PROCEDURE FOR TESTING AND CERTIFICATION
OF IN-WATER CLEANING COMPANIES

BIMCO

International Chamber of Shipping

Shaping the Future of Shipping

Procedure for testing and certification of in-water cleaning companies

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Introduction

The objective of this procedure is to set minimum requirements for independent testing and certification of cleaning companies for various types of cleaning operations with capture to facilitate the granting of local permissions from ports and/or relevant authorities.

The *Procedure for testing and certification of in-water cleaning companies* ensures:

1. that the cleaning system and process are tested and certified in accordance with the *Procedure for testing and certification of in-water cleaning companies* by a competent organisation.
2. that testing results can be utilised to apply for local permissions from ports and other relevant authorities to operate within their jurisdictions.

The original *Approval procedure for in-water cleaning companies* was written by an industry working group consisting of AFS manufacturers, in-water cleaners, shipowners, ports, international organisations and authorities. The following were represented in the work: Akzo Nobel, BIMCO, C-Leanship, CMA Ships, DG Diving Group, Fleet Cleaner, Hapag-Lloyd AG, Hempel, HullWiper, International Association of Classification Societies, International Chamber of Shipping (ICS), Minerva Marine, Portland Port (UK), Port of Rotterdam and PPG Coatings.

The Procedure for independent testing and certification of in-water cleaning companies has been based on the Approval procedure for in-water cleaning companies and specifically focuses on providing confidence in an in-water cleaning system's capability to capture waste substances. The Procedure has been aligned with recent developments and with the IMO's 2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species.

11 October 2023

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2 Definitions

Anti-fouling paint coating system (AFC)	A surface coating or paint designed to prevent, repel or facilitate the detachment of biofouling from hull and niche areas that are typically or occasionally submerged.
Anti-fouling system (AFS)	A coating, paint, surface treatment, surface or device that is used on a ship to control or prevent attachment of organisms.
Background sample	A sample of water from the place or in the vicinity where cleaning takes place but that is not impacted in any way by the cleaning activity. The sample can be collected before, during and/or after a designated test cleaning event.
Biocide	A chemical substance incorporated into anti-fouling coatings to prevent settlement or survival of aquatic organisms.
Biofouling	The accumulation of aquatic organisms such as microorganisms, plants and animals on surfaces and structures immersed in or exposed to the aquatic environment. Biofouling can include pathogens.
Cables and hoses	Equipment which is used to connect the cleaning unit to the unit ashore or on a barge. The hoses may carry water or provide other means of transporting the captured material from the cleaning unit to the separation and/or treatment unit. Cables are used to power the cleaning unit.
Capture	The process of containment, collection and removal of biofouling material and waste substances detached from submerged surfaces during cleaning in water or in dry dock.
Cleaning company	A person or company who provides services in reference to underwater cleaning which may also include services such as in-water inspection.
Cleaning unit	The cleaning device which interacts with the ship's hull and other areas to remove and capture the material attached to the surface. This unit maybe operated by a diver or by a remotely operated vehicle (ROV) pilot.
Competent organisation	An organisation that oversees the testing of a cleaning system in accordance with the *Procedure for testing and certification of in-water cleaning companies*. The competent organisation and independent testing organisation can be the same as long as the criteria for acting as an independent testing organisation are met. If the competent organisation does not meet the criteria then an independent testing organisation will need to be selected to undertake the testing.
Continuous, time-integrated water sample	A representative sample taken continuously during the designated cleaning period. An approach which integrates concentrations of water quality parameters over the testing period into one single sample.
Control unit	The unit which houses the controls such as remote control of ROVs, communication devices with divers, camera monitors etc.

Diver	A person who is qualified to dive underwater safely using self-contained breathing apparatus or other similar systems. He/she is trained in one of the diving standards recognised by relevant authorities and has working knowledge on the use of tools normally used in in-water cleaning/visual inspection as well as emergency escape training.
Heavy microfouling	Large patches or submerged areas entirely covered in macrofouling with coverage between 41 to 100% of the surface.
Independent testing organisation	An organisation with appropriate quality assurance and quality control (QA/QC) regarding handling of samples and taking samples in place that has been independently accredited by an appropriate international or national body (for example the International Organization for Standardization (ISO)). Independent means that it must not be owned or affiliated with the cleaning company, manufacturer or vendor of any equipment, by the manufacturer or supplier of the major components of that equipment.
Invasive aquatic species	Species which are non-native to a particular ecosystem which may pose threats to human, animal and plant life, economic and cultural activities and the aquatic environment.
In-water cleaning	The removal of biofouling from a ship's hull and niche areas while in the water.
Light macrofouling	Presence of microfouling and multiple macrofouling patches. Fouling species cannot be easily wiped off by hand with coverage between 1 to 15% of surface.
Macrofouling	Biofouling caused by the attachment and subsequent growth of visible plants and animals on structures and ships exposed to water. Macrofouling consists of large, distinct multicellular individual or colonial organisms visible to the human eye such as barnacles, tubeworms, mussels, fronds/filaments of algae, bryozoans, sea squirts and other large attached, encrusting or mobile organisms.
Medium macrofouling	Presence of microfouling and multiple macrofouling patches with coverage between 16 to 40% of surface
Manufacturer	A company who manufactures the equipment utilised in the in-water cleaning process (eg hull cleaning equipment, water treatment systems etc).
Marine growth prevention system (MGPS)	An AFS used for the prevention of biofouling accumulation in niche areas or other surface areas but may also include methods which apply surface treatments.
Niche areas	A subset of the submerged surface areas on a ship that may be more susceptible to biofouling than the main hull owing to structural complexity, different or variable hydrodynamic forces, susceptibility to AFC wear or damage, or inadequate or no protection by AFS.
Proactive cleaning	The periodic removal of microfouling on ships' hulls to prevent or minimise attachment of macrofouling.
Remotely operated vehicle (ROV)	A vehicle that may be used as part of a cleaning unit, which is and navigated remotely from the surface to inspect and/or cleansubmerged hull and niche areas.
Reactive cleaning	A corrective action during which biofouling is removed from a ship's hull and niche areas either in water with capture or in dry dock.

