

## Introduction

### Water as a tool for clean environment

The high-pressure waterjet technology has now been employed for decades in simple ship cleaning tasks. Today, due to environmental and economical consideration, it is an important tool for surface preparation work on ships prior to coating application.

Ultra-High Pressure (UHP) waterjets with operating pressure up to 3,000 bar (43,500 psi) is accepted by the maritime industry all over the world for cleaning and cutting applications. Some of these applications are highlighted below:

- Cleaning of ship hulls.
- Cleaning of superstructures and on-board equipment
- Cleaning of ballast tanks.
- Cleaning of tanks, vessels and internal pipe systems.
- Surface preparation prior to coating application.
- Removal of deteriorated protective coating systems.
- Spot repair on partially deteriorated coating systems.
- Selective paint stripping.
- Cleaning and descaling of weld seams.
- Emission-free surface preparation on ship hulls and superstructures.
- Large-scale surface preparation with mechanically guided tools.
- Cutting of steel
- Cutting of internal pipe systems.

### Why using Waterjetting Technology?

Because waterjet technology offers distinct advantages over other methods for surface preparation

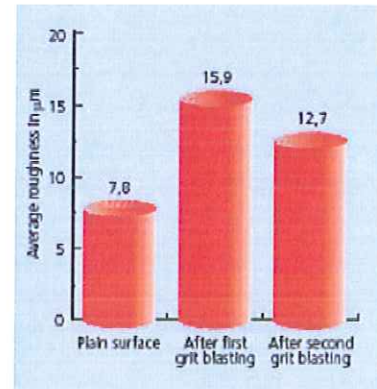
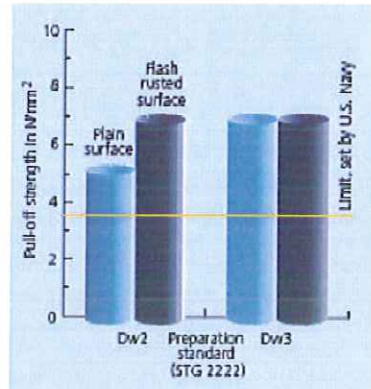
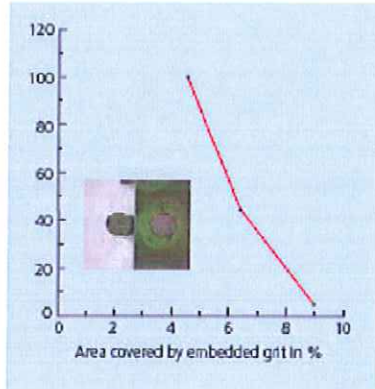
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**Reasons for using waterjet technology over other conventional methods:**

- ✓ Waterjetting significantly reduces the amount of deposit. Compared to grit blasting, up to 98 percent less solid waste material need to be considered. Customers save large amounts in disposal costs.
  - ✓ Waterjetting significantly reduces the time required for clean-up because no grit needs to be collected and removed at the end of the job. Customers save hundreds of hours of time and labor.
  - ✓ Waterjetting is dust-free, allowing different trades, to work side by side. Moreover, dust-sensitive area can be maintained while the Waterjetting is carried out. Customers save expensive time in drydocks.
  - ✓ Waterjetting generates very low impact forces on surfaces; working almost vibration-free. No substrate material will be removed. Customers avoid damage on their structures.
  - ✓ Waterjetting is used in rainy or windy environment. Customers are not dependent on weather conditions and can readily schedule work with high reliability.
  - ✓ Waterjetting guarantees the highest possible cleanliness level among all surface preparation methods. The remaining level of salt, chloride and other elements is minimized. *There is no embedded grit as found after grit blasting being a source for new corrosion.* Customers therefore offer an excellent surface to painter with minimal risk of osmotic blistering.
  - ✓ Waterjetting ensures excellent adhesion conditions between substrate and coating even if flash rust is present. Customers guarantee limits set by regulatory bodies (such as 3.5N/mm<sup>2</sup> required by the U.S. Navy).
  - ✓ Waterjetting exposes the original profile. In contrast, grit blasting reduces the original profile height due to particle impact. Customers offer an excellent surface profile to the painter giving a good mechanical bond between substrate and coating.
  - ✓ Waterjetting operates emission-free in closed loop systems. Sealed tools connected to vacuum and water treatment systems prevent any exposure to paint particle dust, fume or water mist. Customers contribute to safe and clean environment.
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## SURFACE PREPARATION BY HYDRO BLASTING

### Waterjetting Guarantees Highest Surface Quality



✓ **No Embedded Grit**

Grit blasting embeds particles in the substrate which drastically reduces the adhesion of the applied coating to the surface.

Measurements: Brunel University, UK.

✓ **Excellent Pull-Off Strength**

Waterjetting produces excellent adhesion conditions, even if flush rusting appears.

Measurement: W&J Leigh & Co, Bolton, UK.

