

Ships at sea are exposed to one of the most corrosive environments above and below the waterline



- Steel superstructure <u>above the waterline</u> suffers from UV damage to the protective organic coating and salt-spray corrosion
- > Steel structures below the waterline suffer from direct salt-water corrosion and bio-growth

Corrosion and Weathering Protection of Ships

- Ships built with steel are traditionally protected by paints of all kinds. Epoxy and/or polyurethane are predominant among them.
- Epoxy-Polyurethane paints are vulnerable to UV degradation
- Epoxy-Polyurethane paints are "molecularly porous" with high permeability to moisture, corrosives and salts.
- Ship hull and infrastructure <u>above the waterline</u> are vulnerable to degradation and corrosion failure by:
 - UV induced damage of traditional epoxy-polyurethane coatings results in direct exposure of steel to saltspray and salt-fog
 - 2. Gradual penetration of corrosive ions and/or acidic gases laden salt-fog and salt-spray.
- Ship hull and infrastructure <u>below waterline</u> are vulnerable to degradation and corrosion failure by:
 - Gradual penetration of corrosive ions and/or acidic gases laden salt-water
 - 2. Mechanical damage induced by direct contact of the steel with salt-water
 - 3. Bacteria, seaweeds, barnacles and other bio-elements



ABOVE WATERLINE SHIP PROTECTION REQUIRES BLOCKING UV FROM DAMAGING THE COATING AND PREVENTING SALT-SPRAY FROM CONTACTING THE STEEL STRUCTURE



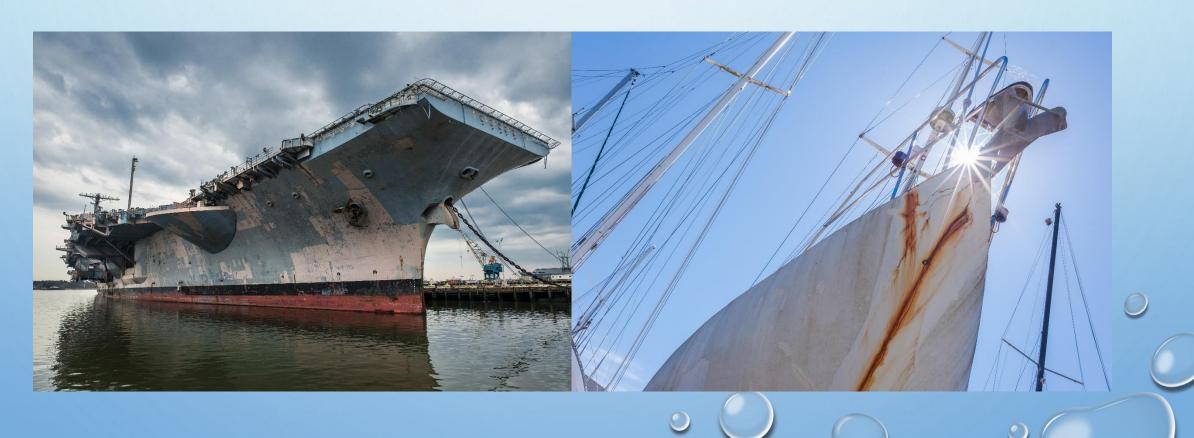
- > 50 micron of FLUOROSEAL® CPC-EXT-7150 over existing or newly coated steel structure provides 2-4 times duration of protection before dry dock rework
- > FLUOROSEAL® CPC-EXT-7280 provides abrasion resistance for deck level traffic, while blocking UV, salt-spray and fog from causing corrosion.

BELOW WATERLINE SHIP PROTECTION REQUIRES BIOCIDE AND CORROSION PROTECTION



- More aggressive biocides commonly used in marine industry can be added for barnacles and other bio-growth deterrence.
- FLUOROSEAL® CPC-EXT-7280 provides abrasion resistance using AIT unique cross-linked technology, and protection from aggressive salt-water ionic corrosion and impact damage from submerged objects at sea.

HOW DOES FLUOROSEAL® PVDF COATINGS PREVENT CORROSION?



