



The Sleek Waterjetting Factor: Smooth hull environmentally- friendly technology advances Applications case studies

Σύλλογος Διπλωματούχων Ναυπηγών Μηχανικών Ελλάδας
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WATERJETTING





For several decades, abrasive blasting has been the surface preparation of choice for preparing underwater hull, tank, and freeboard surfaces of ships

During this process, several tonnes of pulverised debris and fractured paint chips may be deposited in the surrounding area, resulting in costly and time-consuming clean-up

Waterjetting has environmental and safety advantages because it suppresses the dust created in surface preparation operations



Waterjetting is getting increasing attention these days in the protective and marine coatings industry, mainly because of its environmental advantages.

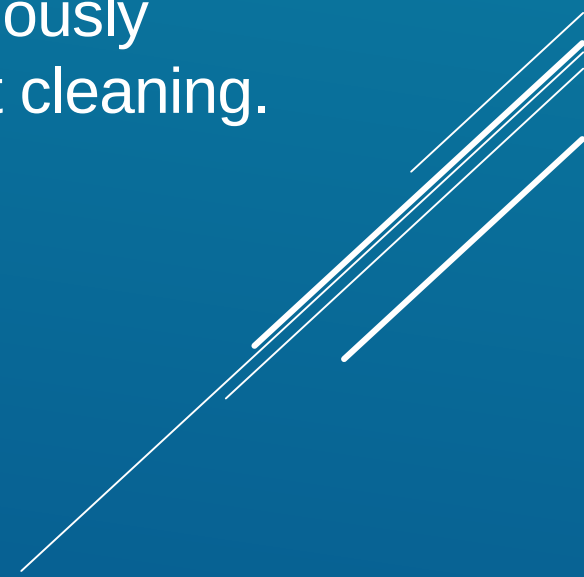
- The process creates no dust to contaminate the environment and substrate.
- There is no handling of abrasives before or after cleaning.
- Less waste is produced than with abrasive blast cleaning, and removal of waste after cleaning is easier and faster than with abrasive blasting.
- Sensitive areas can be cleaned without special protection.

UHP Waterjetting

Ultra-high-Pressure UHP Waterjetting an alternative to traditional blast cleaning, taking into account ecological and financial constraints relative to the recovery and treatment of contaminated abrasive particles.

Surface preparation by UHP water-jetting of previously painted steel plates is simpler than abrasive blast cleaning.

UHP cleaning requires only one operation.





high pressure water jetting (10,000 to 25,000 psi) and ultra-high pressure water jetting (above 25,000 psi).

The 4 end conditions range from the highest degree of cleaning, designated in the standard as WJ-1, to the lowest degree of cleaning, WJ-4

SSPC-SP / NACE - AMMP

WJ 1 Waterjet Cleaning of Metals – Clean to Bare Substrate
2000 - 2800 bar @ 15 - 25 Litres/min

WJ 2 Waterjet Cleaning of Metals – Very Thorough Cleaning
1400 - 2000 bar @ 15 - 25 Litres/min

WJ 3 Waterjet Cleaning of Metals – Thorough Cleaning
850 - 1400 bar @ 35 - 50 Litres/min

WJ 4 Waterjet Cleaning of Metals – Light Cleaning
500 - 800 bar @ 16 - 40 Litres/min

"L," "M," and "H" degrees of flash rusting—light, medium, and heavy

Flash Rusting

- The natural phenomenon of oxidation (flash rusting) occurs on the steel surface after UHP surface preparation.
- The lack of surface contamination greatly retards this process.
- The degree of flash rusting will depend on factors such as environmental conditions, steel conditions, and duration after surface preparation.





Ultra high-pressure waterjetting prepares a superior surface faster.

Cleaning a painted surface by UHP water-jetting produces areas of bare steel with a **roughness equivalent to the original** and areas of residual coating materials.

It has been found that the higher the operating pressure, the higher the removal rates.

The benchmark in the field for productive coating removal rates is 40,000 psi (2,666 bar).



1. Pressures from 10,000 to 25,000 psi (69 to 172 MPa) are used for **partial removal of coatings or spot blasting**.
2. Pressures above 25,000 psi (172 MPa) are used for complete coating removal.

With UHP WJ, the pressure, i.e., **velocity**, of the water is the main energy characteristic that performs the cleaning.

This is different from high-pressure water-jetting (HP WJ) units that operate between 700 and 1,700 bar (10,000 and 25,000 psi) where **flow rate** plays a role equal to water velocity in cleaning.