✓ **No Profile Reduction**

Grit blasting reduces the initial roughness obtained after the first grit blasting job. Note the 20% reduction. Measurement: Swinburne University of Technology, Melbourne, Australia

Element	Soluble Substance in µg/cm <sup>3</sup>	
	Waterjetting	Grit Blasting
Aluminum	0.003	0.352
Calcium	0.121	1.989
<b>Chloride*</b>	<b>0.846</b>	<b>62.55</b>
Copper	0.033	0.250
Iron	0.018	9.450
Lead	0.015	0.045
Magnesium	0.021	0.672
Manganese	0.003	0.031
Nickel	0.006	0.057
Potassium	0.414	0.513
Sodium	0.855	42.03
Sulfate	0.211	1.260
Zinc	0.063	1.512
<b>Total</b>	<b>2,611(100%)</b>	<b>120,71(4,650%)</b>

✓ **Minimal Residues**

Waterjetting most reliably removes any residues (especially salts) from the substrates and, therefore, minimizes the probability of osmotic blistering.

Measurement: Navy Sea Systems Comm., 1997

✓ **No Microscopic Impurities**

Grit blasting produces non-visible residue (dark appearing areas) on the substrate surface generating areas of subsequent coating failure.

Measurement: Swinburne University of Technology, Melbourne, Australia



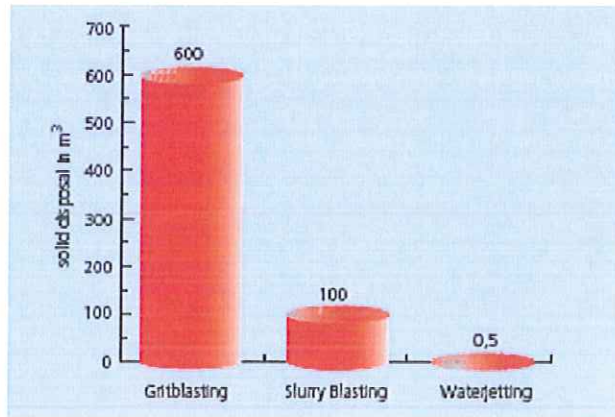
SEM-Image of grit blasted steel surface with embedded grit.



Backscattered SEM-image of Grit blasted steel surface  
Photo: IRIS, Melbourne, Australia



## SURFACE PREPARATION BY HYDRO BLASTING



✓ **Reduction in amount of solid disposal** Dramatic reduction in solid waste. Note the extremely low amount of 0.5m<sup>3</sup> for waterjetting compared to the 600m<sup>3</sup> for grit blasting. Measurement: Blohm & Voss, Hamburg, Germany

✓ **Waterjetting Guarantees High Efficiency at any Surface Preparation Standard and meets the requirements of the basic surface preparation standards.**

Standard/Condition	STG Guide No. 2222	Fitz' Atlas of Coating Defects	SSPC-VIS 4(1) NACE No. 7	International Hydroblasting	Hempel's Photo Reference	Jotun Degree of Flash Rusting	U.S. NAVY Standards	Cleaning Rates
Coating	Dw 2	DS 1 Wa 2 1/2	No definition	No definition	WJ-1	No definition	NAVY 5 AC	up to 150 m <sup>2</sup> /h
Rust Grade (LEVel: C)	Dw 2	DC 1 Wa 2 1/2	CV5 WJ-2	CHB 2 1/2	WJ-1	JG-1	No definition	up to 170 m <sup>2</sup> /h
Flash Rust	No definition	FR 3	CV5 WJ-2 L	CHB 2 1/2 L	WJ-1 FR-1	JG-3	NAVY - LFR No visual definition	for painters only

## Surface Preparation

### A Visual Explanation of the Surface Preparation Standard NACE 5/SSPC 12 1995.

"Surface preparation and cleaning of steel and other hard surfaces by High and Ultra high Pressure Water Jetting prior to recoating."

The following images are linked to show the surface prior to preparation and then in stages to the best possible standard with water jetting.

There are four visual surface preparation definitions, these are:-

#### **WJ-4**

The surface shall have all loose rust, loose mill scale and loose coating uniformly removed.

#### **WJ-3**

The surface shall be cleaned to a matte finish with at least two-thirds of the surface free of all visible residues (except mill scale) and the remaining one-third containing randomly dispersed stains of previously existing rust, coating and foreign matter.

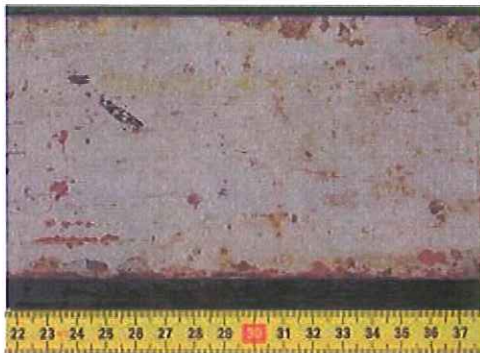
#### **WJ-2**

The surface shall be cleaned to a matte finish with at least 95% of the surface area free of all previous visible residues and the remaining 5% containing only randomly dispersed stains of rust, coating and foreign matter.

#### **WJ-1**

The surface shall be free from all previously visible rust, coatings, mill scale and foreign matter and have a matte metal finish.