Sea water effluent	The water that has been filtered, and/or treated to remove waste substances and is ready to be discharged backinto the environment.
Sea water influent	The water that is captured into the cleaning system during the cleaning process. This water may still contain waste substances.
Separation unit	The equipment that uses physical processes to remove waste substances from sea water, consisting for example of settling tanks, filtration, and centrifugation. Separation and treatment stages may be combined into one unit.
Ship	A watercraft of any type whatsoever operating in the aquatic environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft, fixed or floating platforms (excluding licensed aquaculture assets), floating storage units (FSUs) and floating production storage and off-loading units (FPSOs).
SOP (Standard Operating Procedure)	A set of step-by-step instructions compiled by a cleaning company to help workers carry out routine operations.
Storage unit	The unit in which captured waste substances are pumped directly into which might include tanks, a barge, etc. The captured material and seawater in storage can then either be directly disposed of appropriately or subsequently processed through separation and/or treatment units.
Subcontractor	A person or company providing services to the cleaning company.
Subsidiary	A company partly or completely owned by the cleaning company.
Test cleaning event	An event which covers the entire cleaning process. A test cleaning event starts with the onsite safety preparation of the in-water cleaning and lasts until the cleaning and associated equipmenthave been returned to its original state.
Treatment unit	A unit for treatment of waste substances. Treatment can consist of a physical, chemical or biological addition(s) to alter or remove waste substances. Treatment can include but is not limited to flocculation, metals sorbent media, UV and biocides.Treatment and separation stages may be combined into one unit.
Total suspended solids (TSS)	Solids in water that can be trapped by a filter. Any particle that is smaller than two (2) microns is considered a total dissolved solid (TDS). Particles captured within a systems filter may be dried and weighed, and the mass is expressed as milligrams per litre (mg/L) or parts per million (ppm). The measurement provides information about the concentration of solid material suspended in the liquid.
Waste substances	Dissolved and particulate materials that may be released or produced during cleaning or maintenance, and may include biocides, metals, organic substances, removed biofouling, pigments, microplastics or other contaminants that could have a negative impact on the environment.

3 In-water cleaning systems

1. This *Procedure for testing and certification of in-water cleaning companies* is specific to in-water cleaning service providers that remove and capture microfouling, light macrofouling, medium macrofouling and heavy macrofouling organisms, which have colonised the immersed surfaces of ships. Cleaning systems comprise a series of units, which manage the cleaning process (Figure 1).

Figure 1: Schematic diagram of a cleaning system outlining the various component parts that are common to such systems.

2. The cleaning system is made up of one or more of the modules shown on Figure 1 and the order of operation in which these components are placed will vary between systems. The cleaning system can be self-contained on a waterborne platform or contained from a jetty or pier.

3. The cleaning unit may be either diver operated or remotely operated using a remotely operated vehicle (ROV). The cleaning unit is used to clean the hull, propeller and/or niche areas. The cleaning unit removes and captures waste substances and is attached to the separation and/or treatment unit by hoses.

4. Some cleaning systems pump the captured material and seawater into a storage unit (eg, a barge). The captured material and seawater in the storage unit will subsequently be pumped to the separation and/or treatment unit.

5. The hoses provide means of transporting the captured material and seawater from the cleaning unit to the separation and treatment unit or a storage unit. Cables are used for communication purposes and to power and control the ROV or other cleaning technology.

6. The separation unit houses the equipment that removes the captured material from the seawater influent.

7. The treatment unit can be used as an integrated part of the separation unit or as an additional unit to further treat the influent water after the separation unit. Treatment may include use of heat, biocides or sorbent media, as examples. The separation and treatments units can be used to ensure the seawater effluent comply with the performance criteria of this standard and local regulations.

8. Seawater effluent is generally returned to the environment although there are examples where the seawater can or must be discharged elsewhere eg to comply with local regulations.

4 Test and certification requirements

1. Certificates may be issued by the competent organisation based on test results, and other relevant documentation confirming the performance criteria.

2. The certificate should clearly state the scope of services including type of equipment whilst specifying any limitations or restrictions imposed.

3. A certified cleaning company is given the permission to operate in a country, region or port by the relevant authority.

4. A port, region or country may approve a cleaning company by accepting the performance of the in-water cleaning system shown in the certificate issued in accordance with the Procedure for testing and certification of in-water cleaning companies and may add on additional local, regional or national testing requirements before giving permission to operate.

5. The cleaning company should inform the competent organisation when it has been given permission to operate in a country, region and/or port based on the certificate and make this information publicly available for example on its web page.

Verification testing

1. In-water cleaning companies will be tested for the performance criteria relevant to their declaration of the cleaning system's operational capabilities and performance ie (A) the effectiveness of the separation and/or treatment unit system at removing material, and (B and C) control of the emissions to the local environment from the cleaning unit and from the separation and/or treatment unit.

2. The verification testing will take place on actual ship surfaces (submerged hull, propeller and/or niche areas) and AFC (non-biocidal and/or biocidal) depending on cleaning company's declarations. The cleaning company's declaration should, as a minimum, include the following information:
   - Rating scale of the extent of fouling
   - AFC type(s)
   - Division of categories of ship areas to be cleaned:
     - Hull and niche areas that do not need special cleaning equipment
     - Niche areas that require special cleaning equipment; and/or
     - Propellers
   - Visibility and operational limits.

