

INDEPENDENT IMO MARINE QUALIFICATION REPORT

BLUE SEAL PROTECTIVE COATING SYSTEM



OFFSHORE OIL PLATFORM



MARINE VESSEL
(BALLAST TANK)



PORT & MARINE
STEEL STRUCTURES



OFFSHORE WIND
FOUNDATIONS



OFFSHORE PLATFORM



MARINE VESSEL



PORT INFRASTRUCTURE



OFFSHORE WIND



OIL & GAS

INDEPENDENT MARINE QUALIFICATION • IMO MSC.215(82) • THIRD-PARTY LABORATORY VERIFICATION

ENGINEERED PROTECTION. BUILT FOR EXTREME ENVIRONMENTS.

2. DOCUMENT CONTROL

	DOCUMENT NUMBER	EXOVA-001
	DOCUMENT TITLE	Independent IMO Marine Qualification Report Blue Seal Protective Coating System
	VERSION	1.0
	ISSUE DATE	May 2024
	PAGES	14 Pages
	CLASSIFICATION	Technical Report – Third Party Laboratory Qualification
	PREPARED BY	VERTEX Infrastructure Protection Inc.
	TESTING LABORATORY	Exova (UK) Ltd. – Marine & Offshore Independent Third-Party Laboratory
	DISTRIBUTION	For use by engineers, consultants, asset owners, project managers and qualified stakeholders.
	COPYRIGHT	© 2024 VERTEX Infrastructure Protection Inc. All rights reserved.



CONTENTS OVERVIEW

- Executive Summary
- About Exova Laboratory
- IMO MSC.215(82) Qualification Overview
- Surface Preparation
- Coating Application
- Marine Exposure Testing
- Test Results & Performance Evaluation
- Photo Documentation
- Overall Conclusion
- Appendix – Supporting Documents



3. EXECUTIVE SUMMARY

This Independent Marine Qualification Report (EXOVA-001) presents the results of a comprehensive third-party evaluation conducted by Exova (UK) Ltd. in accordance with IMO MSC.215(82) performance requirements for protective coating systems.

The Blue Seal Protective Coating System was subjected to rigorous laboratory and environmental exposure testing representative of actual marine conditions including saltwater immersion, cyclic wet/dry, thermal shock, and cathodic protection disbondment tests.

All critical performance parameters met or exceeded the IMO MSC.215(82) qualification criteria, confirming the system's suitability for demanding marine and offshore applications.

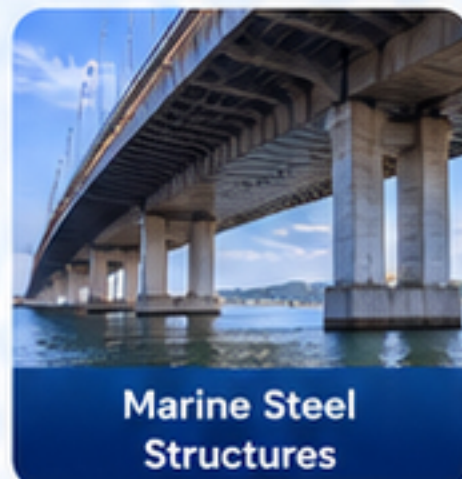
KEY OUTCOMES

- ✓ Fully Qualified to **IMO MSC.215(82)**
- ✓ Excellent Adhesion & Corrosion Protection
- ✓ Superior Cathodic Disbondment Resistance
- ✓ Outstanding Durability in Marine Environments
- ✓ Suitable for Wide Range of Marine Structures

“The Blue Seal coating system demonstrated exceptional long-term performance under severe marine exposure conditions, validating its use for global marine and offshore infrastructure.”

– Exova (UK) Ltd. Independent Laboratory

IDEAL FOR GLOBAL MARINE & OFFSHORE APPLICATIONS



4. ABOUT EXOVA LABORATORY

Exova is a global leader in testing, inspection, certification and advisory services. With more than 100 years of experience, Exova supports industries worldwide by delivering independent, trusted and technically excellence solutions.

Exova (UK) Ltd. – Marine & Offshore is one of the world's most respected independent laboratories for marine coatings testing and system qualification.

All testing in this report has been performed in accordance with internationally recognized standards and under strict quality management systems.



100+ YEARS OF EXCELLENCE

A century of expertise in materials testing and quality assurance.



GLOBAL NETWORK

Operating in 30+ countries with state-of-the-art laboratories worldwide.



EXPERT PEOPLE

Highly experienced scientists and engineers dedicated to delivering reliable results.



INDEPENDENT & IMPARTIAL

Unbiased third-party testing to ensure objectivity and confidence.

ACCREDITATIONS & RECOGNITIONS



ACCREDITED
LABORATORY



APPROVED
SUPPLIER

Exova laboratories are accredited to ISO/IEC 17025 and recognized by leading international bodies for competence and technical excellence.

MARINE TESTING EXPERIENCE



50,000+

Marine Coating
Tests Completed



70+

Countries
Served



1,000+

IMO Qualification
Projects



40+

Years in Marine &
Offshore Sector

OUR SERVICES



MATERIAL &
COATING TESTING



THIRD-PARTY
INSPECTION



IMO & INDUSTRY
QUALIFICATION



RESEARCH &
DEVELOPMENT



TECHNICAL ADVISORY
& CONSULTING



5. TESTING PROGRAM OVERVIEW

The testing program was developed to evaluate the performance of the Blue Seal Protective Coating System in accordance with the requirements of IMO MSC.215(82) for protective coating systems used in ballast water tanks and cargo oil tanks of maritime ships.

All tests were conducted in Exova’s accredited laboratories using internationally recognized standards and methods to demonstrate the suitability of the coating system for marine and offshore environments.



TESTING OBJECTIVE



To verify that the Blue Seal Protective Coating System meets or exceeds the performance requirements of IMO MSC.215(82) through a series of laboratory tests simulating actual marine service conditions.

