


The Tech Patch Repair System (TPRS™) in Nautical Environments

Cross-Linking is Chemistry & Physics working together to make a *permanent repair*.

Precision • Performance • Permanence

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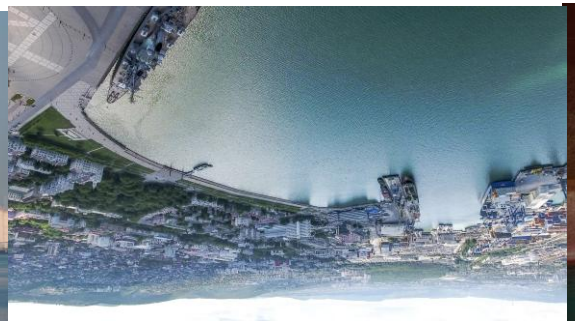
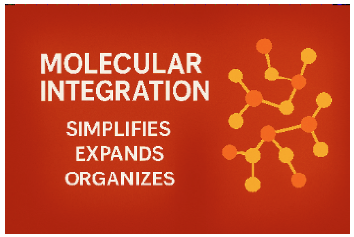


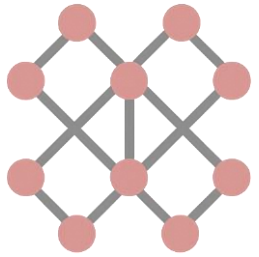
TPRS™ via Cross-Linking Handles:

- Saltwater, vibration, and thermal cycling accelerated failures. **TPRS™ handles all three!**
- Marine tanks and polymer housings frequently crack. **TPRS™ will permanently repair these cracks.**
- Traditional epoxies fail due to creep and moisture intrusion. **TPRS™ permanently stops both creep and intrusion.**
- Cross-linking creates permanent, moisture-proof, vapor-proof bonds. **TPRS™ works equally well on HDPE, steel, composites, and elastomers.**

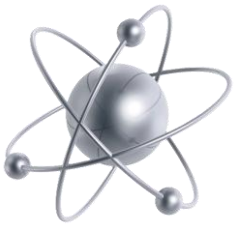
As an end-user of TPRS™, you will save 30 (worst case) to 90% in maintenance expenses.



The *Phenomenon* of Cross-Linking (Molecular Integration) has been proven science for decades.



1800s–Early 1900s: The concept (before the word cross-linking existed).

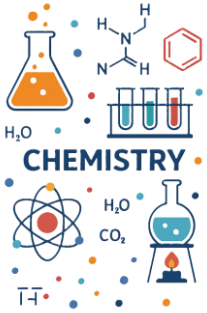


- Chemists noticed that some materials **"set" or "hardened" irreversibly** (like vulcanized rubber) and no longer melted like normal plastics.
- They didn't yet have the modern language of "polymer chains" and "cross-linking," but they were *seeing* the effect.

1920s–1930s: Polymers + cross-linking become real science

- in the 20's, **Hermann Staudinger** proposed that polymers are long chains of repeating units (macromolecules). That idea ***enabled*** the concept of cross-linking between chains.
- By the **1930s**, chemists understood that adding sulfur to rubber (vulcanization) was creating **bridges between chains** — what we now call **cross-links.**
  - **This patent is the source of the Goodyear fortune.**
  - **This breakthrough also led to the establishment of the Rubber Technical Company.**

1940s–1960s: Industrial cross-linking



- Epoxies, phenolic resins, melamine resins, and early thermosets all rely on cross-linking chemistry.
- Radiation cross-linking (gamma, e-beam) and peroxide cross-linking for polyethylene start to appear.
- **By mid-20th century, cross-linking is a standard tool in polymer engineering: creating stronger, more heat-resistant, more chemically-resistant materials.**

The Now … and The Future … of Cross-Linking

The Now

1970s–2000s: Cross-linking everywhere… but mostly in *manufacturing*

Used in:

Tires, Epoxy systems, Cross-linked polyethylene (PEX) tubing, Coatings, foams, elastomers, adhesives