3. The independent testing organisation should, in conjunction with the cleaning company, develop test plans that are based on the individual cleaning devices that the cleaning company wants to be tested. The cleaning company should state limitations to each of the devices. This can for example be the curvature of surfaces, AFC, distances to bilge keels etc. Depending on the intended use of the system, the test plans may include:
   - Areas used for testing on the flat sides of the hull
   - Curved areas used for testing, for example the turn of bilge, and angles where the orientation

of the surface changes abruptly, such as the chine, keel and skegs
- Niche areas used for testing, eg, propeller shafts, rudders, anodes and gratings
- Propellers.

The performance criteria, and protocols to measure them, are described in detail in Annex A.

Documentation

The cleaning company, subsidiaries and subcontractors if any, should provide relevant documentation to the competent organisation:

1. Outline of cleaning company eg organisation and management structure, including subsidiaries

2. Information of agreements and arrangements if any parts of the services provided are subcontracted. This should include quality management by the cleaning company when following-up such subcontracts to ensure the relevant requirements of this procedure are met.

3. Declaration of the services requested to be under the scope of the test and certification

4. Experience of prior in-water cleanings carried out by the cleaning company (ie companies requiring personnel that have experience in cleaning specific ship categories, hull forms, AFC coating types, propellers and niche areas)

5. Description of equipment(s) used in cleaning process, including but not limited to cleaning units, hoses, cables, surface units, separation and treatment units, communication devices, recording devices such as cameras. Manufacturer's technical documentary evidence where applicable, to the operations being carried out eg filter sizes

6. List of operators/technicians/inspectors/divers

7. Training records for operators/technicians/inspectors/divers

A set of procedures covering the following environmental aspects should be submitted for verification against the performance criteria:

1. Operational procedure for separation, treatment, and maintenance of the units in the systems

2. Operational procedures for the handling of the captured material including disposal or alternative arrangements

3. Record of each cleaning operation[1] for eg number of hours cleaning, amount of material captured, record of separation/treatment and discharge of seawater effluent, record of separation/ treatment and disposal of the captured material

4. Operational procedure for self-checks and testing/monitoring of the system on an ongoing basis and associated reporting, including how the risk of incidents is thus reduced.

[1] In instances where a cleaning company has extensive experience detailed and specific information should be given for the last five cleanings. For cleanings before a summary will suffice indicating the number of cleans, types of ships, AFCs cleaned, types of cleaned biofouling, procedures for effluent and waste handling etc.

Training of Personnel

The cleaning company should maintain records of personnel training and present and previous work experience for all cleaning operations performed including but not limited to the following:

1. Qualification of divers
2. Qualification of ROV operators
3. Qualification of diving and/or ROV supervisors

Experience of Personnel

The cleaning company should demonstrate that the experience requirements for its personnel are in line with the cleaning company policy and specific to the procedure/methods/technology adopted for cleaning operations. Furthermore, the following experience is required for specific personnel:

- **Supervisor** – Diving and ROV supervisors should be qualified according to cleaning company's general requirements and should have a minimum of two years' experience as a diver carrying out cleaning or ROV operations as appropriate.
- **Divers** – An assistant diver should participate in a number of cleaning procedures that cover the specific services of the company in accordance with the cleaning companies' internal procedures.
- **ROV operators** – ROV operators should have participated in a minimum number of cleaning operations to be approved in accordance with the cleaning companies' internal procedures.

5 Issuing a certificate

The competent organisation may approve the company and issue a certificate (see Annex B) stating that the cleaning company's operation system, procedures and management are satisfactory and that the results of services performed in accordance with that system can be accepted and utilised by shipping companies and ports.

If the competent organisation and the independent testing organisation are not the same, then the competent organisation should assess the results provided by the independent testing organisation prior to issuing the certificate.

A certificate can be issued for one or a combination of the following services, based on the result of one or more of the performance criteria mentioned in the test protocol for cleaning systems with capture and should be stated in the certificate:

1. Hull, and niche areas present on the vertical side or the bottom of the ship that can be readily cleaned
2. Propellers
3. Niche areas that due to bends, turns etc. need special cleaning equipment and procedures.

The certificate should clearly state the type of service, type of cleaning system and manufacturer, and what criteria have been passed. If the type of equipment and/or names of manufacturers of equipment result in any limitations or restrictions, these should also be listed.

The competent organisation should maintain a record of cleaning companies for which it has issued certificates for the period of validity of the certificate.

Renewal of certificate

Renewal or re-endorsement of the test and certification should normally be carried out at intervals not exceeding five (5) years.

A renewal test, based on the cleaning of a single ship, should be conducted to verify the operational performance of the cleaning system. The test shall be carried out in accordance with Annex A.

Alterations to system or cleaning procedure

When any alteration is made to the system or operating procedure that affects the test criteria of the certified cleaning system, the cleaning company shall immediately notify the competent organisation. Depending on the extent of the alteration and its effect on the system, a renewal of the certificate or a new certificate may be required if deemed necessary by the competent organisation.

Suspension of certificate

The competent organisation reserves the right to suspend or cancel the approval should the cleaning company breach any of the conditions of the certificate. The decision should be made public, and the cleaning company should be deleted from any list of approved cleaning companies.

A cleaning company whose certificate has been suspended may apply for re-testing and certification after it has corrected the breach. This re-approval will be requiring the cleaning company to undergo and pass a renewal test.

In case the certificate is suspended or cancelled, the port and other local authorities should be notified by the competent organization and/or the cleaning company.

ANNEX A Test protocol for in-water cleaning systems with capture

1 Introduction

This annex provides the framework for verification testing of in-water cleaning with capture systems. As part of the independent test and certification process, a cleaning company should be subject to testing of the cleaning system's declared operational capabilities and performance. This testing will take place on actual ship surfaces (hull, propeller and/or niche areas) depending on the cleaning system's declared operational capabilities and performance and will be based on a series of water quality samples which will be collected and analysed to quantify impacts of in-water cleaning on local water quality.