FLUOROSEAL® PVDF COATING IS A CORROSION PROTECTION COATING FOR SHIPS WITH SPECIAL CAPABILITIES

- 1. <u>Blocks UV</u> light from damaging the molecules in epoxy and/or polyurethane paint causing the coating to peel off or delaminate from the ships steel structure. The exposed steel surfaces and steel interfaces under the damaged coating are then directly exposed to salt-spray and other corrosive elements inducing rapid corrosion.
- 2. <u>Blocking salt-spray and salt-fog, laden with corrosive ionic salts and corrosive acidic gases, from passing through the more permeable epoxy-polyurethane coating layers and creating aqueous solutions at the coating-steel interfaces, resulting in corrosion weakening.</u>
- 3. <u>Blocking corrosive gases (e.g., H</u>₂S, SO₂, CO₂, NO, CL₂) from passing through the more permeable epoxy-polyurethane coating, reaching the steel structure and causing corrosion.





Corrosion Protection Coatings must be UV Resistant and Block UV light While also Preventing Ingress of Moisture Laden with Corrosive Salts and Gases

Properties Required for Effective Protection of Steel Structures	Polyurethane	Ероху	FLUOROSEAL® Corrosion Protection (CPC-EXT-7150, Clear, UV Blocking) (CPC-EXT-7280, Crosslinked, Abrasion Resistant) (CPC-EXT-7284 Crosslinked with Biocide)	
Moisture-Water Permeability (Relative Ingress Number, g/m²·d)	High (>20)	High (>20)	Very Low (<0.05)	
Corrosive Gases (e.g. H ₂ S, CO ₂ , etc.) Permeability (cm ³ /m ² ·d·bar)	Very High (>2,000)	Very High (>2,000)	Very Low (<0.1)	
Water Repellancy	Fair	Fair	Good	
Water Absorption (Retention)	Medium	Medium	Low	
UV Molecular Stability (Resistance)	Fair (Proven <10 Years)	Fair (Proven <10 Years)	Outstanding (Proven >60 Years)	
Choices of Color	Standard Colors Custom Colors	Standard Colors Custom Colors	1. Clear 2. Custom Colors	
Field Application Method	Spray, Brush, Roller (1-or 2-Component, Ambient Storage, Coating Liquid)	Spray, Brush, Roller (1-or 2-Component, Ambient Storage, Coating Liquid)	Spray, Brush, Roller (1-Component, Ambient Storage, VOC Exempt, Coating Liquid)	
Cost of Material and Labor	Similar for material and labor for the same performance level (Thickness >200 Micron)	Similar for material and labor for the same performance level (Thickness >200 Micron)	Similar for material and labor for the same performance level (Thickness ≈50 Micron)	

FLUOROSEAL® Corrosion Protection Coatings:

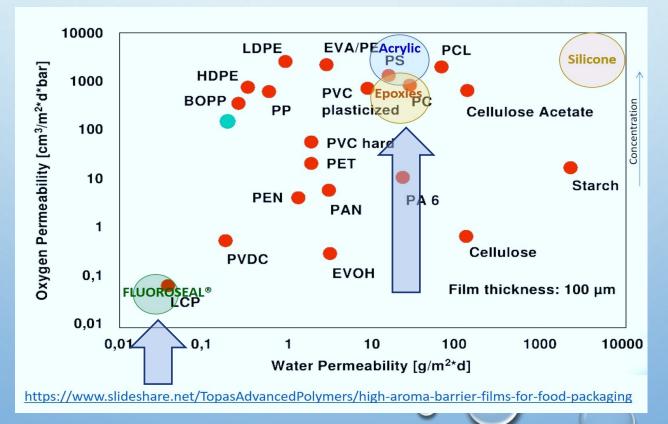
- 1. Proven Unparalleled Moisture Barrier
- 2. Proven Corrosive Gases Blocking
- 3. Proven UV Blocking and Resistant
- 4. Proven Water Repellent
- 5. Field Applicable Ambient Storage 1-Component VOC Free Coating Liquid
- 6. Air Drying
- 7. Apply Over Existing EpoxyPolyurethane Coatings or Over Bare
 Steel and Metal Surfaces
- 8. Proven protection with 50+/-μm coating thickness

BLOCKING MOISTURE-WATER LADEN WITH SALT IONS AND DISSOLVED ACID GASES IS THE KEY FOR FLUOROSEAL® PVDF AS TRANSPARENT COATINGS IN PREVENTING CORROSION



