WHITE PAPER



STEEL: ASTM A1011 MATERIAL

BY: CST INDUSTRIES, INC.

CST utilizes ASTM 1011 steel for enamel tank construction that is supplied by an American Steel mill. This material is specifically designated in AWWA D103, which makes us compliant not only with respect to tank construction, but material designation as well.

CST has competitors who market usage of ART310 material. Please note: ART310 material is a new proprietary blend steel (as of ~2007) based out of China with only one supplier readily available in the market. The recently imposed tariffs on China will make the use of this material more expensive for the supplier, which in turn will affect pricing for customers. The only standard found associated with this steel was Q/ASB 106, a Chinese standard which is not equivalent to any American standard for material that is specific for AWWA D103 compliance. The specific materials listed in AWWA D103 are: ASTM A36, A283 Grade C or D, A1011 Grade 30, 33, 36, 40, 45, 50, 55, 60, 65 or 70; A572 Grade 50, 60, or 70. In the table below, it shows that the ART310 material does not correlate to these material types.

Material Type	Composition														
	C	Mn	P	S	Al	Si	Cu	Ni	Cr	Mo	V	Cb	Ti	N	Ti/C
ASTM A36	0.25 - 0.29	1.03	0.04	0.05		0.28	0.2								
ASTM A283 Grade C	0.24	0.9	0.03	0.03		0.15 - 0.4	0.2								
ASTM A283 Grade D	0.27	0.9	0.03	0.03		0.15 - 0.4	0.2								
ASTM A1011 Grade 30	0.25	0.9	0.035	0.04			0.2	0.2	0.15	0.06	0.008	0.008	0.025		
ASTM A1011 Grade 33	0.25	0.9	0.035	0.04			0.2	0.2	0.15	0.06	0.008	0.008	0.025		
ASTM A1011 Grade 36	0.25	0.9	0.035	0.04			0.2	0.2	0.15	0.06	0.008	0.008	0.025		
ASTM A1011 Grade 40	0.25	0.9	0.035	0.04			0.2	0.2	0.15	0.06	0.008	0.008	0.025		
ASTM A1011 Grade 45	0.25	1.35	0.04	0.04			0.2	0.2	0.15	0.06					
ASTM A1011 Grade 50	0.25	1.35	0.04	0.04			0.2	0.2	0.15	0.06					
ASTM A1011 Grade 55	0.25	1.35	0.04	0.04			0.2	0.2	0.15	0.06	0.005	0.005	.005 min		
ASTM A1011 Grade 60	0.26	1.5	0.04	0.04			0.2	0.2	0.15	0.06	min	min			
ASTM A1011 Grade 65	0.26	1.5	0.04	0.04			0.2	0.2	0.15	0.06					
ASTM A1011 Grade 70	0.26	1.65	0.04	0.04			0.2	0.2	0.15	0.06					
ASTM A572 Grade 42	0.21	1.35	0.04	0.05		0.4									
ASTM A572 Grade 50	0.23	1.35	0.04	0.05		0.4									
ASTM A572 Grade 60	0.26	1.35	0.04	0.05		0.4									
ASTM A572 Grade 65	0.26	1.65	0.04	0.05		0.4									
ASTM A656 Grade 50											0.08	0.1		0.02	
ASTM A656 Grade 60	0.18	1.65	0.025	0.035		0.6									
ASTM A656 Grade 70															
ART310	0.06	0.35	0.06	0.015	.01-.055	0.1							0.06 - 0.2		2.5

ART310 steel is a new material utilized in the field; therefore, studies of long-term effects of its use, and performance of the enameled tank in service are not available. CST has tanks out in the field that are over 50 years old and still functioning.

FRITS: Proprietary Formulated with Glass/Frit Supplier Ferro

CST has always milled its own blended enamel formulations for each coating of glass that is utilized in our Vitrium™ three coat-one fire (3C1F), and three coat-two fire (3C2F) enameled tanks. These formulations are specifically designed to provide glass layers that are thermochemically fused to the steel substrate material. The nickel oxide (NiO) based precoat utilized in our coating system is necessary for glass adhesion and fish scale resistance. This is widely known and accepted in the enamel industry. A NiO precoat study has shown that it is an integral constituent in the interfacial enamel layer that aids in controlling the distribution of interfacial bubbles. Large bubbles become entrapped at the

steel/enamel interface layer by means FeNi rich dendrites. Metal reactions that occur inside these bubbles provide diffusion paths for hydrogen; thereby increasing fish scale resistance. [1]

Our durable, field tested, glass coatings have thicknesses in the range of 10 – 18 mils. This holiday free glass coating thickness provides the lowest maintenance requirement over the life of the tank, and thus a greater lifetime value compared to alternative coating materials.

TiO₂- rich Vitrium™: Patented Coating Process

In 1998 CST Storage launched an R&D project to develop a process for the direct application of our patented, titanium dioxide (TiO₂)-rich glass. The goal of the research project was to increase value by providing three coat–two fire coating performance with a single pass through the furnace. This achievement resulted in a totally new, patented “three-coat-one-fire” (3C1F) process for applying TiO₂-rich glass. The patented process and coating were trademarked as Vitrium (from Vitreous and Titanium). No other enameled tank manufacturer in the world can duplicate this 3C1F process.

Vitrium Glass combines the superior chemical resistance and outstanding physical properties of titanium dioxide rich glass with process-optimized, ultra-fine bubble structure. This translates to longer tank life, durability at competitive pricing, maximum coating effectiveness without excess coating thickness and 100% holiday free sheets. The high TiO₂ content is unique to glass-fused-to-steel and provides exceptional properties to fit colder conditions common to the North American market.

CST’s porcelain enamel surfaces, Vitrium as well as 3C2F processes, adhere to the requirements of International Standard 28765 and to AWWA D103. Furthermore, CST Storage complies with its own published standards that have been formed from over 125 years of experience in dealing with many different liquids and field conditions throughout the world.

Plate Edges: Edgecoat II™

Edgecoat II is a result of CST’s commitment to an ongoing product development and improvement program. Edgecoat II edge encapsulation maximizes corrosion protection by eliminating exposed, uncoated steel. CST mechanically rounds the sheet edges to a specific radius which allows a consistent, seamless glass coating to the sheet edges—resulting in unmatched protection. This continuous innovative Edgecoat technology is the only process in the world that provides optimum glass encapsulation on all (4) four sides of the rectangular sheet edges. Edgecoat II technology conforms to Porcelain Enameling Institute guidelines (PEI-101). Part Size to metal thickness relationship is outlined as a starting point guideline for materials up to 14GA in PEI-101. The resources available to our R&D department along with CST’s years of experience enable us to factor in greater thicknesses for part design and fabrication.

References

1. X. Yang, A. Jha, R. Brydson, R. C. Cochrane, “The Effects of a Nickel Oxide Precoat on the Gas Bubble Structures and Fish-scaling Resistance in Vitreous Enamels,” *Mat. Sci. & Eng. A36* (2004) 254.