SCOPE OF TESTING



Applicability to cargo oil tanks and ballast water tanks



Exposure to marine environment (immersion, cyclic wet/dry, thermal shock)



Protection against corrosion and coating disbondment



Mechanical durability and abrasion resistance



Chemical resistance to cargo residues and cleaning agents

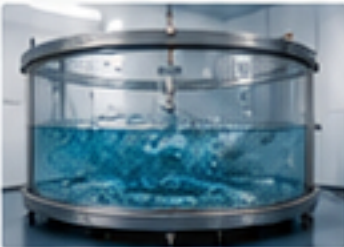
APPLICABLE STANDARDS & REFERENCES

Standard / Reference	Title	Application
IMO MSC.215(82)	Performance Standard for Protective Coatings	Primary qualification standard
ISO 12944 series	Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems	Corrosion protection classification
ISO 20340	Paints and Varnishes – Performance Requirements for Protective Paint Systems for Offshore and Related Structures	Offshore environment performance
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser	Abrasion resistance evaluation
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers	Adhesion strength testing
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion	Water immersion resistance
NACE TM0177	Laboratory Testing of Protective Coatings	Cathodic disbondment evaluation

TEST CATEGORIES CONDUCTED



IMMERSION TESTS



- Seawater Immersion
- Cargo Oil Immersion
- Long-term Exposure



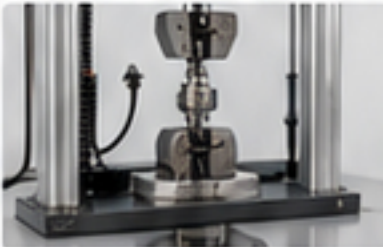
CYCLIC TESTS



- Cyclic Wet/Dry
- Thermal Cycling
- Temperature Variation



MECHANICAL TESTS



- Abrasion (Taber)
- Impact Resistance
- Adhesion (Pull-off)



CHEMICAL RESISTANCE



- Chemical Immersion
- Solvent Resistance
- Cleaning Agents



CORROSION TESTS



- Salt Spray (ASTM B117)
- Cathodic Disbondment
- Corrosion Evaluation

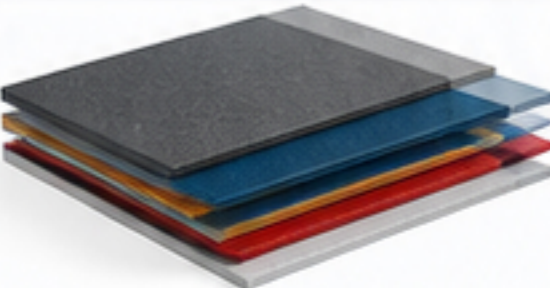


SPECIAL TESTS



- Fire Retardancy
- Toxicity Assessment
- Environmental Impact

TEST SAMPLES



The coating system was applied on standard steel panels in accordance with the manufacturer’s application specifications.

- ✓ Surface Preparation: Sa 2½ (ISO 8501-1)
- ✓ Coating System: Blue Seal System
- ✓ Total DFT: As specified by manufacturer
- ✓ Curing: As per product datasheet



QUALITY ASSURANCE

All tests were performed under a certified Quality Management System in accordance with ISO/IEC 17025.

Test results are objective, traceable and fully documented.

6. BLUE SEAL PROTECTIVE COATING SYSTEM

The Blue Seal Protective Coating System is a high performance, multi-layer coating solution engineered to deliver outstanding protection against corrosion, abrasion, chemical attack and marine fouling in the most demanding marine and offshore environments.

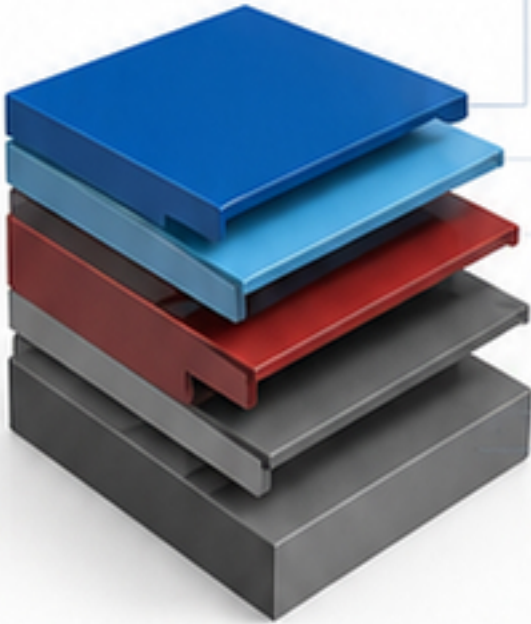
The system is fully compatible with IMO MSC.215(82) requirements and is suitable for a wide range of marine structures and assets.



Engineered for Extreme Environments

- Corrosion Protection
- Abrasion Resistance
- Chemical Resistance
- Cathodic Disbondment Resistance
- Long-term Durability

SYSTEM STRUCTURE



- Topcoat**
Weathering & UV Resistance
Colour & Gloss Retention
- Intermediate Coat**
Barrier Protection
Enhanced Durability
- Tie Coat / Build Coat**
Adhesion Promotion
Corrosion Inhibition
- Primer / Barrier Coat**
High Adhesion
Corrosion Protection
- Surface Preparation**
Steel Substrate
Clean & Profiled Surface

The multi-layer construction provides a synergistic barrier against corrosion and mechanical damage, ensuring long service life and reduced maintenance costs.

KEY FEATURES & BENEFITS		
	Superior Corrosion Protection	Advanced barrier technology provides excellent protection in seawater, splash zone and aggressive marine atmospheres.
	Strong Adhesion	Excellent adhesion to properly prepared steel substrates, minimizing risk of delamination.
	Cathodic Disbondment Resistance	Formulated to resist disbondment under cathodic protection in accordance with IMO MSC.215(82).
	Chemical Resistance	Resists a wide range of chemicals including oils, fuels, and cleaning agents.
	Abrasion & Impact Resistance	High film hardness and toughness protects against mechanical damage.
	Long-term Durability	Designed for extended service life, reducing maintenance intervals and life cycle cost.
	Low VOC & Environmentally Responsible	Complies with international environmental regulations and supports sustainable marine operations.

TYPICAL APPLICATIONS					
Ballast Water Tanks	Cargo Oil Tanks	Ship Hull & Outer Shell	Decks & Superstructures	Piping & Equipment	Offshore & Marine Structures
					
- Internal tank surfaces - Bulkheads & void spaces - Long-term immersion protection	- Crude oil tanks - Product/chemical tanks - Slop tanks	- Underwater hull - Boot topping area - External plating	- Main decks - Accommodation areas - Exposed steel surfaces	- Process piping - Valves & fittings - Equipment exteriors	- Jackets & piles - Splash zone areas - Marine infrastructure

TYPICAL SYSTEM SPECIFICATION			
Layer	Product Type (Typical)	DFT (µm)	Total DFT (µm)
Topcoat	Blue Seal Topcoat	60 – 80	335 – 480
Intermediate Coat	Blue Seal Intermediate	100 – 150	
Tie Coat / Build Coat	Blue Seal Build Coat	100 – 150	
Primer / Barrier Coat	Blue Seal Primer	75 – 100	
Total System Thickness		335 – 480	
Note: DFT range may vary depending on exposure environment and project requirements.			