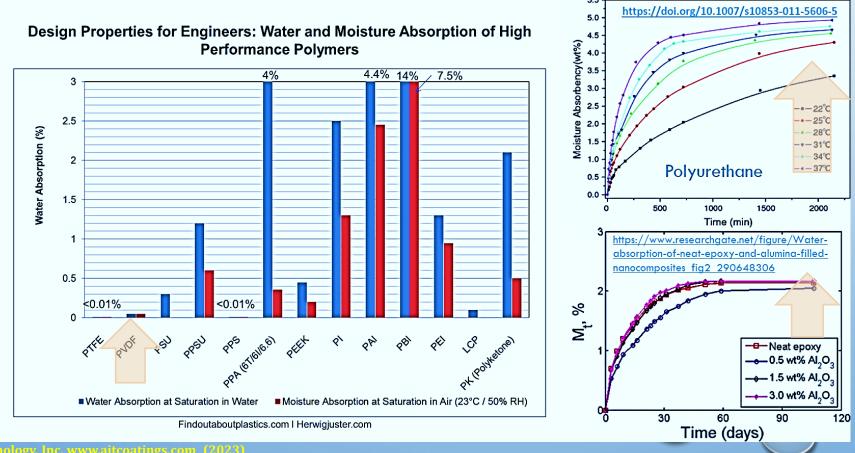
Corrosion Protection Coating-Sealant must be an Effective <u>Barrier to Moisture-Water (and when Laden with</u> <u>Dissolved Salts and Acidic Gases):</u>

- Acrylic, Epoxy, Polyurethane coatings are not good as moisture barrier
- > PVDF is scientifically proven as an unparalleled moisture-water barrier
 - FLUOROSEAL® PVDF concrete protection coating is VOC-exempt and field applicable



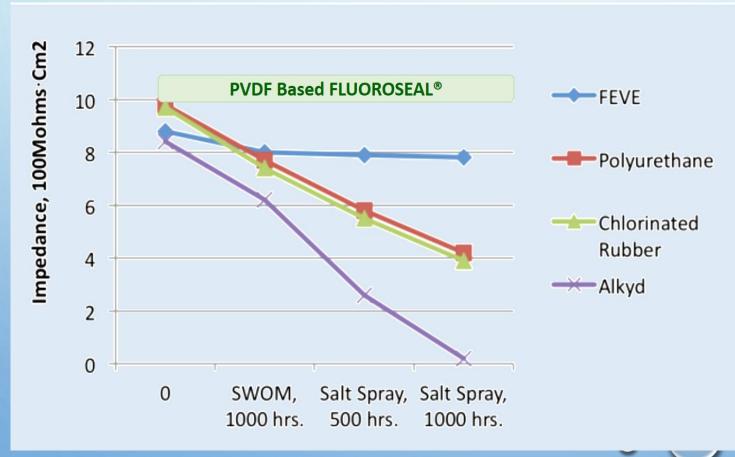
Corrosion Protection Coating-Sealant must also be <u>LOW in</u> <u>absorbing and retaining water</u> and water laden with dissolved salts and corrosive acidic gases:

- Acrylic, Epoxy, Polyurethane coatings absorb and retain good amount of water
 - Silicone does not absorb water but is one of the highest moisture permeability
- > PVDF is technically known and proven to absorb and retain one of the lowest amount



Salt-Spray is a good test and measurement for coating-sealant as <u>Barrier to Moisture-Water Laden with Dissolved Salts</u> (Similarly for Dissolved Acidic Gases):

- Acrylic, Epoxy, Polyurethane coatings are not good as moisture barrier
- PVDF is technically proven as an unparalleled salt laden moisture-water barrier



- Impedance test provides good measurement for the penetration of moisture laden with salt that are dissolved with sodium, chloride, and other ionic impurities to cause corrosion.
- It is also a good test for assessing acid rains with moisture and water carrying corrosion elements such as H₂S, SO₂, CO₂ and corrosive gases.
- <u>Blocking moisture</u> and preventing it from carrying ionic impurities and acidic elements from penetrating is critical in protecting the underlying structural coatings and/or materials

STEEL WITH FBE COATING WHEN EXPOSED TO SALT-WATER (WATER WITH DISSOLVED CORROSIVE IONS) SUFFERED CORROSION IN A MATTER OF DAYS AT THE EDGES WHERE STRESSES ARE CONCENTRATED