#### **Practical Example**



**Old Coating - Initial Condition**

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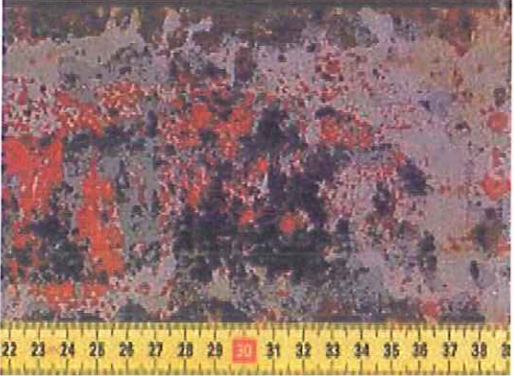
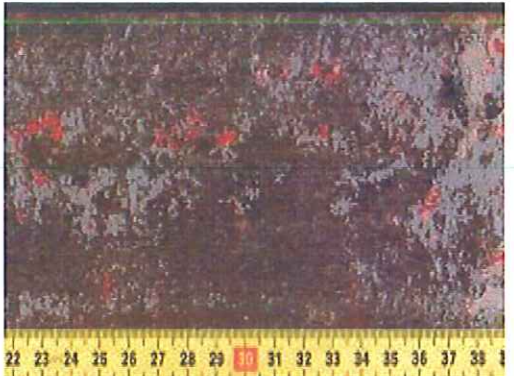
##### **Description:**

A multilayer system with undercoat flaking and slight rust.

##### **Requirement:**

To prepare the surface for recoating by the use of high or ultrahigh pressure water jetting without the use of abrasive to various WJ Standards: 1-4.

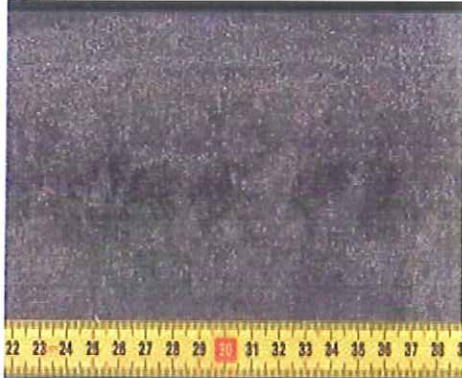
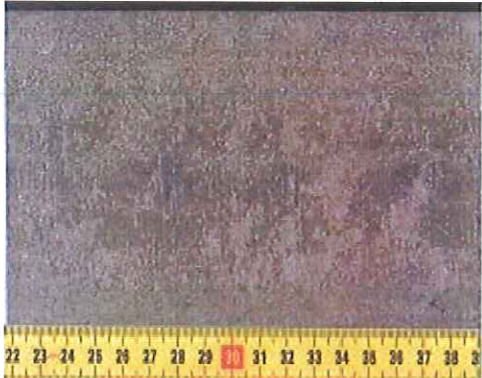
## SURFACE PREPARATION BY HYDRO BLASTING

 <p style="text-align: center;"><b>WJ-4</b></p>	<p><b>Standard: WJ 4</b></p> <p><b>Description:</b> The surface shall have all loose rust, loose mill scale and loose coating uniformly removed.</p> <p><b>Approximate requirements to achieve this standard:</b> 700 - 800 bar @ 35 - 50 Litres/min.</p> <p><b>Approximate work rates:</b> 10 - 15 square metres per hour.</p>
 <p style="text-align: center;"><b>WJ-3</b></p>	<p><b>Standard: WJ 3</b></p> <p><b>Description:</b> The surface shall be cleaned to a matte finish with at least 67% of the surface free of all visible residues (except mill scale) and the remaining 33% containing randomly dispersed stains of previously existing rust, coatings and foreign matter.</p> <p><b>Approximate requirements to achieve this standard:</b> 850 - 1000 bar @ 35 - 50 Litres/min.</p> <p><b>Approximate work rates:</b> 8 - 12 square metres per hour.</p>





## SURFACE PREPARATION BY HYDRO BLASTING

 <p style="text-align: center;"><b>WJ-2</b></p>	<p><b>Standard: WJ 2</b></p> <p><b>Description:</b> The surface shall be cleaned to a matte finish with at least 95% of the surface area free of all previous visible residues and the remaining 5% containing only randomly dispersed stains of rust, coatings and foreign matter.</p> <p><b>Approximate requirements to achieve this standard:</b> 1400 - 2000 bar @ 15 - 25 Litres/min.</p> <p><b>Approximate work rates:</b> 8 - 12 square metres per hour.</p>
 <p style="text-align: center;"><b>WJ-1</b></p>	<p><b>Standard: WJ 1</b></p> <p><b>Description:</b> The surface shall be free from all previously visible rust, coatings, mill scale and foreign matter and have a matte metal finish.</p> <p><b>Approximate requirements to achieve this standard:</b> 2000 - 2500 bar @ 15 - 25 Litres/min.</p> <p><b>Approximate work rates:</b> 6 - 10 square metres per hour.</p>