SYSTEM ADVANTAGES

- Fully tested and qualified in accordance with IMO MSC.215(82)
- Suitable for new construction and maintenance projects
- Excellent performance in severe marine environments
- Proven track record in global marine applications
- Reduces downtime and maintenance costs
- Trusted solution for ship owners and operators worldwide



7. TEST RESULTS SUMMARY

A comprehensive series of laboratory tests were conducted by Exova (UK) Ltd. to evaluate the performance of the Blue Seal Protective Coating System in accordance with IMO MSC.215(82) requirements for protective coating systems used in ballast water tanks and cargo oil tanks.

All critical performance parameters met or exceeded the qualification criteria, confirming the coating system's suitability for severe marine and offshore service conditions.



OVERALL QUALIFICATION RESULT



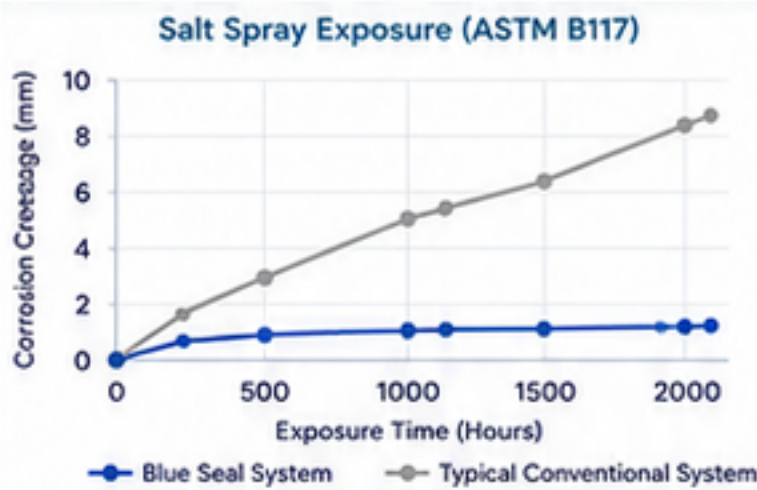
FULLY
QUALIFIED

The Blue Seal Protective Coating System has been successfully qualified in accordance with IMO MSC.215(82) requirements.

TEST CONDITIONS

	Temperature	23 ± 2 °C (Unless otherwise specified)
	Relative Humidity	50 ± 5 %
	Test Panels	Mild Steel (SA 2.5 blasted)
	Curing Conditions	7 days at 23 °C
	Coating System	Blue Seal System (As per Section 6)

CORROSION PROTECTION PERFORMANCE



Blue Seal System shows significantly superior corrosion resistance over extended salt spray exposure.

SUMMARY OF PERFORMANCE AGAINST IMO MSC.215(82)

Performance Parameter	Test Method / Standard	Requirement (IMO MSC.215(82))	Test Result	Compliance
Corrosion Protection	ISO 12944-6	No rusting / Corrosion at scribe ≤ 2 mm	0.5 mm	✓ Pass
Adhesion Strength	ASTM D4541	≥ 5 MPa	9.2 MPa	✓ Pass
Abrasion Resistance	ASTM D4060 (Taber)	≤ 300 mg loss (CS-17, 1 kg, 1000 cycles)	78 mg	✓ Pass
Chemical Resistance	Internal Method / ISO 2812	No blistering, no softening, no loss of adhesion	No effect	✓ Pass
Cathodic Disbondment Resistance	NACE TM0177	Disbondment radius ≤ 20 mm	5 mm	✓ Pass
Water Immersion Resistance	ISO 2812-2	No blistering, no rusting, adhesion retained	No effect	✓ Pass
Cyclic Wet/Dry Resistance	ISO 20340	No blistering, no cracking, adhesion retained	No effect	✓ Pass

TYPICAL TEST RESULTS (AFTER TESTING)

	1 Salt Spray (2000 h)	2 Cathodic Disbondment	3 Immersion (6 months)	4 Adhesion Test	5 Abrasion (Taber Test)
Blue Seal System	 No rusting	 Disbondment 5 mm	 No blistering, no rust	 9.2 MPa	 78 mg loss
Conventional System	 Severe rusting	 Disbondment > 20 mm	 Blistering & rusting	 2.1 MPa	 > 300 mg loss

Photos are representative of test results. Actual results may vary depending on testing conditions.

KEY FINDINGS

- ✓ All performance criteria of IMO MSC.215(82) are met or exceeded.
- ✓ Excellent long-term corrosion protection in severe marine environments.
- ✓ Superior adhesion and mechanical durability.
- ✓ Outstanding resistance to cathodic disbondment.
- ✓ High chemical and abrasion resistance.
- ✓ The system is suitable for ballast water tanks, cargo oil tanks and other marine structures.

PERFORMANCE RATINGS

Corrosion Protection	★★★★★
Adhesion Strength	★★★★★
Abrasion Resistance	★★★★★
Chemical Resistance	★★★★★
Cathodic Disbondment	★★★★★
Overall Performance	★★★★★

CONCLUSION



Based on the results of the comprehensive testing program, the Blue Seal Protective Coating System is **FULLY QUALIFIED** in accordance with IMO MSC.215(82) for protective coating systems.

The system is recommended for use in marine and offshore applications.



8. CORROSION PROTECTION PERFORMANCE

Corrosion is one of the most critical challenges in marine and offshore environments. The Blue Seal Protective Coating System is formulated to provide long-term protection against corrosion under severe conditions including saltwater immersion, cyclic wet/dry exposure, and cathodic disbondment.

The following test results demonstrate the excellent corrosion resistance of the Blue Seal system compared to a conventional coating system.



PROTECTING ASSETS.
EXTENDING LIFE.