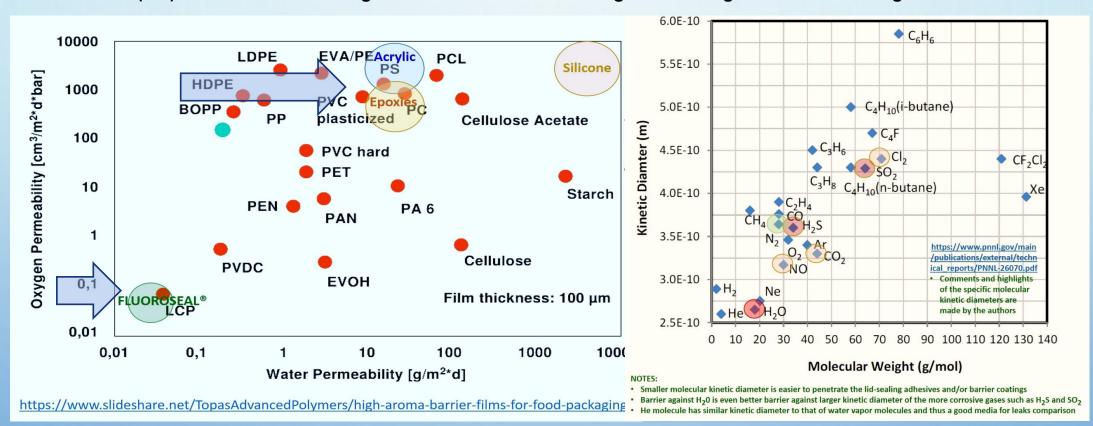
FBE coated edges corrode quickly upon exposure to 5% salt water. The corrosion quickly propagated outward to other areas.

FLUOROSEAL® Corrosion Protection Coating is used to coat on the side that was cut to exposed bare-steel. No sign of corrosion is seen under the same salt water condition.

THE ABILITY TO BLOCK CORROSIVE GASES FROM PENETRATING THE STRUCTURAL COATING LAYER IS ANOTHER KEY ADVANTAGE OF FLUOROSEAL® PVDF IN PREVENTING SHIP CORROSION



- ➤ The left chart summarizes the relative <u>moisture permeability</u> of polymer thin film. FLUOROSEAL® PVDF coating has intrinsic density in the range 1.6-1.8 is similar to LCP (>1.3) to afford one of the highest moisture barrier as coating.
- ➤ The left chart summarizes the relative <u>permeability of O₂</u> having similar to or smaller kinetic diameter than corrosive gases such as NO, C0₂, H₂S, SO₂, Cl₂ (right chart). FLUOROSEAL[®] PVDF coating has intrinsic density (molecular packing density) of 1.6-1.8 is similar to PVDC (1.6) afford one of the highest barrier as thin coating in blocking these corrosive gases.



FLUOROSEAL® PVDF COATINGS ARE MOLECULARLY PACKED TO AFFORD ONE OF THE HIGHEST MOISTURE AND CORROSIVE GASES BARRIERS

STEEL WITH FBE EPOXY COATING SUFFERED CORROSION FROM MOISTURE LADEN WITH CORROSIVE GASES QUICKLY WHEN ANY COATED SURFACES ARE SCRATCHED OR PEELED AWAY EXPOSING THE BARE STEEL SURFACES



FLUOROSEAL® MODIFIED PVDF COATING IS ORDERS OF MAGNITUDE BETTER IN BLOCKING MOISTURE AND CORROSIVE GASES FROM PENETRATING AND INGRESS

FLUOROSEAL® Under Flower of Sulfur Testing

Silver foil under microscope

Uncoated Before FoS Test



Coated with FLUOROSEAL® AFTER 10 day FoS Test



Same Bright Sheen



Humid Sulfur Test at 60°C for 10 Days

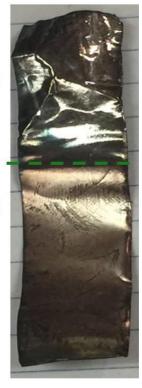
Uncoated





Uncoated

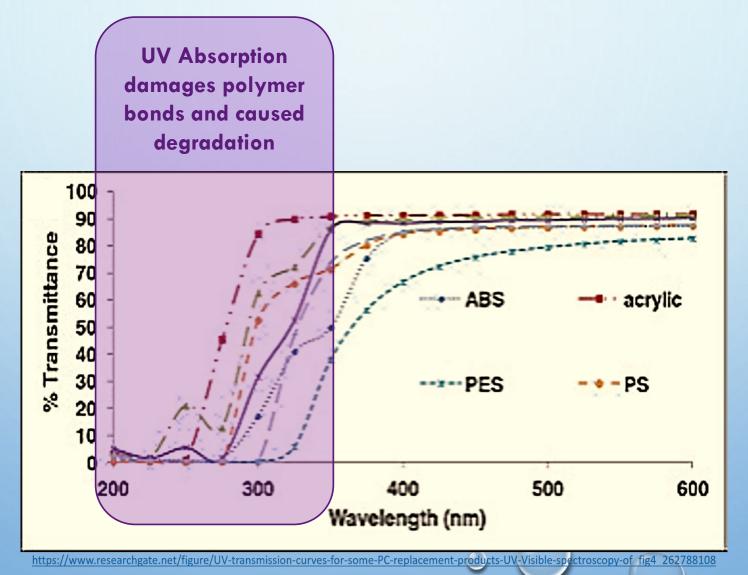
Coated with
Other
Conformal
Coating
Types