But: **almost all cross-linking is done: in a factory, under controlled conditions, often with heat, pressure, or radiation, on *new* materials—not out in the field on existing infrastructure.**

The Future

Tech Bond has created: A **field-deployable, room-temperature** way to:

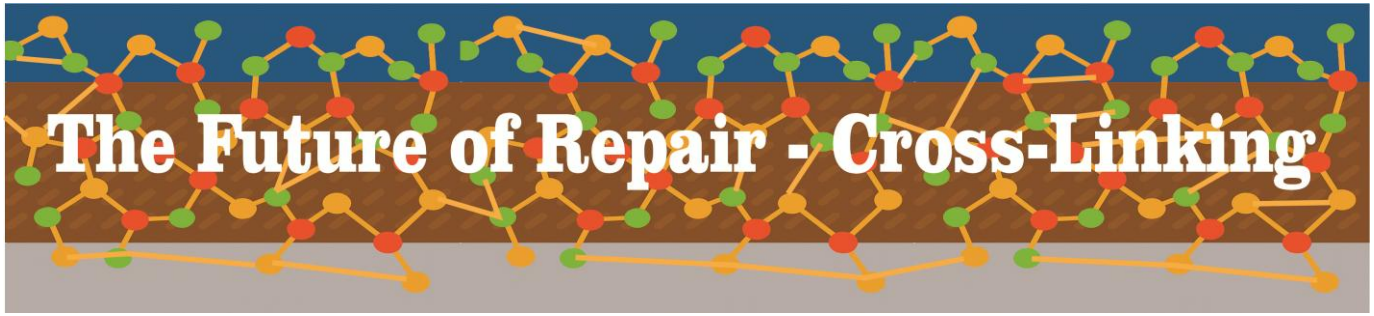
- cross-link *on* existing polymers (HDPE, PP, PTFE),
- on in-service assets (pipes, tanks, ships),
- and **bond dissimilar materials** (polymer-to-steel, etc.)
- With: short working times, simple application steps, and permanent performance in real-world industrial conditions.

What Tech-Bond has created … and has a patent on … is, and will be, bigger than what has come before.

Tech-Bond's future - and the fortunes to be made – will be covered in another slide deck.

Cross-Linking's Technical Advantages

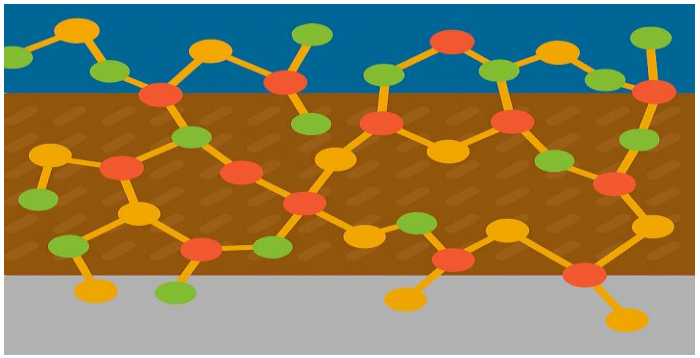
- Permanent repairs even under vibration and flex.
- Salt spray and wet-environment resistant.
- Eliminates creep, delamination, and thermal failure.
- Bonds polymer-to-polymer and polymer-to-steel.
- Safe onboard: no hot work required.



Cross-Linking eliminates interfaces by unifying layers!

Marine Applications for TPRS™

What TPRS™ Will Permanently Repair



- Hull penetrations.
- Polymer housings.
- Kick Pipes
- Fuel tanks (plastic and steel).
- Water and hydraulic lines (HDPE, PVC, steel).
- Deck equipment housings.
- Emergency leak repairs underway.

With TPRS™ Each Repair becomes Unified – 2 layers, 3 layers, 4 layers, or more, become one.