Surface Cleanliness - Wetting

Water-jetting prepares the surface to be painted by impacting the substrate surface, lifting the contaminants and existing coatings from the **bottom of pits**, and washing them from the surface.

Two actions in waterjet cleaning

- the direct impact due to the velocity of the jet and
- the sideways flow or shear that is controlled by the volume.

Lower pressure and higher volumes do not degrade coatings much.

WJ has very smooth comparable surfaces

A cleaner, contaminant-free surface will result in longer coating life and less rework.



UHP WJ systems consist of

1. a high-pressure pump,
2. hoses,
3. a control valve,
4. lance (wand),
5. and nozzle assembly.

“water is propelled through a single jet, a fan jet, or multiple rotating jets.”

Nozzles are available for **full or partial removal of coatings**



The heart of each system is the **UHP pump**, which pressurises the water and delivers it to the tools.

The most common form is a positive displacement **(plunger)** is a **triplex (three piston) pump**

Attached to the crosshead is the high-pressure plunger, contained in the high-pressure fluid end.

Higher pressures and nozzle advances have pushed productivity to rates comparable to hand-held abrasive blasting

UHP Water jetting Applications *Drydocks and Shipyards*

Waterjetting Compared to dry blasting, there is no risk of abrasive contamination to neighboring residential or industrial areas, which allows for other repair processes to be conducted simultaneously.

- There is no handling of abrasives before or after cleaning.
- Concurrent repair work reduced the time in dry dock, contributing to cost savings for both the vessel owner and the shipyard.
- Water jetting is used adjacent to sensitive deck equipment



UHP water-jetting is an accepted alternative to abrasive blasting

Annual consumption of blast cleaning abrasive in Greece shipbuilding and ship repairing is high.

The dominant expendable abrasive is nickel slag

Surface preparation and coating operations are a vital part of the Greek ship repair industry

Ultra-high-pressure (UHP) water-jetting can be used effectively to reduce the cost and adverse effects of maintenance recoating work in a variety of applications

Rules on ship carbon intensity and rating system

From 1 January 2023 it will be mandatory for all ships to calculate their attained Energy Efficiency Existing Ship Index (EEXI) to measure their energy efficiency and to initiate the collection of data for the reporting of their annual operational carbon intensity indicator (CII) and CII rating.





Hull coatings are a significant factor

Coatings have an important role to play in helping fleets become more efficient, as increased drag from biofouling on the underwater hull of a vessel is one of the biggest impacts on fuel consumption and CO2 emissions.



Case studies

full or partial removal of coatings from ship hulls, dry docks,
or cargo holds and tanks

High pressure water jetting as a surface preparation tool for
ship hull maintenance painting at

10,000 psi, 15,000 psi, and 20,000 psi with **nozzle fan jet**

UHP water under pressure (up to 280 MPa [40,000 psi]) was
the sole medium for surface preparation, resulting in virtually
no impact on the environment.

KRYSTALIDIS P69

Hellenic Shipyards,
Skaramanga October 2020





ultra-high pressure water jetting Underwater Hull ,
Freeboard , Decks

Ultra high pressure fresh water blast at 2500bar (36000+psi)
to Wa 2M ISO 8501-4 (International Marine Coatings
Pictorial Standard HB2M) to strip the coatings from the
surface.

WJ work total removal techniques—WJ-1 (clean to bare
substrate) and WJ-2 (very thorough cleaning)

UHP WJ, uncovered the existing profile and PCP primer.

Sensitive areas can be cleaned without special protection

Other Work Can Be Done During Waterjet

Ultra high pressure fresh water
blast at 2500+bar (36000+psi) to
Wa 2M



Ultra high pressure fresh water
blast at 2500+bar (36000+psi) to
Wa 2M





Advanced Fluoropolymer Foul Release Coating after 12 months in service



BLUE STAR 2

Nafsi Shipyard April 2021

Blue Star Ferries





ultra-high pressure water jetting external ship hull
Ultra high pressure fresh water blast at 2800bar (40000psi)
to Wa 2M ISO 8501-4 (International Marine Coatings
Pictorial Standard HB2M) to strip the coatings from the
surface.

complete coating removal.