UV RESISTANCE AND UV BARRIER PROTECTION IS REQUIRED TO PREVENT SHIP CORROSION

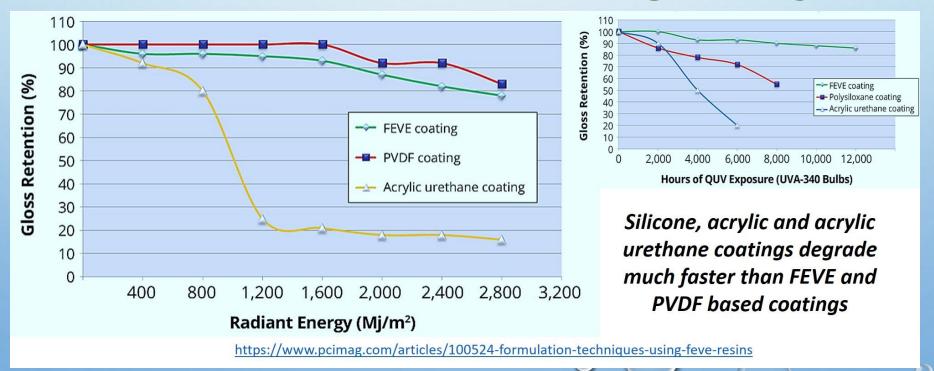


Acrylic, Polyurethane and Epoxy coatings are known to be vulnerable to molecular damage by UV exposure

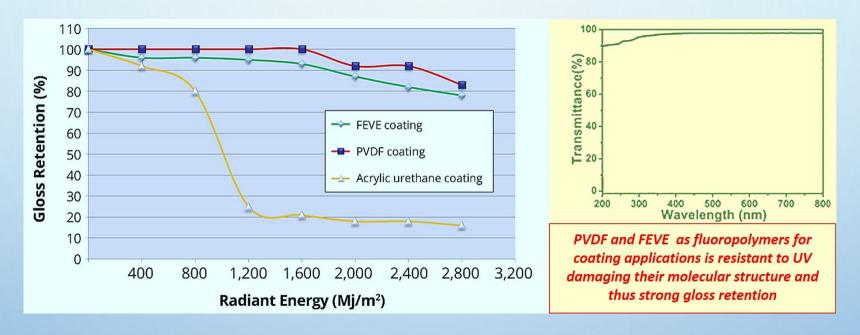


PVDF (Polyvinylidene fluoride) and FEVE (Fluoroethylene Vinyl Ether) Powder Coating with 60%-70% Fluorinated Polymer Segments are Proven Coatings That Maintain Gloss and Color under Tropic UV Exposure for Over 60 Years

FLUOROSEAL® are the only VOC-Exempt, <u>Transparent</u>
 PVDF Corrosion Protection Coatings today

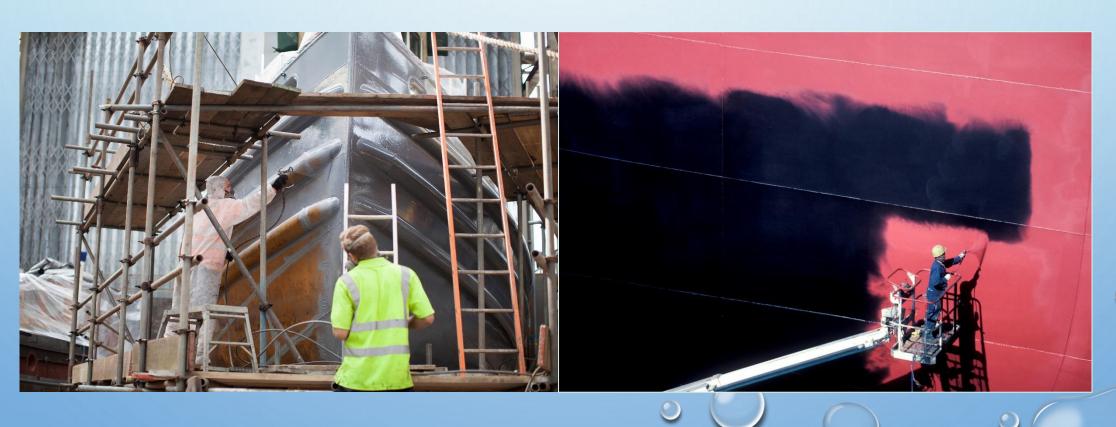


Gloss retention and resistance to UV exposure are NOT good indicators of UV protection from damaging the underlying epoxy-polyurethane coatings