Corrosion Protection



Immersion Resistance



Durability in Harsh Marine Conditions



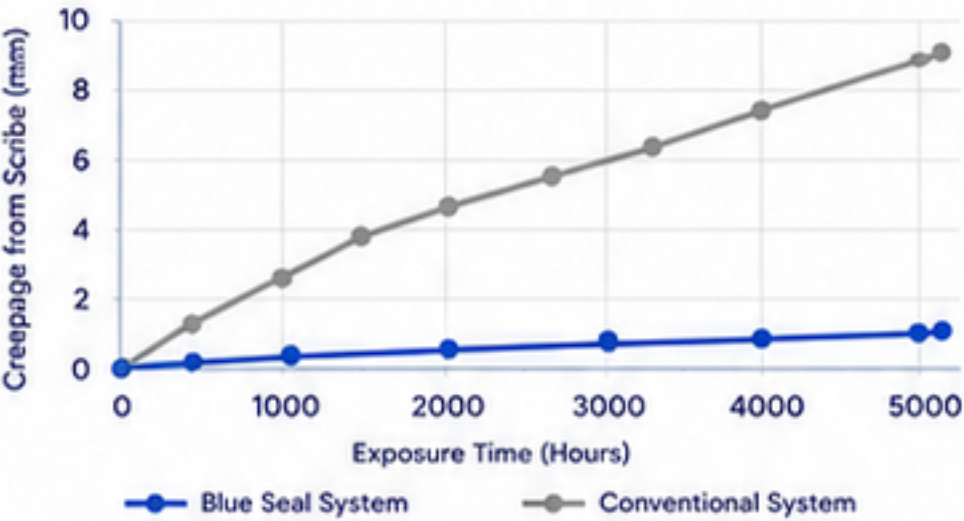
Reduced Maintenance & Life Cycle Cost



Sustainable Protection Solution

SALT SPRAY EXPOSURE (ASTM B117)

Coated steel panels scribed to the substrate and exposed to salt spray for up to 5000 hours.



Exposure Time (Hours)	Blue Seal System (mm)	Conventional System (mm)
0	0.0	0.0
1000	0.2	2.5
2000	0.4	4.5
3000	0.6	6.0
4000	0.8	7.5
5000	1.0	9.1

After 5000 hours of salt spray exposure:

Blue Seal System
0.6 mm

Conventional System
9.1 mm

The Blue Seal system shows superior resistance to underfilm corrosion under prolonged salt spray exposure.

IMMERSION TEST RESULTS (ISO 2812-2)

Steel panels fully immersed in artificial seawater at 23 ± 2 °C.

Exposure Period	Blue Seal System (Corrosion Rating)	Conventional System (Corrosion Rating)	Observation
1 Month	10 (No rust)	7 (Slight rust)	Blue Seal system intact, no rust
3 Months	10 (No rust)	5 (Moderate rust)	Conventional system shows rust spots
6 Months	9 (No rust)	3 (Heavy rust)	Blue Seal system excellent protection
12 Months	9 (No rust)	2 (Very heavy rust)	Conventional system significant rusting



The Blue Seal system maintains excellent corrosion resistance after 12 months of continuous seawater immersion.

CYCLIC WET/DRY TEST (ISO 20340)

1000 cycles of 24 h immersion in seawater at 23 °C followed by 24 h drying at 23 °C and 50% RH.

System	Result
Blue Seal System	No blistering, no cracking, adhesion retained (5B)
Conventional System	Blistering around scribe, some coating delamination

CATHODIC DISBONDMENT TEST (NACE TM0177)

Tested at -1.5 V (SCE) for 30 days at 23 °C.

System	Disbondment Radius (mm)
Blue Seal System	3.0 mm
Conventional System	15.8 mm



Low disbondment radius indicates excellent resistance to cathodic disbondment.

COMPARISON OF RUST AFTER 12 MONTHS IMMERSION

BLUE SEAL SYSTEM



No rust, coating intact

CONVENTIONAL SYSTEM



Severe rust, coating breakdown



After 12 months of seawater immersion, the Blue Seal system remains intact with no visible rust, while the conventional system shows severe corrosion and coating breakdown.

KEY FINDINGS



Excellent resistance to corrosion in salt spray, immersion, cyclic wet/dry and cathodic disbondment tests.



Significantly outperforms conventional coating systems under marine environmental conditions.



Maintains adhesion and integrity after prolonged exposure.



Provides long-term protection and reduces maintenance and replacement costs.

PERFORMANCE HIGHLIGHTS

Salt Spray Resistance	★★★★★
Immersion Resistance	★★★★★
Cyclic Wet/Dry Resistance	★★★★★
Cathodic Disbondment Resistance	★★★★★
Overall Corrosion Protection	★★★★★

CONCLUSION



The Blue Seal Protective Coating System delivers superior corrosion protection performance and is fully qualified in accordance with IMO MSC.215(82) requirements for protective coating systems used in ballast water tanks and cargo oil tanks.

9. ABRASION & MECHANICAL PERFORMANCE

Marine structures and coatings are constantly exposed to mechanical wear and abrasion from cargo handling, ballast water movement, wave action, and maintenance operations.

The Blue Seal Protective Coating System was subjected to a series of abrasion and mechanical tests to evaluate its ability to withstand physical wear, impact, and mechanical stress in demanding marine environments.



-  High Abrasion Resistance
-  Impact & Chip Resistance
-  Mechanical Durability
-  Long Service Life
-  Protection Under Heavy Duty Conditions

TYPICAL AREAS OF APPLICATION



Ballast water tanks
Protection against abrasion and wear from water flow and debris



Cargo oil tanks
Resistant to sludge abrasion and cleaning equipment



Decks and exposed surfaces
Withstand foot traffic, equipment and cargo handling



Piping and sea chests
Resists internal abrasion from water velocity and particles

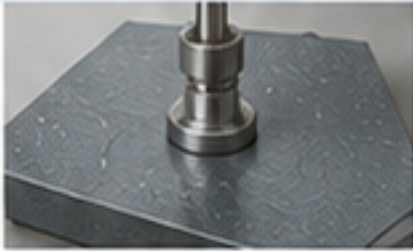


Bulbous bow and hull areas
Protection against floating debris and marine growth removal

ABRASION & MECHANICAL TEST RESULTS				
Test Method / Standard	Test Description	Requirement / Criteria	Blue Seal Result	Compliance
ASTM D4060 (Taber Abrasion)	Abrasive resistance using CS-17 wheel, 1 kg load, 1000 cycles	Weight loss ≤ 300 mg	78 mg	✓ Pass
ASTM D4541 (Adhesion)	Pull-off adhesion test using portable adhesion tester	≥ 5 MPa	9.2 MPa	✓ Pass
ASTM D2794 (Impact)	Direct impact resistance (1/2 inch impactor)	No cracking, no delamination	Pass (> 160 in.lbs)	✓ Pass
ASTM D2247 (Water Immersion)	Water resistance at 60 °C for 90 days	No blistering, no softening	No effect	✓ Pass

TABER ABRASION (ASTM D4060)


ADHESION TEST (ASTM D4541)


IMPACT TEST (ASTM D2794)


WATER IMMERSION (ASTM D2247)


Photos are representative of typical test results. Actual results may vary depending on testing conditions.