UHP WJ, uncovered the existing profile of previously
painted ship hull

Localities prohibit the use of open air abrasive blasting in
shipyard activities, leaving water-jetting as the sole
productive medium for coating removal

Application Advanced fluoropolymer foul release coating for
the control of slime reduce the frictional resistance which
reduced emissions

BLUE STAR 2

Nafsi Shipyard April 2021



Advanced Fluoropolymer Foul Release Coating



LE BOUGAINVILLE

New Hellenic Shipyard Spanopoulos Group November 2021



LE BOUGAINVILLE

New Hellenic Shipyard Spanopoulos Group November 2021

Surface Preparation External Hull

High-pressure waterjetting produced an excellent surface for painting

Pressures from 15,000 to 20,000 psi (102 to 138 MPa) used for

Waterjet cleaning has become the tool to achieve "clean" and to create the situation so the coatings will perform as expected.

Premium Low friction antifouling applied in **very smooth surface**

Waterjetting and Paint Application complete 3 days

Waterjetting is an environmentally friendly process



GENEVE



GENEVE DWT 76596

Avlis Shipyard, Chalkis May 2022



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Surface Preparation External Hull water jetting

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ENDLESS HORIZON

VOFTSLP

ITSLP
CHI

15M
3
5
4
2
1-1/2
3

FPP/VO
L
VO
FPP

ENDLESS HORIZON

DWT 58018 Bulk Carrier

Avlis Shipyard, Chalkis May 2022



ENDLESS HORIZON

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ENDLESS HORIZON

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Surface Preparation External Hull abrasive blasting and
then pressure wash with fresh water to clean blasting
dust and grit: slurry blasting





S-BRILLIANT DWT 48800

Bulk Carrier

New Hellenic Shipyard Spanopoulos
Group August 2022



S-BRILLIANT DWT 48800 Bulk Carrier

New Hellenic Shipyard Spanopoulos Group August 2022

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The image shows the interior of a ship's hull under construction. The walls are made of large, reddish-brown steel plates with vertical stiffeners. A central vertical access ladder is visible. The ceiling consists of a complex network of steel beams and girders.

MAGIC SEAS DWT 64000 Bulk Carrier

New Hellenic Shipyard Spanopoulos Group

August 2022



MAGIC SEAS DWT 64000 Bulk Carrier

New Hellenic Shipyard Spanopoulos Group

August 2022

Cargo Holds x 5 – 22000 m²

WJ Pressurized water at 15000 psi and 20000 psi was sufficient to get the pits from gouging damage cleaned out without affecting intact coatings .

High-pressure water-jetting x 2 pumps eliminated the clouds of dust from dry abrasive blasting and the costs of recovery and treatment of polluted waste

High-pressure waterjetting produced an excellent surface for painting

Waterjetting and Paint Application complete 14 days



MAGIC SEAS

Bulk Carrier

64000 DWT

New Hellenic Shipyard Spanopoulos Group

August 2022

Comparative Study Cargo Holds 22000 m²



Surface preparation by traditional dry blasting with nickel slag abrasive carries ever-increasing costs of recovery and treatment of polluted waste

Using a mean consumption rate of 40 kg/m² of abrasive x 22000 m² spot blasting 5 Cargo Holds area

Total consumption and recovery of abrasive 500 tonnes

Prior to coating application, surfaces must be blown or swept free of minute dust particles adhering to the blasted steel.

Even then, the steel surface is not guaranteed to be completely free of contaminants.

Cargo Holds were delivered smooth in immaculate condition



New Hellenic Shipyard Spanopoulos Group began using high-pressure (HP) water-jetting technology long ago and is one of the first using UHP WJ technology

Waterjetting is more environmentally friendly in several ways, it doesn't create any dust or air pollution during operation.

The environment is getting more important every day, as it should be.



LEVANTES

LEVANTES DWT 76015 Bulk Carrier
ONEX Neorion Shipyard Syros March 2022



LEVANTES DWT 76015 Bulk Carrier

ONEX Neorion Shipyard Syros March 2022

Accident Repairs Forepeak Ballast Tank was a new steel construction

ONEX Neorion shipyard is located on the island of Syros.