Traction

Proof of Difference

If someone Googles tank or pipe repair, hundreds of options will appear. All of these options are epoxy, fiberglass or epoxy and fiberglass based. The best of the epoxy and fiberglass-based options are labeled “Composite Wraps”.
Not one of the above options use molecular integration to hole the surfaces together. Epoxy, fiberglass-based repair solutions use mechanical adhesion to hold surfaces together. There is no cross-linking with mechanical adhesion. Without molecular integration, moisture intrusion happens and liquids may escape. When subjected to one of the following tests, composite wraps almost always develop one of the following problems: moisture penetration, which will lead to rust on steel pipes, gradual stretching, blisters form on the surface, resin movement, micro cracking, and, worst of all, resin movement, which leads to delamination. In the following test, TPRS™ did not exhibit any of these problems. In fact, TPRS™ looked new at the end of the test period. This was due to molecular integration.

ASTM B-117 Salt Spray Test – No rust, delamination, creep, or delamination.
Tribology Testing for vibration – No degradation of any type.
US Navy field trial. After a year at sea, there was no degradation of any type.

Nautical Failure Modes TPRS™ Solves

- Cracked HDPE water lines from vibration and hull flex.

TPRS is the ONLY repair system that repairs HDPE pipes and tanks.

- Corrosion-induced steel failures near saltwater exposure.

TPRS will repair steel pipes, steel tanks and steel walls.

- Leaking polymer tanks (fuel, potable water, greywater).
- UV-degraded polymer housings and deck components.
- Kick pipe repair.
- Failures at polymer-to-metal interfaces.
- Impact damage from docking, equipment, or shifting loads.
- Moisture intrusion into bonded or epoxied repairs.

How much money will be saved?

ROI for Maritime Operators Using TPRS™

- Avoids costly dry-dock events for polymer/steel repairs.
- Repairs completed onboard—zero downtime waiting for shipyard.
- Extends service life of tanks, lines, housings, and fittings.
- Eliminates recurring epoxy or welding repairs.
- Reduces risk of environmental discharge from leaks.
- Minimal crew training—repairs done by maintenance staff.
- **Permanent repairs completed by TPRS™ reduce lifetime ownership cost by 60–90%.**

Repairing Poly Tanks Onboard Ships Using TPRS™ & Poly Fill™

- Most modern ships use HDPE/PP tanks for potable water, waste, chemicals, and fuel
- These tanks crack from vibration, flexing, UV degradation, and impact loads
- Traditional repairs (epoxy, welding, adhesives) do not bond permanently to HDPE
- TPRS™ creates a permanent cross-linked molecular repair directly on the tank surface. **There are no interfaces**.
- Poly Fill™ can rebuild polymer structure or reinforce weakened sections. **There are no interfaces**.
- Repairs can be made while underway, with no dry dock required
- Result: permanent, moisture-proof, fuel-proof repairs with full thermal conformance

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Kick Pipes

High-Risk, High-Value Repair Zone

- Constant vibration, salt-spray cycling, mechanical abrasion
- Traditional coatings/epoxies fail from micro-cracking and creep

TPRS™ Advantages:

- Cross-linked molecular network absorbs vibration
- Eliminates creep, delamination, and moisture intrusion
- PTFE-E-glass wrap survives impact & abrasion
- Poly Fill rebuilds lost wall thickness

TPRS™ and Poly Fill Advantage:

- Rust Mitigation and Prevention, saving $Billions worldwide.

Poly Fill

Rebuilding Structural Integrity at Sea

Poly Fill creates a molecularly integrated polymer ‘rebuild layer’:

- 3D-printed polymer sheet applied directly to steel or HDPE
- Restores lost surface thickness where corrosion removed metal
- Chemically integrates — no cracking, no breaking, no delamination
- Proven under extreme HDPE burst tests (Borouge)

Applications on Ships:

- Rebuild corroded kick pipes
- Restore bulkhead penetrations
- Reinforce deck fittings & brackets
- Seal corrosion pits before TPRS wrapping

Vibration Mechanics & Creep Failure — Why Epoxies Fail

Why Marine Piping Systems Fail:

- Constant vibration from engines and pumps
- Shock loading and harmonic oscillation
- Saltwater cycling → micro-cracking & creep

Tribology Testing at IIT–ISM:

- Epoxies showed friction-driven wear and micro-crack propagation
- TPRS™ maintained a continuous cross-linked network
- Zero creep, zero delamination, zero moisture intrusion
- TPRS™ passed full tribology wear test with no loss of integrity

The Conclusion:

- TPRS™ is not an adhesive layer — it creates a new, unified surface.
- Under vibration, epoxy separates… TPRS™ unifies.