2 Performance criteria

The passing of tests of in-water cleaning systems with capture will be based on the assessment of the following criteria:

Criterion A. The separation and/or treatment of captured waste substances during in-water cleaning must:

1. Remove at least 90% (by mass) of material from seawater influent

   and

2. Achieve that at least 95% of particulate material in effluent water is < 10 µm in equivalent spherical diameter (ESD).

Criterion B. Local water quality parameters of total suspended solids (TSS), in the vicinity of the cleaning unit and at the effluent discharge point from the separation and/or treatment systems, are not elevated above ambient levels during the same time period.

Criterion C. When applicable, dissolved and particulate biocides found in AFC (eg, copper and zinc), in the vicinity of the cleaning unit and at the effluent discharge point from the separation and/or treatment systems, are not elevated significantly above ambient levels during the same time period.

To be approved, the test results will have to equal to or better than performance criteria A and B. The test results of Criterion C are optional. Whether to carry out these tests will largely depend on local requirements made by relevant local authorities.

- While not formal performance criteria: an in-water cleaning system with capture should be capable of removing macrofouling and microfouling. Observations of any remaining fouling after testing of the in-water cleaning system should be documented.
- Observations of any damage to ship coatings, surfaces and structures during the testing of the in-water cleaning system should also be documented (eg, scratches, brush marks, paint flakes, pits, bare metal/polish through, and blemishes).

3 Independent verification testing

Given the complexities of cleaning systems with capture and their application, the following test protocol is focused on a predictive and feasible series of field trials. It is not feasible or practicable to test all possible conditions, parameters and variables that can impact in-water cleaning performances, but specific test plans should be designed to be as predictive as possible to verify the cleaning system's declared operational capabilities and performance to the fullest extent possible.

Testing should involve development of test plans for each in-water cleaning system tested, in consultation with the cleaning company. The cleaning company should secure permission from local authorities to undertake testing if applicable.

All testing of in-water cleaning systems should be planned by the competent organisation and samples should be taken by either the competent organisation or an independent testing organisation if the two are not the same. The independent testing organisation should:

1. Be independent from the cleaning company and technology manufacturer or vendor
2. Have implemented appropriate quality assurance and quality control (eg International Organization for Standardization/International Electrotechnical Commission [ISO/IEC] 17025 standard)

The independent testing organisation should as a minimum:

1. Provide instructions for sample collection, processing and transportation of samples
2. Carry out the verification of testing of the samples and convey the results of the test(s) as determined under each of the relevant Criteria A-C.

Any modifications to the cleaning unit which may be required to facilitate the testing, eg mounting of cameras or affixing testing equipment should be agreed with the cleaning company. Any such modifications should be made by the cleaning company or the equipment manufacturer.

4 Experimental design

A single test cleaning event, on an individual test ship, is considered the unit of replication. A minimum of three consecutive test cleaning events involving a different ship on each occasion is required for certification. The goal is to capture variability in operations, applications and environmental conditions that will allow for verification of in-water cleaning company claims with respect to the cleaning system's declared operational capabilities and performance. Thus, if the in-water cleaning company claims to meet the criteria for safe and effective biofouling removal on both hull, propeller or niche areas, performance will be quantified on hull, propeller or niche areas on each of the three test ships. Similarly, if the in-water cleaning company claims to meet criteria on both non-biocidal and biocidal AFCs, at least two of the three ships must have appropriate biocidal coating for testing.

Conditions or applications (eg, niche areas, biocidal AFCs, biofouling level, etc) outside of specifications and claims for the cleaning system's declared operational capabilities and performancedo not need to be included in the tests but those restrictions or limitations will be clearly noted in the certificate.

5 Documentation of test conditions and operations

As part of the documentation, a list of the people who take part in the test and operation should be made (for example handlers, workers, controllers, and/or divers). Details of who does what should be documented.

The following information should be documented and reported for each test ship:

- Ship type (design, complexities/niche areas and operational profile of the ship)
- Ship availability/access for cleaning and/or testing (eg, time at berth or anchorage)
- AFC type, age, and history
- Type of biofouling and coverage on relevant surfaces (hull, propeller and/or niche areas) eg from a recent inspection report
- History of cleaning operations of the ship since last drydocking.

The following environmental information should be measured, documented, and reported for each test trial:

- Water depth and under keel clearance
- Water visibility
- Currents, wind and waves
- Water quality parameters of interest (eg, salinity, temperature, TSS)
- Ambient levels of biocides (eg, background levels of copper).

The following cleaning system design and operational information (during the cleaning of each test ship), should be documented and reported (excluding propriety and commercially confident information):

- In-water cleaning system design and operations
- Whether diver or ROV driven
- Operator/diver skill and experience
- Mode of attachment to, and movement over ship, cleaning brushes, blades, or water jets and type, amount, configuration, etc
- Planned and actual rate of movement of cleaning unit over the test area
- Number and overlap of passes (accuracy of surface coverage)
- Capture methods (eg, cleaning unit shroud and suction)
- Flow rate of influent water including waste substances
- Waste substances and seawater influent and effluent transport and processing (eg, time for particle settlement, level of handling, treatment, separation, type media removal of metals)
- Various pre-set modes of operations and operational adjustments during cleaning
- Contingency plans and response to system failures
- The claimed maximum curvature, and the maximum curvature where cleaning was carried out successfully during the test without loss of material into the water column
- The diameter of the hose from the cleaning unit to the treatment and/or separation unit and the declared flow rate.

6 Criterion B – Effectiveness of the separation and/or treatment unit of removing captured materials

The separation and/or treatment units remove(s) captured materials during in-water cleaning as follows:

1. At least 90% (by mass) of material from seawater influent and
2. At least 95% of particulate material in effluent water is < 10 µm in equivalent spherical diameter (ESD).