Because of its close proximity to the city, it presented an interesting case for practical application of the so-called “**sustainable development**” philosophy”

ONEX Neorion Shipyard began using high-pressure (HP) water-jetting technology long ago and is one of the first using UHP WJ technology



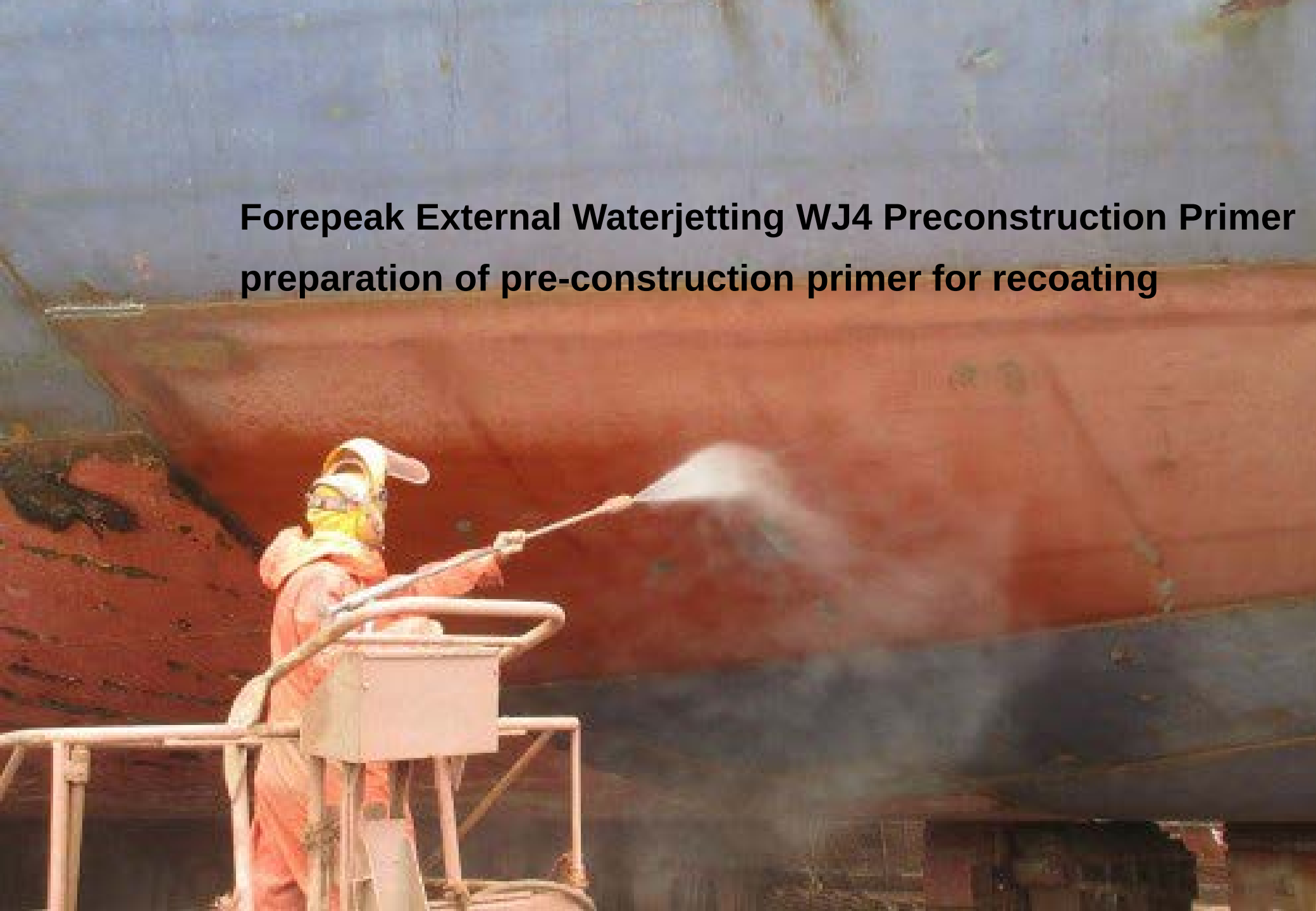
HOCHLEITNER
MARINE & INDUSTRIAL CORROSION AND COATINGS
CONSULTANCY & TRAINING





Accident Repair new steel with preconstruction primer