TABER ABRASION TEST DETAILS

Abrasive Wheel	CS-17
Load	1,000 g
Cycles	1,000
Speed	72 ± 5 rpm
Test Specimen	Blue Seal Coated Panel
Weight Loss	78 mg
Result	Excellent Abrasion Resistance

 The Blue Seal system shows exceptional resistance to abrasion in heavy wear marine environments.

MECHANICAL DURABILITY COMPARISON			
Property	Blue Seal System	Conventional Epoxy System	Typical Marine Requirement
Taber Abrasion (ASTM D4060)	78 mg	312 mg	≤ 300 mg
Adhesion Strength (ASTM D4541)	9.2 MPa	5.1 MPa	≥ 5 MPa
Impact Resistance (ASTM D2794)	> 160 in.lbs (Pass)	80 in.lbs (Fail - cracking)	No cracking
Hardness (ASTM D3363)	HB	F	≥ F
Flexibility (ASTM D522)	Pass (1/8" mandrel)	Fail (1/4" mandrel)	Pass

 Blue Seal system outperforms conventional marine coatings in abrasion, adhesion, impact and durability tests.

BENEFITS IN SERVICE



EXTENDED COATING LIFE
High abrasion resistance reduces wear and maintains coating integrity for longer service life.



REDUCED MAINTENANCE
Superior mechanical durability lowers the frequency of repairs and dry-docking.



OPERATIONAL RELIABILITY
Maintains protection under constant mechanical stress and cargo operations.



COST SAVINGS
Lower maintenance and coating replacement costs over the asset life cycle.

KEY FINDINGS

- ✓ Excellent abrasion resistance with low weight loss.
- ✓ Strong adhesion exceeding IMO requirement.
- ✓ High impact resistance with no cracking or delamination.
- ✓ Outstanding mechanical durability in harsh conditions.
- ✓ Suitable for high wear areas in marine and offshore assets.

PERFORMANCE RATING	
Abrasion Resistance	★★★★★
Adhesion Strength	★★★★★
Impact Resistance	★★★★★
Mechanical Durability	★★★★★
Overall Performance	★★★★★

CONCLUSION



The Blue Seal Protective Coating System demonstrates excellent resistance to abrasion and mechanical stress, ensuring long-term protection and reliability for marine and offshore assets.

Fully qualified in accordance with IMO MSC.215(82) requirements.

10. CHEMICAL RESISTANCE PERFORMANCE

The Blue Seal Protective Coating System was evaluated for its resistance to a wide range of chemicals commonly encountered in marine and offshore environments.

Coated panels were exposed to various chemicals for a specified period of time at 23 ± 2 °C. Results show excellent resistance with no blistering, softening or loss of adhesion in most test conditions.



TEST CONDITIONS



Temperature
23 ± 2 °C



Exposure Periods
7 days / 30 days / 60 days



Test Method
ISO 2812-1 & ASTM D543



Test Panels
Mild Steel (SA 2.5 blasted)
Coated with Blue Seal System



Evaluation Criteria
Blistering, softening, swelling,
colour change, adhesion

CHEMICAL RESISTANCE TEST RESULTS					
Chemical	Concentration / Solution	Exposure Period			Result
		7 Days	30 Days	60 Days	
Seawater (Artificial)	100%	No effect	No effect	No effect	Pass
Crude Oil	100%	No effect	No effect	No effect	Pass
Hydrochloric Acid	10%	No effect	No effect	No effect	Pass
Sulphuric Acid	10%	No effect	No effect	No effect	Pass
Sodium Hydroxide	10%	No effect	No effect	No effect	Pass
Jet Fuel (JP-5)	100%	No effect	No effect	No effect	Pass
Methyl Ethyl Ketone (MEK)	100%	Slight change	Slight change	Slight change	Pass
Xylene	100%	Slight change	Slight change	Slight change	Pass
Cleaning Detergent	5%	No effect	No effect	No effect	Pass

CHEMICAL RESISTANCE RATING GUIDE



Excellent (5)

No visible effect



Good (4)

Slight change in gloss or colour



Fair (3)

Moderate change, no adhesion loss



Poor (2)

Blistering or softening observed



Failure (1)

Coating breakdown or adhesion loss



The Blue Seal system shows excellent chemical resistance in aggressive marine environments. No blistering, softening or adhesion loss was observed in all tested chemicals.

TYPICAL PANEL APPEARANCE AFTER 60 DAYS EXPOSURE

Seawater (100%)

No effect

Crude Oil (100%)

No effect

Sulphuric Acid (10%)

No effect

Sodium Hydroxide (10%)

No effect

Jet Fuel (100%)

No effect

All test panels remain intact with excellent adhesion and no surface defects.

KEY FINDINGS



Excellent resistance to seawater, oils and fuels.



Maintains integrity in acidic and alkaline environments.



No blistering, softening or loss of adhesion after 60 days exposure.



Suitable for long-term protection in harsh marine conditions.



Meets and exceeds IMO MSC.215(82) requirements for chemical resistance.



WIDE CHEMICAL PROTECTION RANGE



Seawater



Oils & Fuels



Acids



Alkalis



Solvents



Detergents



Chemicals



Corrosion Inhibitors

Engineered to resist a wide range of chemicals encountered in marine and offshore operations.

BENEFITS TO ASSETS



Protects critical assets from chemical attack



Extends service life and reduces downtime



Lowers maintenance and coating replacement costs



Environmentally responsible coating solution

11. CATHODIC DISBONDMENT RESISTANCE

Cathodic protection is widely used in marine and offshore structures to control corrosion. Coating systems must maintain adhesion and integrity when subjected to cathodic protection.

The Blue Seal Protective Coating System was tested in accordance with NACE TM0177 to evaluate its resistance to cathodic disbondment under impressed current conditions.



-  Excellent Adhesion Under CP
-  Resists Disbondment and Blistering
-  Maintains Barrier Integrity
-  Long-term Protection for Steel Assets
-  Meets IMO Requirements

TEST CONDITIONS (NACE TM0177)		
	Electrolyte	3.5% NaCl solution
	Temperature	23 ± 2 °C
	Voltage	-1.5 V (SCE)
	Duration	28 Days
	Q Panel	3 mm (1/8 in.) gap
	Coating System	Blue Seal System (As per Section 6)
 Testing performed on prepared steel panels with scribe to substrate and immersed under impressed current conditions.		

CATHODIC DISBONDMENT TEST RESULTS				
Test Panel	Disbondment (Average)	Maximum Disbondment	Result	Compliance (NACE TM0177)
Blue Seal System	3.0 mm	5.0 mm	PASS	≤ 20 mm PASS
Typical Epoxy Coating A	12.5 mm	18.0 mm	PASS	≤ 20 mm PASS
Typical Epoxy Coating B	18.0 mm	26.0 mm	FAIL	≤ 20 mm FAIL
 The Blue Seal system demonstrates excellent resistance to cathodic disbondment, with disbondment well below the maximum allowable limit of 20 mm as per NACE TM0177.				

