

A Coating with Superior Chemical Resistance, with High Impact Resistance, and Elongation Virtually Equal to Steel, for Chemical and Product Tankers



The MarineLine[®] Enhanced cargo tank coating with nano technology has been engineered to provide both high chemical resistance, and high impact resistance, as requested by shipowners to withstand mechanical damages that may be incurred during cleaning, repairs, etc. Advanced Polymer Coatings' MarineLine[®] Enhanced is a tougher version of its previous coating system.

With this R&D breakthrough, several other features have also been realized, thus adding significantly to the overall performance of the coating. Key benefits of the enhanced formulation include:

- ▶ **Increased Impact Resistance more than 50%** creating a tougher, more durable coating.
- ▶ **Increased Coating Elongation (flexibility) more than 100%**, to virtually match the carbon steel cargo tank.
- ▶ **Reduced Surface Energy almost 60%** for easier, faster tank cleaning.

Description

MarineLine[®] Enhanced is a high functionality two component polymer coating having enhanced properties:

- ▶ Impact resistance
- ▶ Toughness
- ▶ Elongation virtually equal to steel
- ▶ Abrasion resistance
- ▶ Lower surface energy

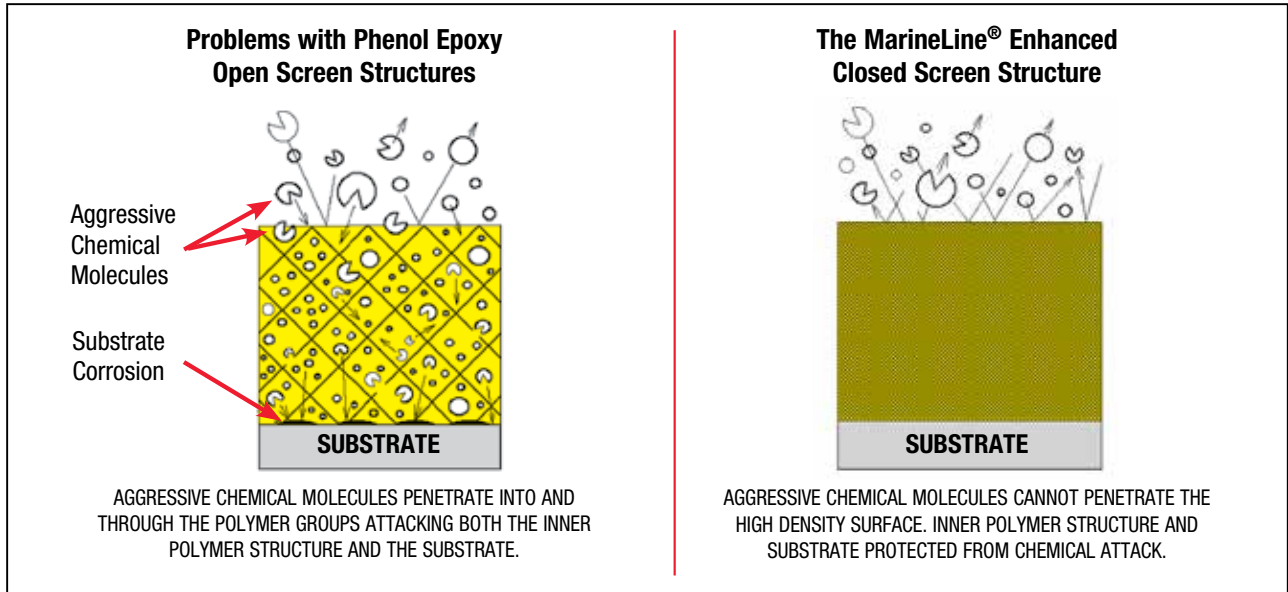
Superior Chemical Resistance to:

- ▶ 1% to 98% Sulfuric Acid
- ▶ 1% to 80+% Phosphoric Acid
- ▶ 10% to 73% Sodium Hydroxide
- ▶ Methanol
- ▶ Methylene Chloride
- ▶ Sodium Hypochlorite
- ▶ Acetic Acid
- ▶ Most Acids, Alkalis and Solvents
- ▶ Wine and Edible Oils (complies with all FDA regulations – GRAS)