6.1 Sampling procedures

A series of water quality samples should be collected and analysed to quantify impacts of in-water cleaning on local water quality during each test of the hull, propeller and/or niche areas, in accordance with Tamburri et al (2020). Continuous, time-integrated water samples, during a predesignated in-water cleaning test period of at least one hour, should be collected at two locations: at the inlet (influent) of the separation and/or treatment unit, and at the outlet (effluent) of the separation and/or treatment unit (Figure 2).

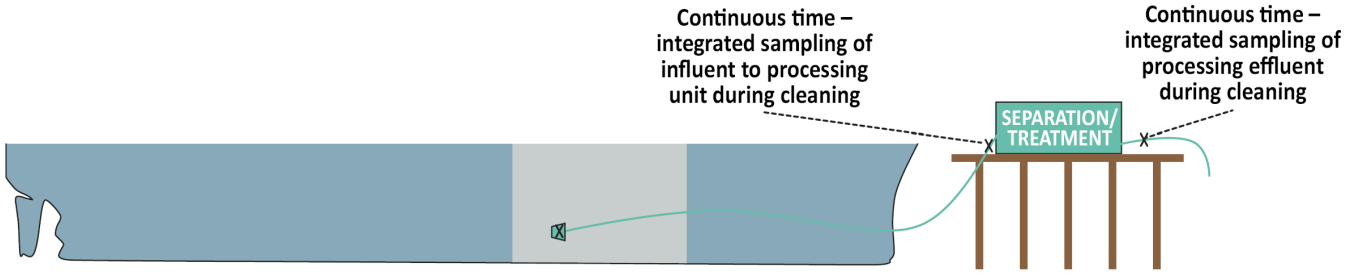

Figure 2: Schematic arrangement of sampling.

Details for each station includes the following:

- **Separation and/or treatment unit inlet sample** – During the test cleaning event, a continuous, time-integrated sample of the influent to the treatment unit, should be collected to quantify captured material and separation and/or treatment unit efficacy. The cleaning company should provide an appropriate inlet sample port. Flow rate should be set to draw at least 10-20 litres of sample water (exact volume and flow rate should be measured) continuously during the entire test cleaning period. The large container sample should be uniformly mixed prior to distributing sub-samples for at minimum, triplicate analyses of each parameter. Note that in some cases, where large amounts of hard macrofouling is captured, a two-stage sampling approach may be needed for effective inlet sampling, which can involve a sieve to both collect and quantify (by wet and dry weight) material larger than 1mm in size and for material passing through the 1mm sieve to be analysed for TSS.
- **Separation and/or treatment unit outlet sample** – During the test cleaning event, a continuous, time-integrated sample of the effluent from the treatment unit, should be collected to quantify separation and/or treatment unit efficacy and environmental safety of treatment discharges. The cleaning company should provide an appropriate outlet sample port. Flow rate should be set to draw at least 10-20 litres of sample water (exact volume and rate should be measured) continuously during the entire test cleaning period. The large container sample should be uniformly mixed prior to distributing sub-samples for, triplicate analyses of each parameter as a minimum and as per any test method requirements (ie ASTM or ISO method necessary for each parameter).

Sampling should only be conducted when the cleaning unit is transferring biofouling material to the separation and/or treatment unit. When cleaning unit is idle during a test cleaning event, but the capturing system remains active, the sampling activities should be paused.

Sample	Location	When sampled	Type of sample	Sample depth	Analyses	Relevant performance criteria
Separation and/or treatment unit inlet	Just prior to separation and/or treatment unit	1x, during cleaning	Time-integrated	NA	TSS, particle size distribution (PSD) and biocide	B
Separation and/or treatment unit outlet	Just after the separation and/or treatment unit	1x, during cleaning	Time-integrated	NA	TSS, PSD and biocide	B and C

Table 2: Water quality collection sampling summary.

6.2 Analytical Procedures

After the initial sample collection, exact container volumes should be measured. Then the container samples should be uniformly mixed prior to collecting sub-samples for triplicate analyses of TSS and PSD. All sub-samples should be placed in cleaned bottles of the appropriate analysis type and size and all sample bottles should be labelled with unique identification numbers prior to sampling. Sub-samples should be stored at the appropriate temperature for the analysis and delivered to the accredited/approved analytical laboratories within the appropriate timeframe for each analysis.

The following standard and/or approved methods may be relevant when determining TSS and PSDin water samples collected during assessment of the cleaning system. The list is not exhaustive andother methodologies may be available. The independent testing organisation should document the method used.

- *US EPA Residue, Non-Filterable (Gravimetric, Dried at 103-105°C) (EPA 160.2)*: Published 1971
- *ISO Particle size analysis – Image analysis methods (13322-1)*: Published May 2014.
- *US EPA Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry (EPA 200.8)*: Published 1994.
- *US EPA Inductively Coupled Plasma – Mass Spectrometry (EPA 6020A)*: Published January 1998.

6.3 Determining if Criteria A has been met

The separation and/or treatment of captured waste substances during in-water cleaning should (1) remove at least 90% (by mass) of material and (2) achieve that at least 95% of particulate material in effluent water is < 10 µm in equivalent spherical diameter (ESD).

For criterion A, the percent reduction in mass of material in water entering the separation and/or treatment unit(s) (influent) versus the water discharged from the separation and/or treatment unit(s) (effluent) for each test cleaning event should be calculated and reported. The mass of material should be determined, per unit volume, using accepted methods for TSS. The two sub-criteria must be met for each individual test cleaning.

7 Criteria B and C – Impact on local water

Particulate and dissolved biocides and compounds relating to the AFS shall be tested and reported. The test is to confirm that local water quality parameters of TSS, and when applicable dissolved biocides found in AFC (eg, copper and zinc), in the vicinity of the cleaning unit and at the effluent discharge point from the separation and/or treatment systems, are not elevated significantly above ambient levels during the same time period.

7.1 Sampling procedures

A series of water quality samples should be collected and analysed to quantify impacts of in-water cleaning on water quality during each test of the hull, propeller and/or niche areas.