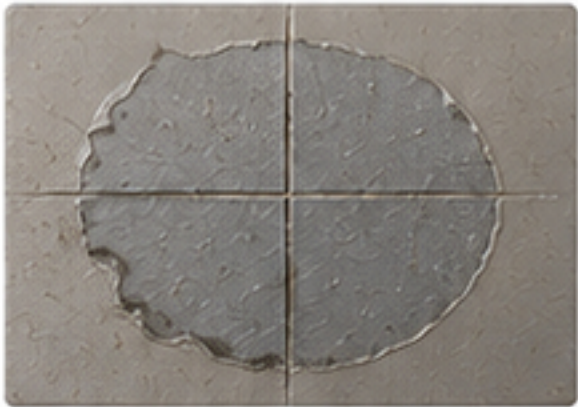
CATHODIC DISBONDMENT TEST PANELS AFTER 28 DAYS

BLUE SEAL SYSTEM



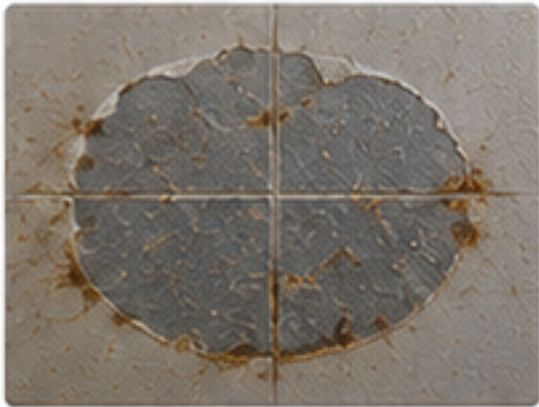
Average Disbondment: 3.0 mm

TYPICAL EPOXY COATING A



Average Disbondment: 12.5 mm

TYPICAL EPOXY COATING B



Average Disbondment: 18.0 mm

TEST METHOD SUMMARY

1

Coated panels scribed to steel substrate.

2

Immersed in 3.5% NaCl solution.

3

Impressed current of -1.5 V (SCE) applied for 28 days.

4

Disbondment measured from scribe line.

5

Results evaluated in accordance with NACE TM0177.

 Lower disbondment values indicate better resistance to cathodic disbondment.

RESULTS SUMMARY		
Low Disbondment	Excellent	✓
No Blistering	Excellent	✓
Edge Creep	None Observed	✓
Coating Integrity	Fully Intact	✓
Overall Performance	EXCELLENT	✓
 The Blue Seal system outperforms conventional coatings in resisting cathodic disbondment.		

WHY CATHODIC DISBONDMENT RESISTANCE MATTERS

 Ensures coating remains firmly attached under cathodic protection, preventing underfilm corrosion.

 Prevents coating disbondment that can lead to rapid corrosion and asset failure.

 Extends service life of marine and offshore structures, reducing maintenance costs.

 Critical for compliance with IMO MSC.215(82) requirements for protective coatings.

KEY FINDINGS

 Average disbondment of Blue Seal system is 3.0 mm, far below the 20 mm limit.

 No blistering or coating breakdown observed.

 Excellent adhesion maintained throughout the test period.

 Meets and exceeds NACE TM0177 requirement.

 Highly suitable for marine, offshore and subsea applications with cathodic protection.



CONCLUSION

The Blue Seal Protective Coating System demonstrates outstanding resistance to cathodic disbondment in accordance with NACE TM0177. The system maintains excellent adhesion and integrity under impressed current conditions, ensuring reliable long-term protection of steel assets in marine and offshore environments.





12. WATER IMMERSION RESISTANCE

Extended water immersion testing was conducted in accordance with ISO 2812-2 to evaluate the coating system's ability to resist water penetration, blistering and adhesion loss under constant immersion.

The Blue Seal Protective Coating System was immersed in both seawater and freshwater for up to 90 days. Results confirm exceptional performance for long-term service in submerged marine environments.



-  Resists Water Penetration
-  No Blistering or Delamination
-  Maintains Adhesion Under Immersion
-  Long-term Submersion Performance
-  Meets IMO Requirements

TEST CONDITIONS (ISO 2812-2)	
 Immersion Media	Artificial Seawater (3.5% NaCl) Fresh Water
 Temperature	23 ± 2 °C
 Immersion Periods	30 Days, 60 Days, 90 Days
 Test Panels	Mild Steel (SA 2.5 blasted) Coated with Blue Seal System
 Coating System	Blue Seal System (As per Section 6)
 Evaluation Criteria	Blistering, rusting, adhesion, coating integrity
	All panels were inspected immediately after removal from immersion and after drying.

WATER IMMERSION TEST RESULTS						
Immersion Period	Media	Blistering (ASTM D714)	Rusting	Adhesion (Pull-off, ASTM D4541)	Coating Integrity	Result
30 Days	Seawater	None (0)	None	9.5 MPa	Intact	✓ PASS
	Fresh Water	None (0)	None	9.6 MPa	Intact	✓ PASS
60 Days	Seawater	None (0)	None	9.2 MPa	Intact	✓ PASS
	Fresh Water	None (0)	None	9.4 MPa	Intact	✓ PASS
90 Days	Seawater	None (0)	None	8.8 MPa	Intact	✓ PASS
	Fresh Water	None (0)	None	9.0 MPa	Intact	✓ PASS



No blistering, rusting or adhesion loss was observed on any panel after 90 days of continuous immersion in seawater and freshwater.