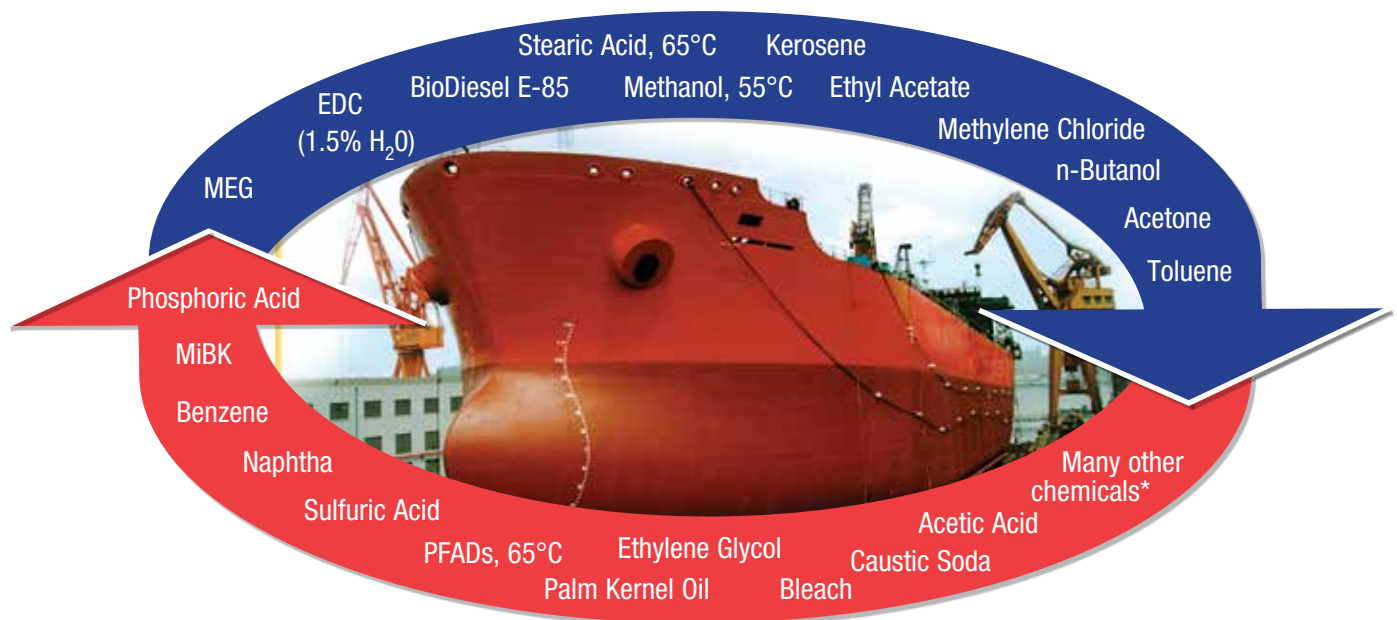
MarineLine® Enhanced Technology Has Higher Functionality, Producing Higher Crosslink Density with High Flexibility

- Higher chemical resistance
- Higher temperature resistance
- Resistance to permeation (absorption)



Protecting Your Assets

- ▶ MarineLine® Enhanced Solves Your Corrosion Problems.
- ▶ MarineLine® Enhanced Gives You Corrosion Resistance with Toughness, and Versatility to Change from One Chemical to Another with Easier Cleaning.

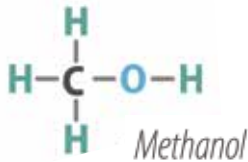


* See Advanced Polymer Coatings MarineLine® Chemical Resistance Brochure.

▶ Operational Efficiencies of MarineLine®

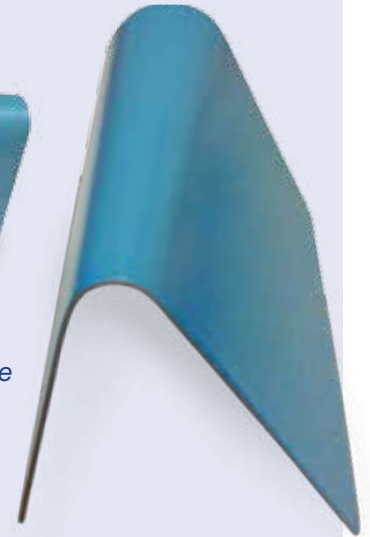
Product Highlights

- ▶ Can load and carry Methanol continuously at up to 55°C (131°F)



- ▶ Superior corrosion resistance with outstanding flexibility
- ▶ Superior bonding qualities
- ▶ Maximum product (chemical) versatility, product cycling
- ▶ Virtually non-permeable and steam cleanable
- ▶ Field repairable
- ▶ Complies with all FDA regulations (GRAS) for food grade products
- ▶ High impact resistance
- ▶ Dry heat resistance to 177°C (350°F), immersion temperature depending on chemical

Enhanced Elongation & Physical Properties



The increase in elongation virtually matches carbon steel as shown in these actual bend photographs. MarineLine® Enhanced elongates and 'flexes' with the severe bend.