Continuous, time-integrated water samples, during a predesignated in-water cleaning test period of at least one hour, should be collected at three locations: on the cleaning unit (to quantify debris capture efficacy), greater than 50 m away from the cleaning activity (as simultaneous quantification of background conditions), and at the outlet (effluent) of the separation and/or treatment unit (Figure 3). It is also recommended that background/ambient water quality conditions also be measured by using discrete time point samples before and after the test cleaning event at the discretion of the competent organisation/testing organisation.

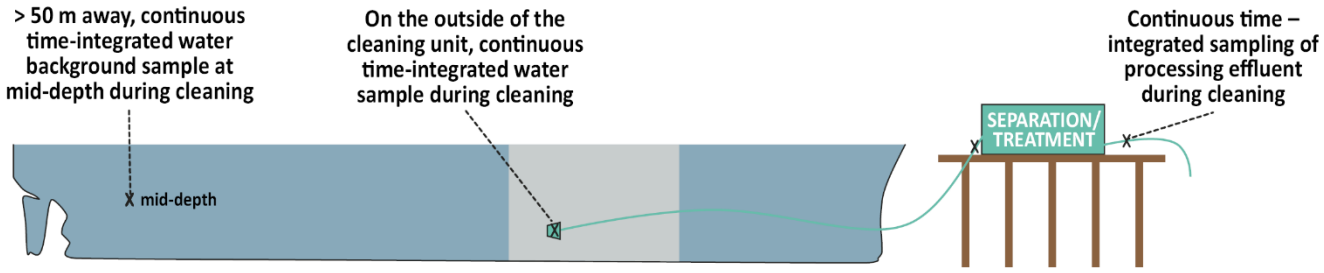

Figure 3: Schematic arrangement of sampling.

Details for each station includes the following:

- **Cleaning unit sample** – A sampling hose or submersible pump should be attached to the cleaning unit to collect a continuous, time-integrated samples for at least 1 hour during each test cleaning event. The intake location (and method of mounting the hose or pump) should be agreed with competent organisation/testing organisation and should be based on location of highest possible signal (eg, computational fluid dynamics assessment of the location of the highest potential concentrations of material removed from the test ship during in-water cleaning). Water should be drawn to sample container(s) using a pump or pushed from a pump attached to the cleaning unit to the sample container(s). The sample collection station can be located on the shoreside or on a small boat/barge positioned at the cleaning unit's point of entry into the water. Flow rate should be set (and recorded) to draw at least 10-20 litres of sample water (exact volume should be measured) continuously. The large container sample should then be uniformly mixed prior to distributing sub-samples for, at minimum, triplicate analyses of each parameter.
- **Background sample during cleaning** – In order to assess ambient levels of measuring parameters during the test cleaning event, a continuous, time-integrated sample should be collected at
- least 50 metres away from the test area (not impacted by cleaning or discharges from the ship). A pump and hose system should be deployed adjacent or adhered to the test ship with intake positioned at mid-depth between water line and bilge keel. Flow rate should be set to draw at least 10-20 of sample water (exact volume and flow rate should be measured) continuously during the

entire test cleaning period. The large container sample should be uniformly mixed prior to distributing sub-samples for at minimum, triplicate analyses of each parameter.

- **Separation and/or treatment unit outlet sample** – During the test cleaning event, a continuous, time-integrated sample of the effluent from the treatment unit, should be collected to quantify treatment unit efficacy and environmental safety of treatment discharges. The cleaning company should provide an appropriate outlet sample port. Flow rate should be set to draw at least 10-20 litres of sample water (exact volume and rate should be measured) continuously during the entire test cleaning period. The large container sample should be uniformly mixed prior to distributing sub-samples for a minimum, triplicate analyses of each parameter.

  Note, that the same outlet/effluent sample, analyses and results above in criteria B can be used for criteria C.

- **Pre and post cleaning background samples (optional)** – Variability in ambient water quality should be characterised by discrete sampling at a predetermined test ship berth or anchorage location before and after the test cleaning event. At least one sample should be collected before the test cleaning event and at least one sample collected after. Sample should be collected using a discrete water sampling device (eg, Van Dorn- or Niskin-style water sampler) lowered to the same depth as the background sample above (approximately mid-depth between water line and bilge keel of the test ship). Each sample should be uniformly mixed prior to distributing sub-samples for at minimum, triplicate analyses of each parameter.

Sample	Location	When sampled	Type of sample	Sample depth	Analyses	Relevant performance criteria
Cleaning unit	Attached to cleaning unit	1x, during cleaning	Time-integrated	Varies over cleaning period	TSS, PSD and biocide	B and C
Separation and/or treatment unit outlet	Just after the separation and/or treatment unit	1x, during cleaning	Time-integrated	N/A	TSS, PSD and biocide	B and C
Background during cleaning	Adjacent to the ship, at least 50 metres from cleaning activity	1x, during cleaning	Time-integrated	Mid-draft	TSS, PSD and biocide	B and C
Optional pre-clean background within 24 hours	Berth or anchorage	1x, during cleaning	Discrete	Mid-draft	TSS, PSD and biocide	B and C
Optional post-clean background within 24 hours	Berth or anchorage	1x, day prior to test	Discrete	Mid-draft	TSS, PSD and biocide	B and C

Table 3: Water quality collection sampling summary.

7.2 Analytical procedures

The analytical procedures for TSS and PSD are described in section 6.2. The following are examples of standard and/or approved methods for quantifying AFS biocides. The list is not exhaustive and other methodologies may be available. The independent testing organisation should document methods used.