Saltwater Corrosion: Epoxy vs. TPRS™

Saltwater Corrosion Reality:

- Salt ions penetrate epoxy micro-cracks → corrosion continues underneath
- Epoxies absorb moisture → blistering, delamination, creep
- Temperature cycling opens fracture lines

TPRS™ Performance in Saltwater:

- PTFE-coated E-glass fabric blocks ion transport
- Cross-linked molecular matrix prevents moisture intrusion
- Zero creep and zero delamination in saline exposure
- Successful results in ASTM B-117 Salt Spray Test

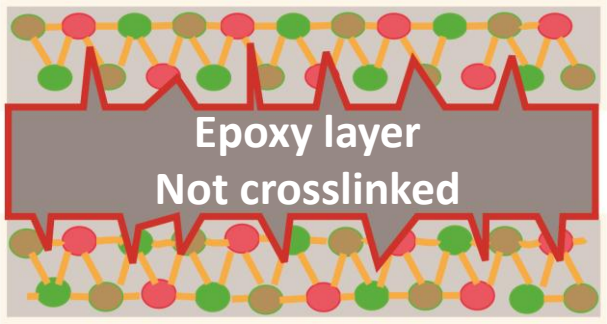
The Comparison:

- Epoxy = surface coating that eventually fails.
- TPRS™ = new corrosion-proof surface created through molecular integration.

The Contest: Epoxies vs TPRS™ in rust prevention/mitigation.

The Hands-down Winner: TPRS™

Next-Generation Maritime Repair Technology



Why Maritime Surfaces Fail:

- Corrosion under coatings due to salt intrusion
- Vibration-induced micro-cracks in epoxy layers
- Moisture absorption → blistering and delamination
- Inability to bond to polymers or mixed substrates on ships

Why TPRS™ Represents a New Category:

- Creates a cross-linked molecular surface — not a coating
- Hydrophobic PTFE-E-glass architecture stops ion transport
- Zero creep, zero delamination, zero moisture intrusion
- Works on metals, polymers, composites, and mixed substrates
- Proven in tribology, salt-spray, burst, and impact tests

The Result:

TPRS™ replaces old coating models with a permanent, moisture proof, vibration-resistant, corrosion-proof surface engineered for maritime environments.

Onboarding a New Partner

Engagement • Experience • Execution

I've started a lot of cases, large clients. The ruling philosophy in these interactions must be Tech-Bond Global's tagline, "Engagement, Experience, Execution". Our attitude must be that TPRS is a proven technology. How well a new partner is setup determines how successful the partnership will be.

1. **Engagement**
    1. Initial contact & Problem Review.
    2. Identify contacts for marketing, onsite work, quality control, training & admin.
    3. Set up repair demonstration and/or field trial.
    4. In discussion with engineers identify greatest need and failure points.
    5. Define the path forward. Start dates, field contact, training schedule.
    6. Ongoing support, documentation, reports,
2. **Experience**
    1. Is knowing the questions to ask
    2. Is being prepared for every meeting
    3. Is understanding meeting dynamics
3. **Execution**
    1. In the field
    2. and setting up feedback loops.

Conclusion

- TPRS™ is the only universal permanent marine repair system.
- Works across polymers, metals, composites, elastomers.
- Eliminates creep, moisture intrusion, blistering, and thermal cycling failure.
- Supports fast onboarding for vessel maintenance crews.

The Benefit: The savings of $Billions.