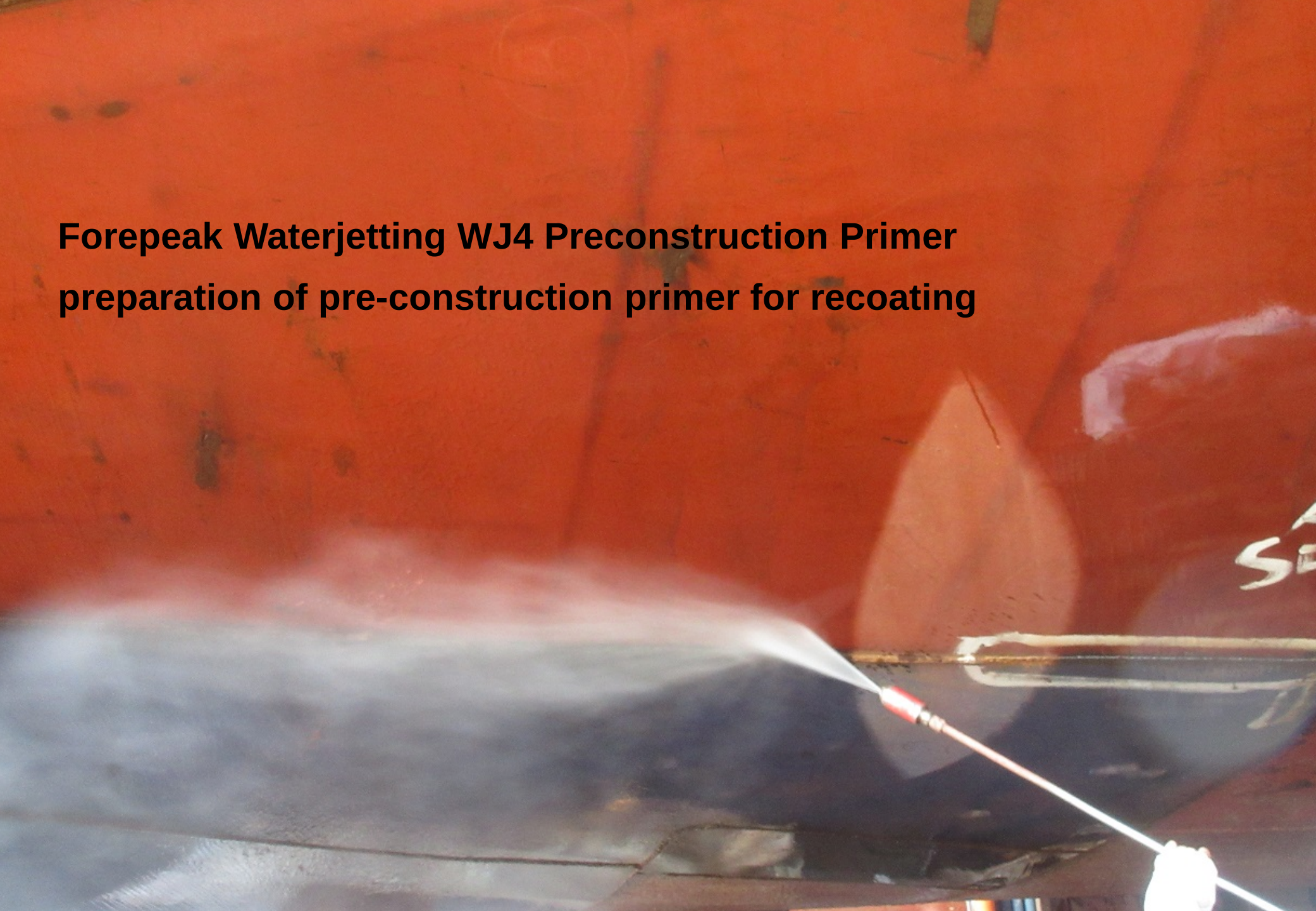
**Forepeak External Waterjetting WJ4 Preconstruction Primer
preparation of pre-construction primer for recoating**



**Forepeak External Waterjetting WJ4 Preconstruction Primer
preparation of pre-construction primer for recoating**



**Forepeak Waterjetting WJ4 Preconstruction Primer
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types of steel surfaces in external and internal areas