- ▶ Elongation Comparison

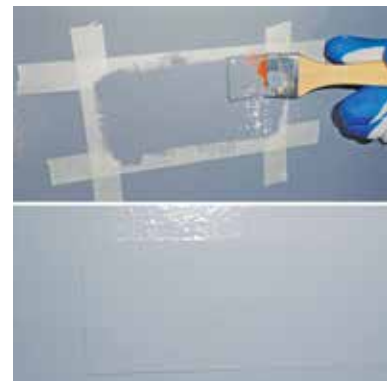
Carbon Steel (AISI 1040)	_____	12-18%
MarineLine® Enhanced (ASTM D522)	_____	12-15%
Phenol Epoxy (ASTM D522)	_____	1-2%
- ▶ Impact Resistance (ASTM D2794) _____ 200in/lbs
- ▶ Pull Off Strength (ASTM D4541) _____ 2800-3100 PSI
- ▶ Tabor Abrasion Resistance _____ 4.2mg/1000 cycles (ASTM 4060) _____ (CS-17, 1000g Load, 1000 cycles)

MarineLine® Enhanced surface energy has also been reduced +57% for easier cleaning.

Long Service Life Potential of MarineLine®

Taking care of your MarineLine® cargo tank coating with proper cleaning and regular maintenance can provide years of profitable service. Well maintained MarineLine® tanks have been in service 10+ years, and are still performing well. The following UNRETOUCHED photos of tankers at

various inspection intervals provide some insight into the performance of MarineLine®. For some tanks, minor coating repairs have been made using the MarineMend Repair coating system (see right top photo) and finished repair (right bottom).