- ASTM Rotating Cylinder (method D6442-06)
- ISO Method for Copper-ION (15181-2): published 01 June 2007.
- ASTM Method for organotin (method D5108-07): re-approved 2007
- ASTM Methods for organic biocides (zinc and copper pyrithione, DCOIT and CDMTD) (method D6903-07): published 2007.
- ISO Method for Zineb (15181-3): published 01 June 2007.
- ISO Method for pyridine-triphenylborane (PTPB) (15181-4): published August 2008. I
- ISO Method for tolylfluanid and dichlofuanid (15181-5): published May 2008. vi.
- ISO Method for tralopyril (15181-6): expected publication, 2011.

7.3 Determining if Criteria B and C have been met

Criterion B

TSS is used as a measure of both biofouling and the impact that particulate material from the AFS has on water quality, and determination of this criteria should assess:

1. Cleaning unit samples, against the same parameter(s) from background samples during the same cleaning time period, and
2. Outlet samples from separation and/ or treatment unit against the same parameter(s) from background samples.

Test results should not be elevated significantly above ambient levels. To determine this statistical analysis (eg confidence interval of 95% or $\alpha = 0.05$ in a t-test) should be used.

Criterion C

Dissolved biocides and compounds (eg copper and zinc) are used as a measure of AFS' impact on water quality and determination of this criteria should assess: eg

1. Cleaning unit samples, against the same parameter(s) from background samples during the same cleaning time period, and
2. Outlet samples from separation and/or treatment unit against the same parameter(s) from background samples.

Results of the test(s) should not be elevated significantly above ambient levels. To determine this statistical analysis (eg confidence interval of 95% or $\alpha = 0.05$ in a t-test) should be used.

If the system cannot comply with the requirements of C, it is recommended that a risk-based approach is used to establish the potential impact on water quality in consultation with the local authorities. The result of testing for dissolved biocides and compounds found in the AFS (eg copper and zinc) shall be stated on the certificate to allow for the system to be evaluated in accordance with local requirements.

8 Assessment of paint damage

Pictures and/or video after the cleaning with capture has taken place should be examined for microfouling and macrofouling. While not a performance criterion, according to the IMO Guidelines (2023), an in-water cleaning system should be capable of removing macrofouling with the aim of achieving an IMO fouling rating 1 or 0 for the cleaned area (no fouling or microfouling). Evidence for this should be included in the final report.

It should be noted that some types of biofouling will adhere to the surface and will leave residual biofouling, often non-viable, skeletal remnants, even after cleaning, which cannot be removed without damaging the AFS. Examples include the baseplates of barnacles and bases of worm tubes. Otherwise, the surface should be free of macrofouling on the cleaned area. Any remaining microfouling such as a slime layer should leave metal and the painted surface visible beneath the fouling.

Pictures and/or videos of AFC should be examined for obvious signs of in water cleaning damage. While not a performance criterion, a description of any and all observed damage should be included in the final report. Such damage can include symmetrical swirl patterns caused by the cleaning mechanism and/or linear traction damage caused by drive wheels.

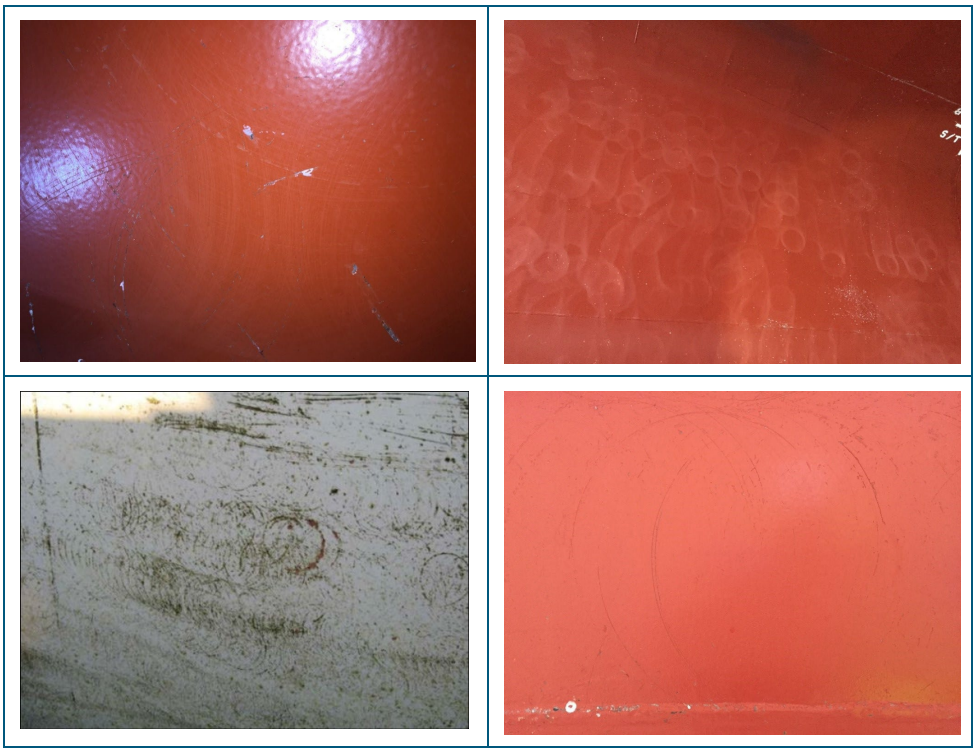

Figure 4: Examples of paint damages.

8.1 Determining if the paint has been damaged

Damage to the paint that has been caused evidently by the cleaning unit should be documented in the testing report.

In case such damage has been found, a dialogue should be commenced between the competent organisation and cleaning company. Based on the dialogue, a correction plan provided by the cleaning company that describes how such damages can be avoided to be drawn up.

The correction plan should be accepted by the competent organisation before further testing can take place.

In case damage is observed on consecutive tests, the competent organisation may add restrictions or limitations to the certificate. Example: Cleaning can be carried out on AFS other than silicone based coatings.

