



# Liberty Tank & Vessels

Coal tar epoxy liquid coating

Overall Rating: 4.9

**Key**

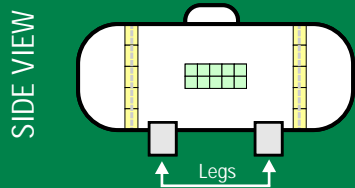
low high

S Tank Side Sample  
W Weld Seam Sample  
L Leg Attachment Sample

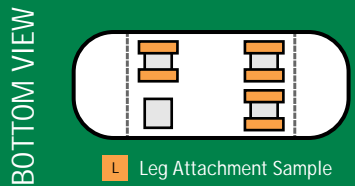
Overall Sample  
in Holidays  
Vapor Phase  
Immersion Phase

No Change  
Minor  
Moderate  
Severe

1-4 Blister Size (4=largest)



W Weld Seam Sample  
S Side Sample



## Testing Process

Tank Manufacturer

Delivery

Group 1 Samples

Pre-Environmental Mechanical Testing

Group 2 Samples

Accelerated Weathering

Chemical Immersion

Thermal Cycling

Post-Environmental Exposure Mechanical Testing

## Mechanical Durability

Pre-Environmental Exposure	Post-Environmental Exposure				
	Nitric Acid	Sodium Chloride	Sodium Hydroxide	Sodium Bicarbonate	Distilled Water
Impact Resistance	S,W,L	S,W,L	S,W L samples deteriorated	S,W L samples deteriorated	S,W L samples deteriorated
Adhesion Resistance	S,W,L	S <sup>v</sup> , W <sup>v</sup> , L <sup>v</sup> , S <sup>v</sup> , W <sup>v</sup> , L <sup>v</sup>	S,W <sup>v</sup> , L	S <sup>v</sup> , L <sup>v</sup> , L <sup>v</sup> , S <sup>v</sup> , S <sup>v</sup> , W	S,L <sup>v</sup> , L <sup>v</sup> , W
Coating Hardness	S,W,L	S,W,L	S,W,L	S,W,L	S,W,L
Abrasion Resistance	S,W,L	S,W,L	S,W,L	S,W <sup>v</sup> , L, W	S,W <sup>v</sup> , L, W <sup>v</sup>

\*In some cases the mechanical properties improved after exposure, which may be related to hardening or softening of the coating, or variations in coating thickness across the samples.

## Environmental Exposure Testing

### Accelerated Weathering—250 hours

Severe color change (black to brown) and gloss reduction; rust spots on most samples

### Chemical Immersion—90 Days

Tank Area and Results	Nitric Acid	Sodium Chloride	Sodium Hydroxide	Sodium Bicarbonate	Distilled Water
<b>Side Wall</b>					
Color & Gloss	△ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup>	△ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup>	○ <sup>i</sup>	△ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup>	△ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup>
Rusting	H <sup>i</sup>	H	○ <sup>i</sup>	✓	H
Blistering	3 ○ <sup>i</sup> , 2 ○ <sup>v</sup>	✓	✓	✓	✓
<b>Weld Seam</b>					
Color & Gloss	○ <sup>v</sup> , △ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup>	△ <sup>v</sup> , ○ <sup>v</sup>	△ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup> *	△ <sup>v</sup> , ○ <sup>v</sup>	△ <sup>v</sup> , ○ <sup>v</sup>
Rusting	✓	○ <sup>i</sup>	✓	✓	✓
Blistering	3 ○ <sup>i</sup>	✓	✓	✓	2 ○ <sup>i</sup>
<b>Leg Attachment</b>					
Color & Gloss	○ <sup>v</sup> , △ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup> *	○ <sup>i</sup>	△ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup> *	△ <sup>v</sup> , ○ <sup>v</sup> , ○ <sup>i</sup>	○ <sup>v</sup> , △ <sup>v</sup> , ○ <sup>i</sup> *
Rusting	✓	△ <sup>v</sup>	✓	✓	✓
Blistering	✓	✓	✓	✓	✓

\* Indicates that the top layer of the coating disbonded from the rest of the coating

### Thermal Cycling—30 24-hour cycles

Nitric acid weld seam* Rusting: ○	Sodium chloride weld seam* Sodium chloride leg attachment Rusting: △	Sodium hydroxide side wall* Blistering: 2 ○ <sup>i</sup>
Nitric acid leg attachment Blistering: 3 ○ <sup>i</sup>	Sodium bicarbonate side wall Color & Gloss: ○ <sup>i</sup>	Sodium hydroxide leg attachment Rusting: ○

\* Indicates that the top layer of the coating disbonded from the rest of the coating

Research was provided by KTA-Tator Inc. under PERC Docket 12469, *Testing and Evaluation of Underground Propane Tank Coatings*. The information provided in this document is intended only as a summary of the tank coating performance results; for more detailed findings, please reference the full report.