3 Years



4 Years



5 Years

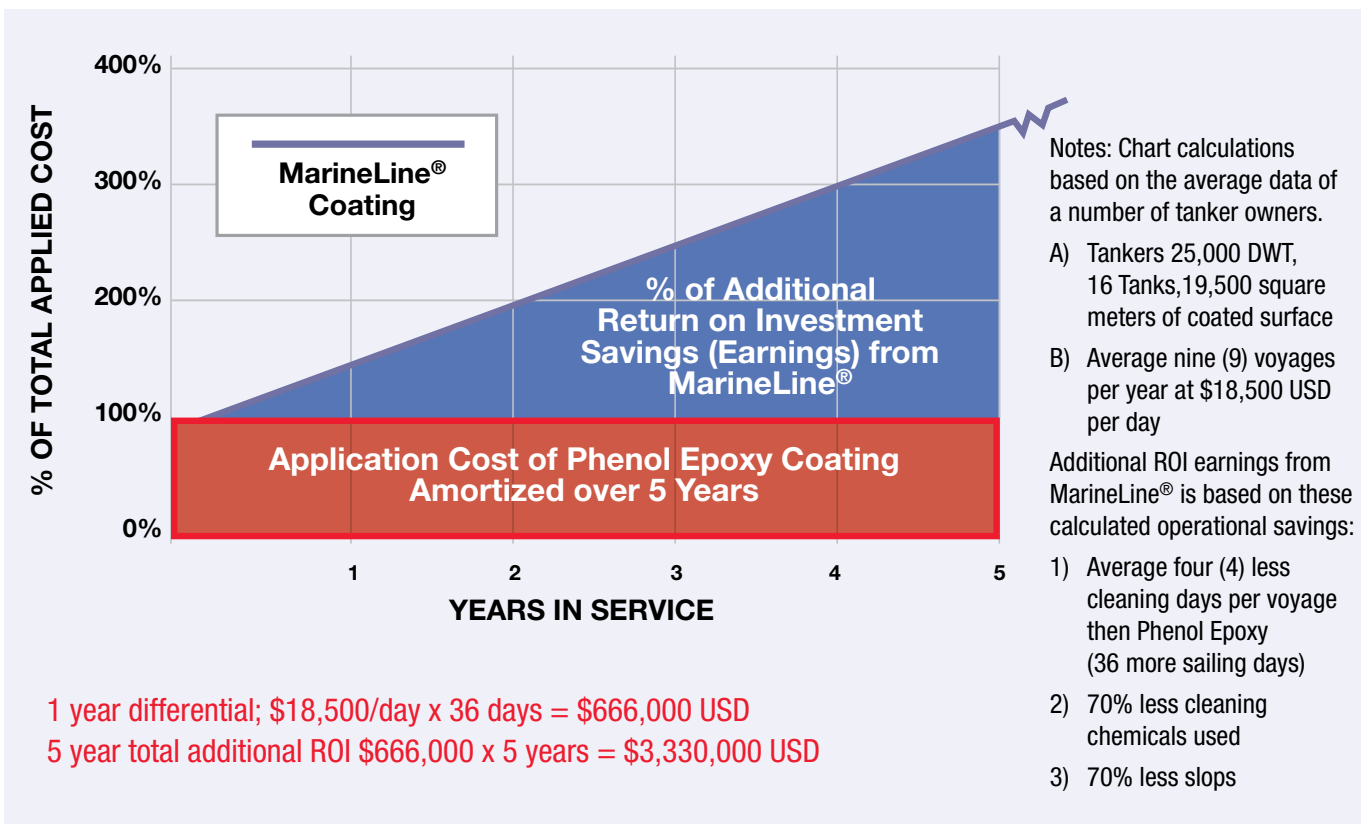


6 Years



11 Years

MarineLine® Delivers Additional Return on Investment (ROI)



Coating Inspection & Monitoring by APC

To ensure the performance of MarineLine® Enhanced, it is imperative that APC provides inspection services throughout the entire application process. APC focuses on the importance of good surface preparation, correct application and proper heat cure, in a 6-Step approach. MarineLine® has set the benchmark regarding heat curing, and spark testing the entire tank surface.

Step 1 Pre-Blast

- Weld & Grind Inspection
- Staging • Dehumidification
- Ventilation • Rain Protection
- Surface Contamination Testing
- Surface Protection



Step 2 Blasting

- Surface Profile
- Surface Cleanliness
- Environmental Conditions
- Cleaning • Blasting
- Visual Blast Inspection
- Rejection of Blast Quality



Step 3 Spray Application

- Environmental Conditions
- Mixing Thinners
- Base Coat (shown here)
- Stripe Coat
- Top Coat



Step 4 Inspection

- Dry Film Thickness Test
- Spark Test



Step 5 Heat Cure

- Equipment
- Set-up
- Charting
- Curing



Step 6 Final Inspection

- Hardness Test
- Solvent Wipe Test
- Inspection Report Prepared



▶ MarineLine® Enhanced Coating Success Story



M/T Sveva.

WHO: Italian shipping company Mediterranea di Navigazione SpA (Medimar), founded in 1908, operates a fleet of 10 specialty ships and tankers serving in

niche markets including the chemical trade, operating in the Mediterranean Sea, the Black Sea, the North Sea, the Baltic Sea, the Atlantic, South America, and Central America regions.

SERVICE: Carriage of various chemicals, Methanol, petroleum products, lubricants, and vegetable oils.

HISTORY: In 1998 Medimar started a year-long testing of MarineLine® for a newbuild chemical tanker application mostly focused on Methanol storage. MarineLine® passed the tests and was applied to the 15,200 chemical tanker *M/T Sveva* launched in 1999. For years, the *M/T Sveva* carried a range of

cargoes including: 100% Acetic Acid, Caustics, Methanol, MTBE and Fatty Acids. In 2015, the company decided to re-coat the ship's cargo tanks and contacted APC for a recommendation on the latest MarineLine® innovation.

THE SOLUTION: APC recommended the new MarineLine® Enhanced coating which was applied to the *M/T Sveva* in Turkey that year and has been in service since then. In 2017 another tanker in the Medimar fleet, the *M/T Cosmo* was also coated MarineLine® Enhanced, thus becoming the first and second ships now using the new coating system.

"I am extremely pleased with the performance of MarineLine® Enhanced for the M/T Sveva and choose this same tank lining again for the M/T Cosmo and our newbuild." - Signore Paolo Cagnoni, Chairman & CEO of Medimar

The following photos show various cargo tanks of the M/T Sveva with MarineLine® Enhanced, including a slop tank, that were coated in Turkey.



MarineLINE[®] Enhanced

A History of Performance

MarineLine[®] Enhanced is based on APC's MarineLine[®] cargo tank coating that has been applied to more than 750 maritime chemical and product tankers, covering over 10 million square meters of surface.

- The majority of ships coated are over 8 years old with some over 15 years old.
- MarineLine[®] has been applied successfully in major shipyards around the world.
- These tankers have carried thousands of different chemicals, including Acids, Caustics, Solvents, Inorganic Chemicals, and Edible Oils, with some tankers changing their chemical cargoes up to 85 voyages a year.
- APC's MarineLine[®] coating withstands the stresses of twisting and bending in rough seas while resisting temperature extremes of the cold Baltic winters to the hot Middle East summers.

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The information, evaluations and statements herein pertain to the material currently offered and represent the tests believed to be dependable. Published technical data and instructions are subject to change. Consult your Advanced Polymer Coatings representative

for coating recommendations. Product covered under one or more of the following Patents or Patents Pending. 5,169,912, 5,658,966, or 5,874,501

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