8.2 Determining remaining fouling

If a quantitative assessment of biofouling after testing reveals any remaining macrofouling, a dialogue should be initiated to find out if the equipment was operating outside any claimed limitations or restrictions. In case this is not the case, more runs should be carried out to determine if this will remove the macrofouling to a fouling level of 1 or 0 as per the IMO guidelines (2023).

In case macrofouling is observed on consecutive tests, the competent organisation may add restrictions or limitations to the certificate. Example: Cleaning cannot be carried out on ships with heavy macrofouling.

9 Data management and quality

The independent testing organisation should follow standard/accepted data management and analysis procedures. For example, data logs should be recorded throughout testing, copied or duplicated, and archived. The datasheets should be signed by the analyst upon completion, verified, and stored until the data are logged into a digital file, and the data themselves are verified. Additionally, data from other analyses should be recorded in standard formats, such as data collection forms, bound and paginated laboratory and field notebooks, spreadsheets, and electronic data files.

Means should be provided by the testing organisation to seal the sampling containers and instructions should be given with regards to:

- The cleanliness of the sample containers prior to use
- The collection of samples to ensure the integrity of each sample
- The temperature and other conditions by which the samples should be stored and transported.

Immediately following collection of the retained sample, the sample container should be sealed with a tamper proof security seal and a unique means of identification installed on the sampling container. In case the seal of the sample container is broken before reaching the Testing Organisation, the sample should be considered unfit for use.

A label should be affixed to the sample bottles with following information:

1. Sample ID number
2. Name of the ship
3. Port of collection
4. Date and time of collection
5. Identification of the persons that collected the sample.

10 Reporting

The test report should include the test plan, all logged instrument data collected, and all raw data (both direct verification test and ancillary environmental data). Regardless of which of the three criteria that is being tested, all results should be included in the final reports.

The following should be reported:

1. A description and specification of the cleaning system tested (Chapter 3)
2. Details of the ship
    - Ship type (design, complexities/niche areas and operational profile of the ship)
    - Ship availability/access for cleaning and/or testing (eg, time at berth or anchorage)
    - AFC type, age, and history
    - History of cleaning operations of the ship since last drydocking.
3. A list of people who took part in the test (Annex 1, section 5)
4. Details of how the test was undertaken for each of the criteria A-C, including:
    - Claimed limitations of operations
    - A description of the procedures followed during set-up, testing of the system and close down.
5. Before cleaning: description and coverage of biofouling present
6. Environmental information (Annex A, section 5)
7. Cleaning system design and operational information (Annex A, section 5)
8. Experimental design and conditions under which the results of samples were taken, including where and when the samples were taken and the total duration of treatment (Annex A, sections 4-7)
    - Number of test areas and size of each area
    - Locations of the test areas
    - A description of residual biofouling observed in images of each replicate treated area selected for analysis
    - Whether a ship underwent a full or partial clean and rate of cleaning as expressed in m^2/unit time.
9. Any damage to the condition of the anti-fouling coating in each test area (Annex A, section 8)
10. Description of any variations or deviations in application of the test relative to the SOP and test requirements
11. A discussion of the system efficacy, including whether the criteria were met
    - Based on report from the independent testing organisation
    - Documentation in form of pictures and video.
12. Recommendations for system or SOP improvement
13. Résumé of test result including detailed information of the measured concentrations etc for all criteria (A-C) and whether the system passed the test
14. Conclusion stating criteria that were passed/failed and restrictions or limitations that will need to be added to the certificate.

ANNEX B Sample format of a certificate

CERTIFICATE OF IN-WATER CLEANING COMPANIES Cert Number: *XXXXXX*

This is to certify that the operations and management systems of [*name of company*] is in accordance with the *Procedure for testing and certification of in-water cleaning companies* and has been approved to perform [*in-water cleaning of the hull and niche areas that do not need special cleaning equipment*] [*in-water cleaning of the niche areas that require special cleaning equipment*] [*in-water cleaning of propellers*]

The following performance criteria have been tested:
Criterion A: The cleaning system is able to perform the separation and/or treatment of captured waste substances.

During in-water cleaning the system:
removes *XX*% of material from seawater influent (by mass) and
XX% of particulate material in seawater effluent is < 10 µm in equivalent spherical diameter (ESD).

Criterion B: The level of applicable TSS and particulate biocides of anti-fouling system (eg copper and zinc) found in the local water are/are not statistically elevated above ambient levels during cleaning -

Criterion C (if applicable): Dissolved biocides and compounds (eg copper and zinc) in the effluent are/are not statistically elevated above ambient levels.

Restrictions or limitations: (height of hard calcareous biofouling, non-compatibility with certain AFS etc). Insert restrictions or limitations, if any, else write “none.”

Details of the cleaning system:

Type of cleaning system:

Name of the manufacturer:

Model:

This certificate is valid until *enter date* Issued at *enter text* on *enter date*

Details of competent organisation: *enter text*

Digitally signed

Approval conditions:

The operation of cleaning system should take place within the criteria mentioned in the Procedure for testing and certification of in-water cleaning companies.

If changes are made to the operations and management system of the cleaning company, such changes shall be reported to the competent organisation.

The full-scale results of test are attached to this certificate as an Appendix.

NOTES ON THE BACK OF THE CERTIFICATE

Performance criteria:

Criterion A – effectiveness of the separation and/or treatment unit of removing captured waste substances.

The separation and/or treatment units remove(s) captured waste substances during in-water cleaning as follows:

1. At least 90% (by mass) of material from seawater influent and
2. At least 95% of particulate material in effluent water is < 10 µm in equivalent spherical diameter (ESD).

Criteria B and C – Impact on local water quality

Particulate and dissolved biocides and compounds relating to the AFS shall be tested and reported to measure if local water quality parameters of TSS, and when applicable dissolved biocides found in AFC (eg, copper and zinc), in the vicinity of the cleaning unit and at the effluent discharge point from the separation and/or treatment systems, are not elevated significantly above ambient levels during the same time period.