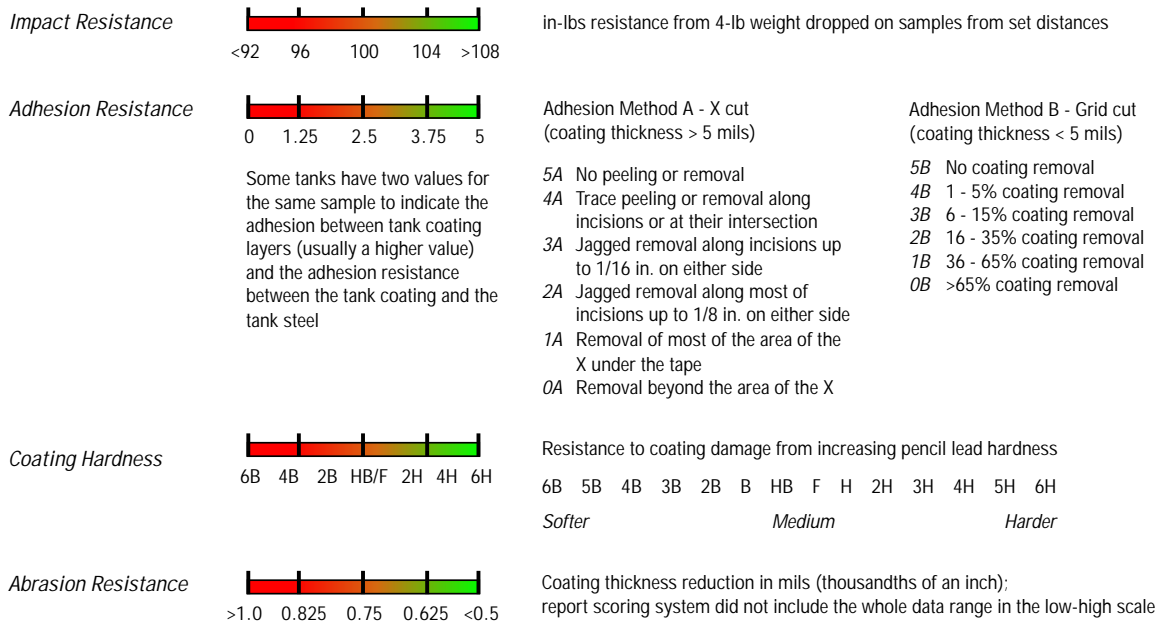
*The ranking of the seven propane tanks used in this study on the basis of performance points should not be misinterpreted. Nothing in this report should be construed to suggest that the tanks that have received the lowest number of performance points and the lowest ranking overall, or in any category, are defective, dangerous, or subject to withdrawal from the market or from use in their intended application. Nothing in this report should be construed to suggest that any type of underground propane tank, or any underground propane tank with a particular type of coating, should not be used in the propane industry.*

The tank evaluation results have been summarized through the following methods.

### Mechanical Durability:

The front page of this document provides a side-by-side comparison of tank performance both before and after environmental exposure (accelerated weathering, chemical immersion, and thermal cycling). KTA-Tator provided pre- and post-environmental exposure test data for tank samples taken from the tank weld seam, side wall, and leg attachment.

The low-to-high scales indicate the performance range unique to each test. Raw performance data was used to rank each sample on the appropriate test's scale:



### Chemical Immersion:

The report includes data for 30-day, 60-day, and 90-day chemical immersion periods. The 90-day results are summarized in this document to demonstrate the longer-term effects of chemical immersion. Color and gloss changes, rusting, and blistering are classified as minor, moderate, or severe for visual purposes using the following scales:

#### Color and gloss change

- Severity was labeled as minor, moderate, or severe in the report.

#### Rusting

- Evaluated according to SSPC VIS 2/ASTM D 610, "Evaluating Degree of Rusting on Painted Steel Surfaces."
  - In some cases, rusting was classified as minor/moderate/severe within the report.
  - In other cases, the following numbers were used: 10 (<0.03%); 9 (0.03%); 8 (0.1%); 7 (0.3%); 6 (1%); 5 (3%); 4 (10%); 3 (16%); 2 (33%); 1 (50%).
  - These frequencies are visually conveyed through the following system:

- ✓ No change      Rusting at holidays=minor; corrosion undercutting at perimeter of holidays=moderate; rusted through holidays=severe
- 8-10 = Minor      Rust creep and rust along the weld indicate the presence of rust but is unable to be classified as minor, moderate, or severe
- ▲ 4-7 = Moderate
- 1-3 = Severe

#### Blistering

- Blister sizes given in report: 2, 4, 6, 8, according to ASTM D 714, "Evaluating the Degree of Blistering of Paints."
  - Blister sizes given in the report indicated 8 as the smallest blister size and 2 as the largest blister size.
  - To aid presentation, these ratings were inverted to a 1-4 scale to show a larger number as a larger blister size.
- Blister frequencies given in report: Few, Medium, Medium Dense, Dense for blister density, according to ASTM D 714.

These frequencies are visually conveyed through the following system:

- ✓ No change = no blistering      ▲-■ Medium Dense = moderate-severe
- Few = minor      ■ Dense = severe
- ▲ Medium = moderate