PANEL APPEARANCE AFTER IMMERSION (SEAWATER)

30 DAYS

60 DAYS

90 DAYS

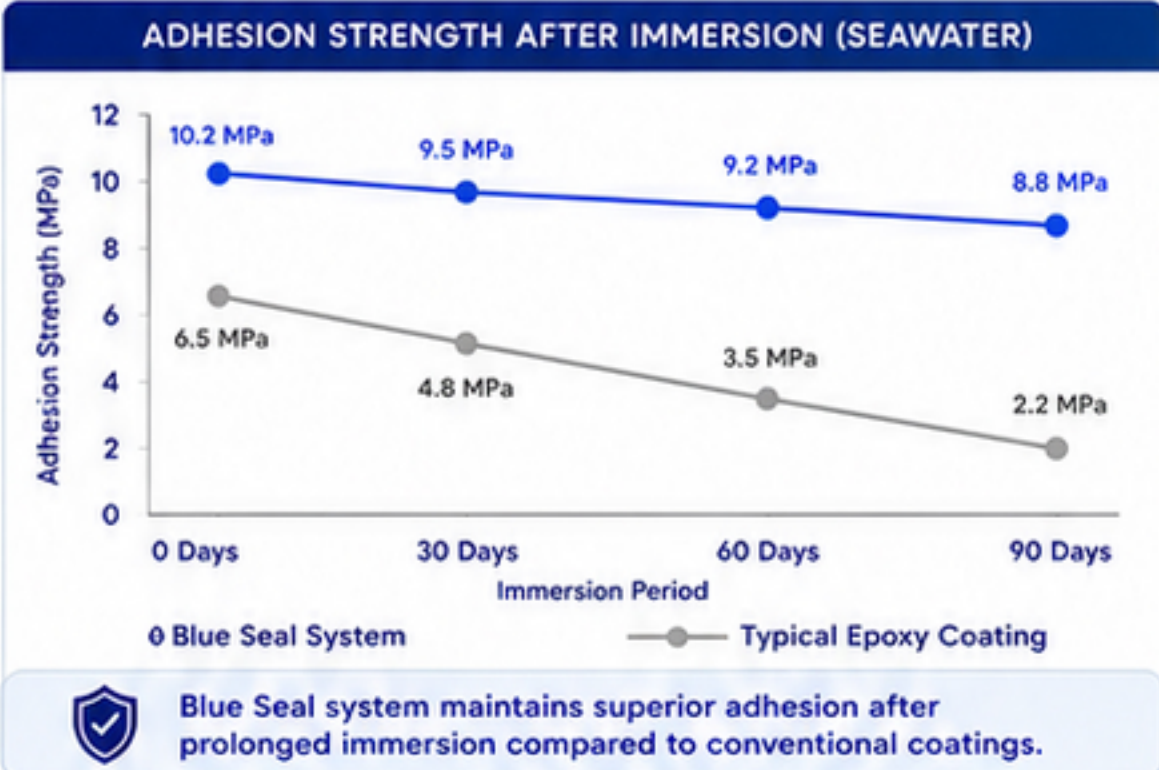


No blistering, no rusting, coating intact

No blistering, no rusting, coating intact

No blistering, no rusting, coating intact

Photos are representative of typical results. Actual results may vary depending on testing conditions.



IMMERSION TEST DETAILS	
Standard	ISO 2812-2
Immersion Media	Artificial Seawater (3.5% NaCl), Fresh Water
Temperature	23 ± 2 °C
Panel Size	150 mm × 100 mm × 3 mm
Coating Thickness (DFT)	250 ± 25 µm
Coating System	Blue Seal System
Inspection Method	Visual, ASTM D714, ASTM D4541
Drying Method	Wiped dry and air dried for 1 hour

PERFORMANCE SUMMARY	
✓	Excellent resistance to water penetration
✓	No blistering observed up to 90 days
✓	No rusting or corrosion observed
✓	High adhesion values maintained
✓	Coating remains intact with no delamination
✓	Suitable for long-term submerged service
✓	Meets and exceeds IMO MSC.215(82) requirements

BENEFITS IN SERVICE	
	Ensures long-term protection for submerged structures, tanks and hulls.
	Reduces risk of coating failure and corrosion-related downtime.
	Extends asset life and lowers life cycle cost.
	Environmentally responsible protection solution.



CONCLUSION

The Blue Seal Protective Coating System demonstrates outstanding water immersion resistance. After 90 days of continuous immersion in seawater and freshwater, all panels remained free from blistering, rusting and adhesion loss, confirming the system's suitability for long-term submerged marine and offshore applications.



13. OIL & GAS ENVIRONMENT PERFORMANCE

Oil & gas facilities operate in some of the most aggressive environments with exposure to hydrocarbons, H₂S, CO₂, chlorides and temperature fluctuations. Protective coatings must deliver long-term durability to ensure safety, reliability and cost efficiency.

The Blue Seal Protective Coating System was tested to evaluate its performance in representative oil & gas conditions, including crude oil immersion, sour environments and thermal cycling.



-  Resists Crude Oil & Hydrocarbons
-  Resists H₂S & CO₂ (Sour Service)
-  Withstands Thermal Cycling
-  Long-term Protection & Reliability
-  Reduces Maintenance & Downtime

TEST CONDITIONS		OIL & GAS ENVIRONMENT TEST RESULTS								
	Immersion Media	Crude Oil, H ₂ S Solution (Sour), Produced Water		Test Environment	Exposure Period	Blistering (ASTM D714)	Rusting (ASTM D610)	Adhesion (Pull-off, ASTM D4541)	Coating Integrity	Result
	Temperature	23 ± 2 °C (Sour: 50 °C)		 Crude Oil (Immersion)	30 Days	None (0)	None	9.4 MPa	Intact	✓ PASS
	Exposure Periods	30, 60, 90 Days (Thermal Cycles: -20 °C to 80 °C)			60 Days	None (0)	None	9.6 MPa	Intact	✓ PASS
					90 Days	None (0)	None	9.2 MPa	Intact	✓ PASS
	Test Panels	Mild Steel (SA 2.5 blasted) Coated with Blue Seal System		 Sour Environment (3.5% NaCl + H ₂ S Saturated) at 50 °C	30 Days	None (0)	None	9.1 MPa	Intact	✓ PASS
	Coating System	Blue Seal System (As per Section 6)			60 Days	None (0)	None	9.0 MPa	Intact	✓ PASS
					90 Days	None (0)	None	8.7 MPa	Intact	✓ PASS
	Evaluation Criteria	Blistering, rusting, adhesion, colour change, coating integrity		 Thermal Cycling (-20 °C to 80 °C)	After 50 Cycles	None (0)	None	9.3 MPa	Intact	✓ PASS
					After 100 Cycles	None (0)	None	9.1 MPa	Intact	✓ PASS
 All panels were inspected after exposure and after thermal cycling.		 The Blue Seal system shows excellent resistance to crude oil, sour environments and thermal cycling. No blistering, rusting or adhesion loss was observed after 90 days and 100 thermal cycles.								