> FLUOROSEAL® is the Only Transparent Protection Coating that Blocks UV Penetration

BESIDES UNPARALLELED CORROSION PROTECTION PROPERTIES, FLUOROSEAL® PVDF COATINGS ARE TRANSPARENCY AND FIELD APPLICABILITY BY BRUSH, ROLLER AND SPRAY COATING ENABLES QUICK REPAIRES AND REPAINTING









THE UNIQUE CAPABILIES OF FLUOROSEAL® PVDF COATING TO BLOCK CORROSIVE GASES AND SEAL AGAINST DISSOLVED IONS AND ACIDIC GASES IS CRITICAL FOR **CORROSION PROTECTION IN OIL AND GAS APPLICATIONS**





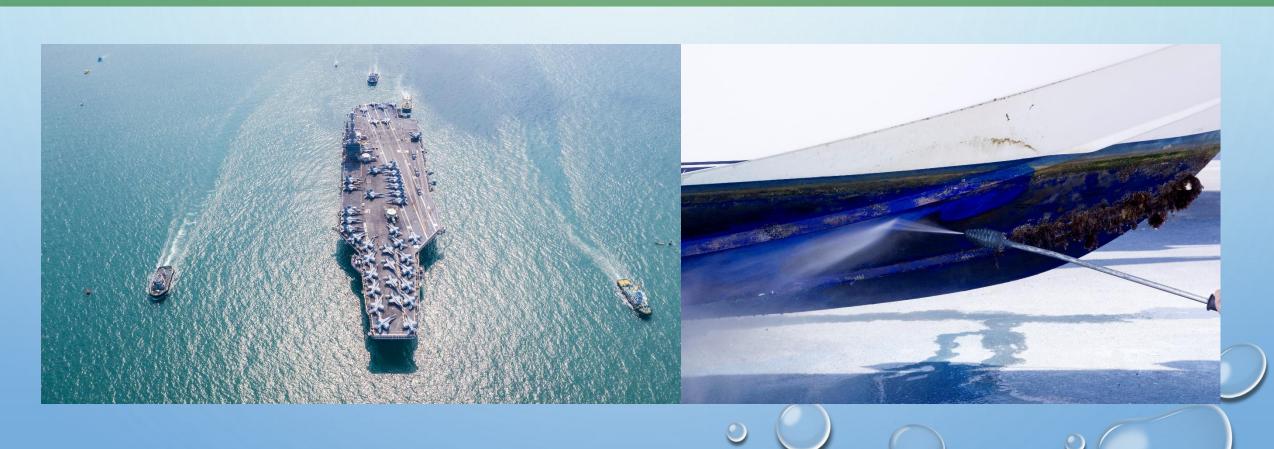
HOW DOES FIELD APPLICABLE FLUOROSEAL® PVDF COATING EXTEND STEEL INFRASTRUCTURE DURABILITY?

FLUOROSEAL® PVDF OVER-COATING WITH PROVEN EFFECTIVENESS:

- 1. <u>Blocks UV from</u> causing epoxy and/or polyurethane structural coatings from molecular disintegration, thereby accelerating the penetration of corrosive elements which cause corrosion
- 2. Blocking moisture and moisture laden with corrosive ionic salts and corrosive acid gases, from passing through and reaching underlying coating layers as water solutions that cause corrosion weakening at the coating-steel and concrete-rebar interfaces
- 3. <u>Blocking corrosive gases</u> such as H₂S, SO₂, CO₂, NO, CL₂ from passing through epoxy-polyurethane coatings or encased concrete, causing corrosion to the steel
- 4. Blocking penetration of moisture and formation of water at the coating-steel interfaces or concrete-rebar interfaces or water pockets in the concrete pores, thus preventing frosting induced expansion, coating delamination and concrete fractures