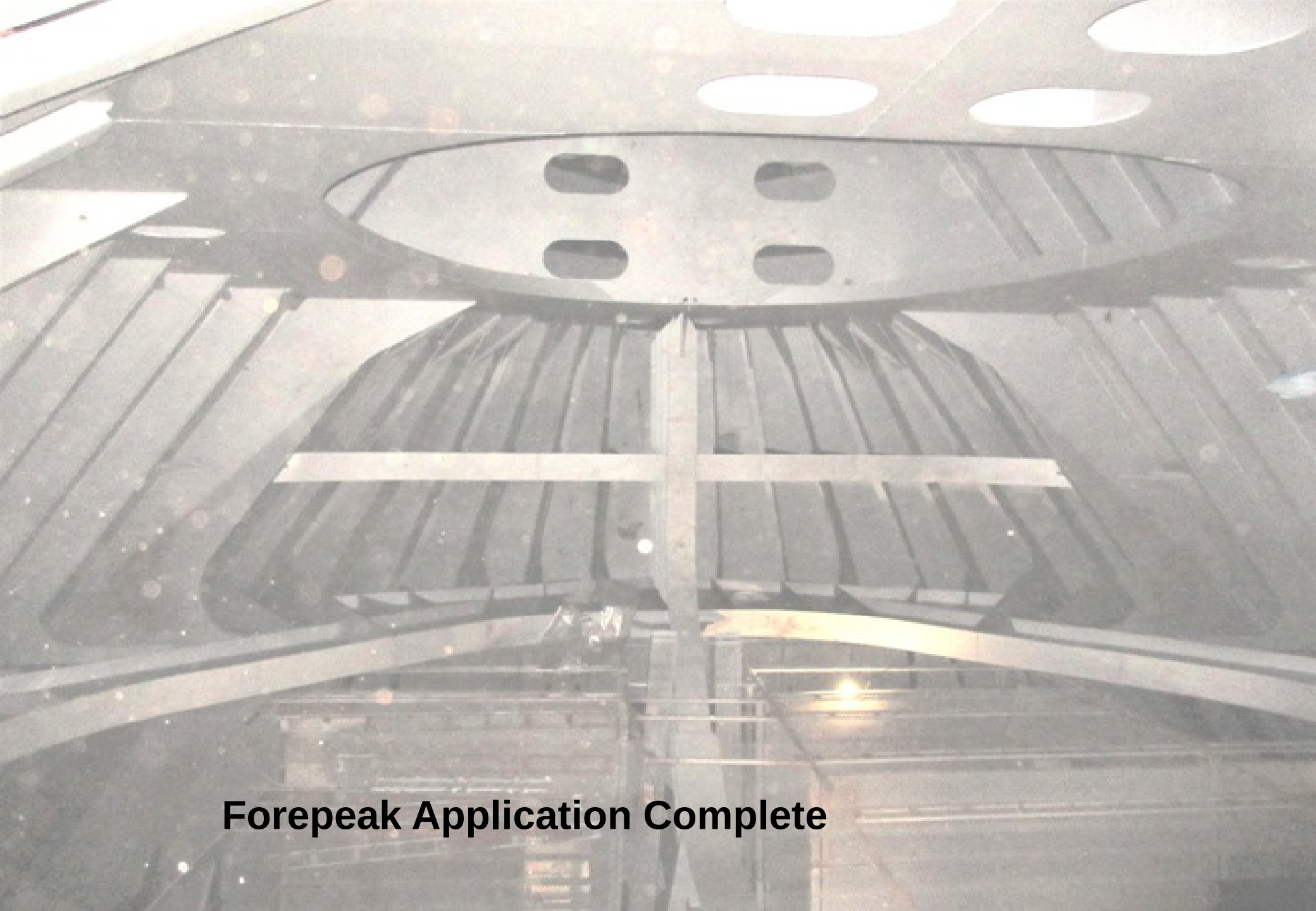
- rusted steel in the welded seams
- new, preconstruction primer-coated surfaces