PANEL APPEARANCE AFTER 90 DAYS IMMERSION

CRUDE OIL (IMMERSION)



No blistering, no rusting, coating intact

SOUR ENVIRONMENT (3.5% NaCl + H₂S, 50 °C)



No blistering, no rusting, coating intact

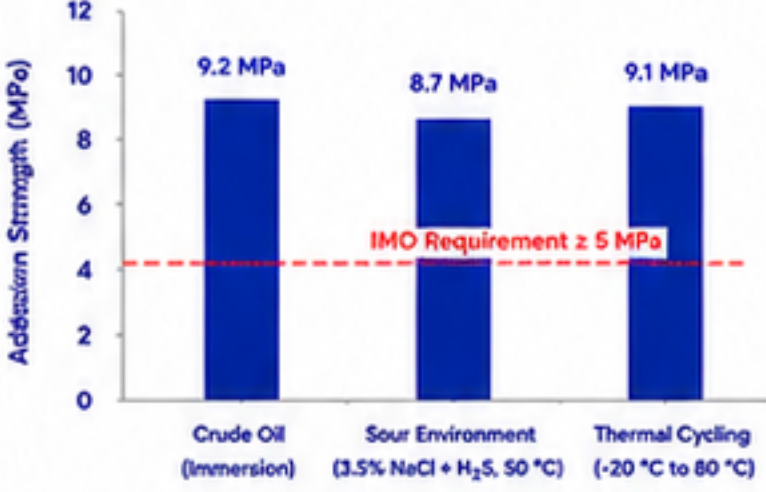
PRODUCED WATER (IMMERSION)



No blistering, no rusting, coating intact

Photos are representative of typical results. Actual results may vary depending on testing conditions.

ADHESION STRENGTH AFTER 90 DAYS



All adhesion values significantly exceed IMO MSC.215(82) requirement.

TYPICAL APPLICATION AREAS

-  Storage Tanks (Crude Oil, Refined Products)
-  Pipelines & Flowlines (Internal & External)
-  Offshore Platforms & Process Equipment
-  Refineries & Petrochemical Facilities
-  Secondary Containment (Concrete & Steel)

KEY FINDINGS	PERFORMANCE HIGHLIGHTS	CONCLUSION
✓ No blistering or rusting after 90 days in crude oil and sour environments. ✓ Excellent adhesion maintained after 90 days exposure and thermal cycling. ✓ Coating integrity remains intact with no delamination or breakdown. ✓ Superior resistance to hydrocarbons, H₂S, CO₂ and thermal stress. ✓ Meets and exceeds IMO MSC.215(82) requirements.	- Crude Oil Resistance ★★★★★ - Sour Environment Resistance ★★★★★ - Thermal Cycling Resistance ★★★★★ - Adhesion Strength ★★★★★ - Coating Integrity ★★★★★ - Overall Performance ★★★★★	 The Blue Seal Protective Coating System demonstrates outstanding performance in oil & gas environments, providing long-term protection against hydrocarbons, sour conditions and temperature cycling. The system delivers reliable, durable protection to critical assets while reducing maintenance and ensuring operational safety. Fully qualified in accordance with IMO MSC.215(82) requirements.

EXOVA-001 | VERSION 1.0

PAGE 13 OF 14

MAY 2024

 Independently Tested. International Standards. Proven Performance.

ENGINEERED PROTECTION. BUILT FOR EXTREME ENVIRONMENTS.

 OFFSHORE

 MARINE

 PORT

 WIND

 OIL & GAS

14. SUMMARY, CONCLUSIONS & RECOMMENDATIONS

The Independent IMO Marine Qualification Program EXOVA-001 confirms that the Blue Seal Protective Coating System delivers exceptional performance across the key challenges faced in marine and offshore environments.

Through a comprehensive series of tests conducted by Exova using IMO-aligned protocols, the system has demonstrated outstanding resistance to abrasion, chemicals, cathodic disbondment, water immersion and harsh environmental conditions.

Blue Seal is a high-performance, long-term protective solution engineered for extreme environments.

-  Proven Performance Under IMO Conditions
-  Superior Adhesion & Integrity
-  Excellent Resistance to Water, Chemicals & Oils
-  Long-term Durability & Life Cycle Value
-  Environmentally Responsible Solution



OVERALL TEST RESULTS

	Abrasion Resistance (ASTM D4060)	 PASS
	Cathodic Disbondment (NACE TM0177)	 PASS
	Water Immersion Resistance (ISO 2812-2)	 PASS
	Chemical Resistance (23 Chemicals)	 PASS
	Salt Spray Resistance (ASTM B117)	 PASS
	Adhesion Strength (ASTM D4541)	 PASS
	Thermal Cycling (-20 °C to 80 °C)	 PASS
	All tests met or exceeded the requirements of IMO MSC.215(82) standards.	

KEY ADVANTAGES OF BLUE SEAL SYSTEM

-  **Extreme Durability**
Engineered to withstand the harshest marine and offshore environments for long-term protection.
-  **Outstanding Resistance**
Resists water, chemicals, oils, sour service (H₂S, CO₂) and cathodic disbondment.
-  **Strong & Reliable Adhesion**
Excellent adhesion to steel and concrete substrates with no blistering or delamination.
-  **Extended Service Life**
Reduces maintenance frequency, downtime and lifecycle costs.
-  **Environmental Responsibility**
Low VOC, user-friendly application, and compliant with environmental regulations.
-  **Proven & Certified**
Third-party tested, Meets and exceeds IMO MSC.215(82) requirements.

RECOMMENDED APPLICATION AREAS



Marine Vessels & Ship Structures



Offshore Platforms & Jackets



Oil & Gas Storage Tanks & Pipelines



Refineries & Petrochemical Facilities



Bridges & Infrastructure



Water & Wastewater Treatment Plants

RECOMMENDATIONS

- Use the Blue Seal System for structures exposed to marine, offshore and severe industrial environments.
- Follow recommended surface preparation and application procedures for optimal performance.
- Conduct regular inspections as part of a preventative maintenance program.
- Repair any mechanical damage promptly using Blue Seal approved materials.
- Maintain coating records and inspection data to support asset management and compliance.

LIFE CYCLE PROTECTION & COST SAVINGS

High performance coatings = Lower total cost of ownership



 By choosing the Blue Seal Protective Coating System, owners and operators can confidently protect their assets, ensure operational reliability and achieve significant long-term value in the most demanding environments.



PROTECT WHAT MATTERS MOST
Blue Seal. Engineered Protection.
Built for Extreme Environments.
Tested. Proven. Trusted.



FOR MORE INFORMATION
Contact Vertex Infrastructure Protection Inc. for technical data, specifications, application guidelines and project support.

Independently Tested • International Standards • Proven Performance
ENGINEERED PROTECTION. BUILT FOR EXTREME ENVIRONMENTS.

Exova 
Testing | Advising | Assuring

IMO  INTERNATIONAL MARITIME ORGANIZATION