EXAMPLES OF FIELD APPLICABLE AIT FLUOROSEAL® PVDF COATINGS





Corrosion Protection Coating

FLUOROSEAL® CPC-EXT-7280

(Abrasion Resistant Crosslinked Gloss Finish)

- For blocking moisture, salt fog and spray, acid rain and moisture laden with acid gases from penetrating through epoxy coating into structural steels
- For blocking H₂S, CO₂ and other corrosive gases from penetrating to cause steel corrosion
- For blocking UV in penetrating epoxy-polyurethane coating to cause molecular damages
- Orders of magnitude more effective as moisture and corrosive gases barrier than acrylic epoxy, polyurethane
- Fluoropolymer proven with > 60 Years UV Stability









Content: 5 Gallon FOR INDUSTRIAL USE ONLY



Instruction for proper use of FLUOROSEAL® CPC-EXT-7280 (Abrasion Resistant Crosslinked Gloss Finish) for steel infrastructure (bridges, tunnels, etc.) corrosion protection:

- FLUOROSEAL® CPC-EXT-7280 is an abrasion resistant, crosslinked gloss finish coating for corrosion protection of structural steel used in infrastructure, oil-gas pipeline, storage and shipping tankers with epoxy and/or polyurethane coating.
- 2. Make sure surfaces are free of dirt, wax, grease and all other contaminants for best adhesion and corrosion protection of structural steels and other metals.
- 3. Mask all areas that do not need protection if applicable.
- 4. Remove any condensation on surfaces before applying protection coating.
- 5. Shake coating in container vigorously before using
- 6. Make sure enough ventilation is available to avoid breathing in solvent vapor.
- 7. Brush, roller or spray coat at least two passes to ensure complete coverage. Thickness of 25-75 micron is sufficient for best protection. Thicker coating can also be used if deemed needed. Add acetone solvent for dilution if for spray coating whenever needed.
- 8. The coating will dry to touch in less than 15 minutes. Ambient dry overnight for complete coating curing.
- 9. Ambient temperature storage only.

CONTAINS: Solvent (T-Butyl Acetate (540-88-5), Acetone (67-64-1), 2-Heptanone (110-43-0), Propylene carbonate (108-32-7)); Modified fluorinated polymer and additives (Non-Hazardous and Proprietary).

DANGER! FLAMMABE. Keep away from sparks, heat or open flames. Vapors will accumulate readily and may ignite explosively. Keep area ventilated during use and until all vapors are gone. DO NOT SMOKE -Extinguish all flames, pilot light and heaters, and any other sources of ignition.

VAPOR HARMFUL! Use with adequate ventilation, Avoid continuous breathing of vapor and spray mist. If you experience eye irritating, headaches, or dizziness, increase fresh air or wear respiratory protection (NIOSH/MSHA approved) or leave the area.

Avoid contact with skins and eves.

FIRST AID – In case of eye contact, flush thoroughly with plenty of water for 15 minutes and get medical attention. For skin contact, wash thoroughly with soap and water. In case of respiratory difficulty, provide fresh air and call physician.

Note: INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING AND WHALING THE CONTENTS MAY BE HARMFUL OR FATAL.

Before using, user shall determine the suitability of the product for his intended use. The manufacturer should not be liable for any injury, loss or damage, direct or consequential, arising out of the use or non-performance with the use of this product. User assumes all risks and liability in connection with the use of the product.

KEEP AWAY FROM CHILDREN



DANGER!

CONTAINS VOC EXEMPT FLAMMABLE SOLVENT

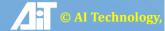
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Corrosion Protection Coating

FLUOROSEAL® CPC-EXT-7150

(Clear and Flat Finish)

- For blocking moisture, salt fog and spray, acid rain and moisture laden with acid gases from penetrating through epoxy coating into structural steels
- For blocking H₂S, CO₂ and other corrosive gases from penetrating to cause steel corrosion
- . For blocking UV in penetrating epoxy-polyurethane coating to cause molecular damages
- Orders of magnitude more effective as moisture and corrosive gases barrier than acrylic epoxy, polyurethane
- Fluoropolymer proven with > 60 Years UV Stability









Content: 5 Gallon FOR INDUSTRIAL USE ONLY



Instruction for proper use of FLUOROSEAL® CPC-EXT-7150 (Clear and Flat Finish) for steel infrastructure (bridges, tunnels, etc.) corrosion protection:

- FLUOROSEAL® CPC-EXT-7150 is a clear, flat finish coating for corrosion protection of structural steel used in infrastructure, oil-gas pipeline, storage and shipping tankers with epoxy and/or polyurethane coating.
- 2. Make sure surfaces are free of dirt, wax, grease and all other contaminants for best adhesion and corrosion protection of structural steels and other metals.
- 3. Mask all areas that do not need protection if applicable.
- 4. Remove any condensation on surfaces before applying protection coating.
- Shake coating in container vigorously before using.
- Make sure enough ventilation is available to avoid breathing in solvent vapor.
- 7. Brush, roller or spray coat at least two passes to ensure complete coverage. Thickness of 25-75 micron is sufficient for best protection. Thicker coating can also be used if deemed needed. Add acetone solvent for dilution if for spray coating whenever needed.
- 8. The coating will dry to touch in less than 15 minutes. Ambient dry overnight for complete coating curing.
- Ambient temperature storage only.

CONTAINS: Solvent (T-Butyl Acetate (540-88-5), Acetone (67-64-1), 2-Heptanone (110-43-0), Propylene carbonate (108-32-7)); Modified fluorinated polymer and additives (Non-Hazardous and Proprietary).

DANGER! FLAMMABE. Keep away from sparks, heat or open flames. Vapors will accumulate readily and may ignite explosively. Keep area ventilated during use and until all vapors are gone. DO NOT SMOKE -Extinguish all flames, pilot light and heaters, and any other sources of ignition.

VAPOR HARMFUL! Use with adequate ventilation, Avoid continuous breathing of vapor and spray mist. If you experience eye irritating, headaches, or dizziness, increase fresh air or wear respiratory protection (NIOSH/MSHA approved) or leave the area.

Avoid contact with skins and eyes.

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KEEP AWAY FROM CHILDREN



DANGER!

CONTAINS VOC EXEMPT
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Corrosion Protection Coating

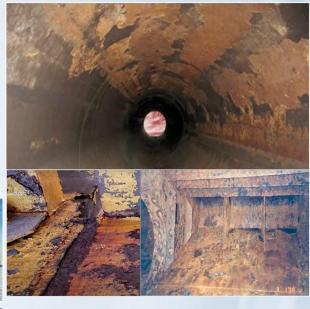
FLUOROSEAL® CPC-INT-7290

(Chemical and Abrasion Resistant Crosslinked Gloss Finish)

- Crosslinked for enhanced chemical and abrasion resistance
- For blocking moisture, salt fog and spray, acid rain and moisture laden with acid gases from penetrating through epoxy coating into structural steels
- For blocking H₂S, CO₂ and other corrosive gases from penetrating to cause steel corrosion
- Orders of magnitude more effective as moisture and corrosive gases barrier than acrylic epoxy, polyurethane
- Fluoropolymer proven with > 60 Years Molecular and Chemical Stability







Content: 5 Gallon FOR INDUSTRIAL USE ONLY



Instruction for proper use of FLUOROSEAL® CPC-INT-7290 (Chemical and Abrasion Resistant Crosslinked Gloss Finish) for Inside of Shipping Tanker, Storage Tank and Transmission Pipeline corrosion protection:

- 1. FLUOROSEAL® CPC-INT-7290 is an abrasion and chemical resistant, crosslinked gloss finish coating for corrosion protection of structural steel used in protecting inside of oil-gas pipeline, storage and shipping tankers with epoxy and/or polyurethane coating.
- 2. Make sure surfaces are free of dirt, wax, grease and all other contaminants for best adhesion and corrosion protection of structural steels and other metals.
- 3. Mask all areas that do not need protection if applicable.
- 4. Remove any condensation on surfaces before applying protection coating.
- 5. Shake coating in container vigorously before using
- 6. Make sure enough ventilation is available to avoid breathing in solvent vapor.
- 7. Brush, roller or spray coat at least two passes to ensure complete coverage. Thickness of 25-75 micron is sufficient for best protection. Thicker coating can also be used if deemed needed. Add acetone solvent for dilution if for spray coating whenever needed.
- 8. The coating will dry to touch in less than 15 minutes. Ambient dry overnight for complete coating curing.
- Ambient temperature storage only.

CONTAINS: Solvent (T-Butyl Acetate (540-88-5), Acetone (67-64-1), 2-Heptanone (110-43-0), Propylene carbonate (108-32-7)); Modified fluorinated polymer and additives (Non-Hazardous and Proprietary).

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KEEP AWAY FROM CHILDREN



DANGER!

CONTAINS VOC EXEMPT FLAMMABLE SOLVENT

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609-799-9388 OR

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