Waterjetting Pressurized water at 15,000-20,000 psi

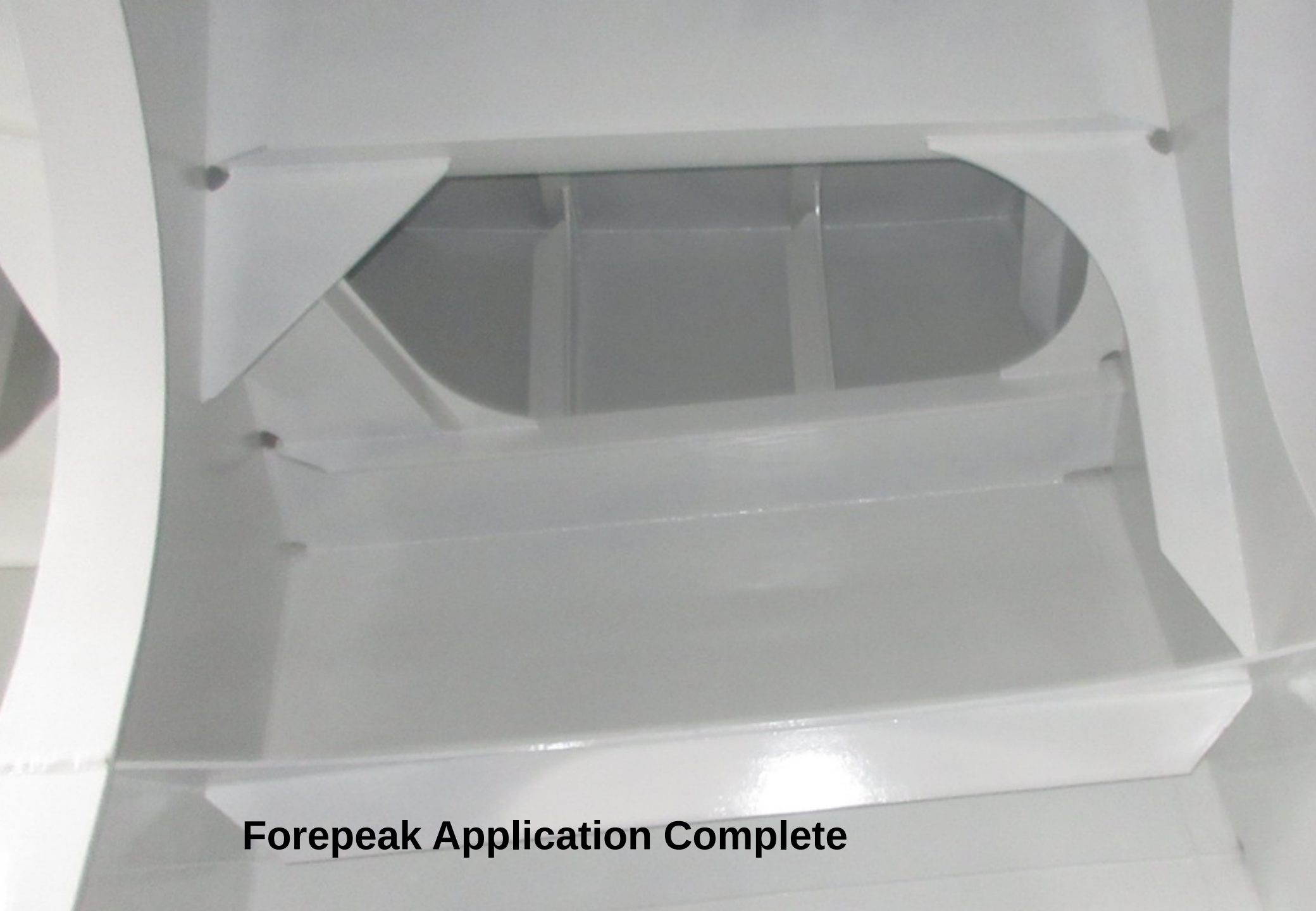
- The process created no dust to contaminate the environment and substrate.
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water-jetting eliminated the cost of abrasives as well as the cost of reclamation or recovery of abrasives after blasting in the dock and inside the forepeak

High-pressure waterjetting produced an excellent surface for painting



Forepeak Application Complete



Forepeak Application Complete



After Water jetting was done, the surfaces were checked for

1. adherence of preconstruction primer
2. surface contamination,
3. and overall effectiveness of the WJ blast

All results were acceptable with top rated performance



Smooth hull after Waterjetting



Comparative Study

Surface preparation by traditional dry blasting with nickel slag abrasive
Maintenance is very time consuming for a variety of reasons.
The chief factor is time spent during abrasive clean-up

Using a mean consumption rate of 40 kg/m² of abrasive x 5000 m²
area of difficult geometry with scaffolding

Forepeak Total consumption and recovery of abrasive 200 tonnes

Prior to coating application, surfaces must be blown or swept free of
minute dust particles adhering to the blasted steel.
Even then, the steel surface is not guaranteed to be completely free of
contaminants.

High-pressure water-jetting eliminated the clouds of dust from dry
abrasive blasting and the costs of recovery and treatment of polluted
waste from Forepeak

Forepeak Waterjetting & Paint Application complete 7 days

LEVANTES DWT 76015 Bulk Carrier
ONEX Neorion Shipyard Syros March 2022



Waterjetting is an environmentally friendly technology



**Waterjetting produced an excellent
surface for painting**

**Waterjetting for a Smooth hull and Tank
Coating –
an environmentally-friendly technology**