

Inspecting and Reporting Biofouling and Antifouling Systems' Condition during Underwater Inspections on Ships

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Foreword

Biofouling accumulation on a ship's hull has a direct impact on fuel consumption and associated greenhouse gas (GHG) emissions and may pose a biosecurity risk due to the presence of non-indigenous, potentially invasive aquatic species.

The antifouling system (AFS) is designed to protect the underwater surfaces from biofouling accumulation. Underwater inspections (UWI) of ships are typically carried out to monitor and verify the condition of the underwater hull and the AFS.

Recipients of UWI reports are reliant on the quality of information provided to make adequate decisions relating to hull performance, AFS condition and performance, biofouling management and associated risk assessments. Consistent and good quality reporting is key to effective underwater hull condition record-keeping and management.

Scope

This AMPP standard practice aims to provide a source of consistent information and guidance on best practices for meaningful and effective reporting of the biofouling and AFS condition during an underwater inspection.

The document provides a methodology for planning, conducting, and reporting the outcome of underwater inspections in terms of biofouling and AFS condition on ships.

Specific aspects related to in-water cleaning operations, damage surveys, repair surveys, security inspections surveys, or classification surveys, are not covered in this document, however, the requirements for biofouling and AFS inspection and reporting shall be applied to any of these types of UWI.

This standard practice is applicable to underwater inspections undertaken in any type of water, including seawater, brackish water, lake, or river non-saline/fresh water; however, as the majority of the world fleet constitutes sea-going vessels, terms such as sea water, sea chest, sea inlet, sea state, etc., are used throughout this document for simplicity.

This standard practice is applicable to underwater inspections undertaken by diver team or Remotely Operated Vehicles (ROVs), however, for the purpose of this standard, terms such as "Diving" or "Diver" are used throughout this document and are applicable to both diving and ROV UWI.

Rationale

Due to the broad variety in stakeholders' requirements and the methodologies adopted by service suppliers involved in the process, the level of detail and overall quality of reporting regarding biofouling and AFS condition differ greatly.

This standard practice promotes the use of consistent reports ensuring that the quantity and quality of data gathered is comparable thus facilitating reliable analysis related to underwater hull monitoring.

It will provide users with a robust framework for planning and conducting UWI to allow meaningful and consistent reporting of biofouling and AFS condition. Standardizing the output of UWI across the industry will enable the use of comparable data to aid the monitoring and assessment of underwater hull condition.

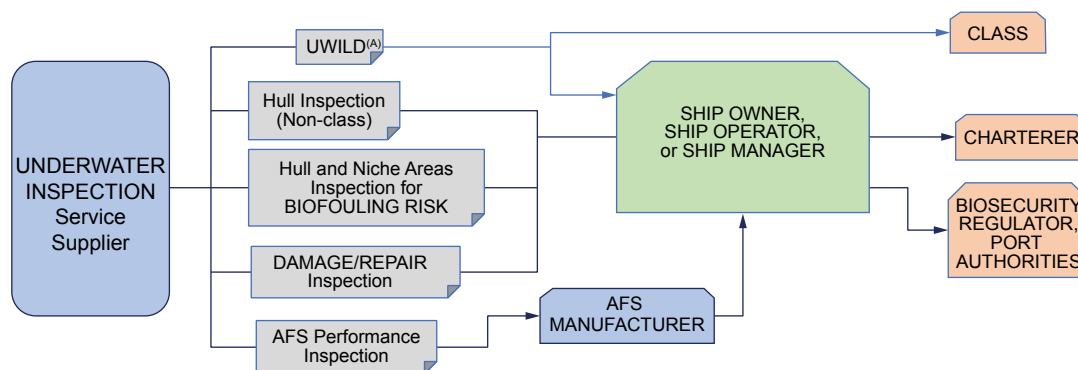
The framework includes references to safety and environmental considerations, highlights critical components of different stages of the process, and provides examples of the level of detail, as well as the type and quality of evidence required during the reporting stage.

The intended primary users of this standard practice are the stakeholders directly involved in requesting and authorizing UWI, such as ship owners, ship operators and charterers, and the service suppliers who conduct UWI.

In AMPP standards, the terms *shall* and *must* are used to state requirements and are considered mandatory. The term *should* is used to state something that is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.

Section 1: General

- 1.1 UWI of ships are carried out worldwide on a daily basis for various reasons. Typically, UWI are requested by parties involved in the owning, operation, and management of ships. UWI serve as means to monitor and assess the condition of underwater surfaces and to demonstrate compliance with statutory requirements.
- 1.2 The output of a UWI can be used by a number of stakeholders to serve different purposes including, but not limited to, determining if and when a biofouling management action, such as in-water cleaning, is required; to monitor AFS condition and performance; to determine the extent of a known or new hull damage or as part of documenting the condition of the underwater surfaces in a pre-purchase survey.
- 1.3 AFS manufacturers also rely on UWI reports to monitor the in-service performance of products including test patches of new products. In the case of warranty claims a UWI is arranged to inspect the AFS condition and collect paint flakes or other samples, if applicable.
- 1.4 An UWI may be requested by relevant local authorities in order to examine the underwater surfaces in relation to biofouling accumulation and the risk of spreading non-indigenous, potentially invasive aquatic species.
- 1.5 UWI intended to satisfy statutory and classification societies' requirements are conducted at planned intervals, whereas other types of UWI may be conducted on an ad hoc basis or as part of ship or fleet specific planned in-water inspection programs.
- 1.6 Different stakeholders involved in underwater inspections or recipients of UWI reports, such as service suppliers, ship owners, ship operator, ship managers, charterers, AFS manufacturers, classification societies, underwriters, research organizations, relevant authorities and other third parties appointed to analyze contents of UWI reports focus on different information as their objectives may also vary. Such third parties may include, for example shipbuilders, hull performance monitoring companies, independent coating consultancies and other agents that may represent stakeholders.
- 1.7 Figure 1 depicts common stakeholders and recipients of UWI reports and some of the specific and differing objectives involved.



^(A)Underwater Inspection in Lieu of Drydock

Figure 1: Stakeholder Map and Common Types of Underwater Inspection

Section 2: Definitions

For the purpose of this standard the following terms and definitions in Table 1 apply:

Anti-Fouling Coating System¹: The combination of all component coatings, surface treatments (including primer, sealer, binder, anti-corrosive, and antifouling coatings) or other surface treatments, used on a ship to control or prevent attachment of unwanted aquatic organisms.

Anti-Fouling System (AFS)¹: A coating, paint, surface treatment, surface, or device that is used on a ship to control or prevent attachment of unwanted organisms

AFS Test Patch Area: An area on the underwater hull where an AFS (e.g. a paint, a lining system, or a technology) has been applied or fitted in order to protect against biofouling. This is typically assessed against the main AFS applied on the hull.

AFS Manufacturers: Companies producing coatings, paints, surface treatment technologies or devices to control or prevent attachment of unwanted organisms to ships underwater surfaces.

Biofouling¹: Accumulation of aquatic organisms such as micro-organisms, plants, and animals on surfaces and structures immersed in or exposed to the aquatic environment. Biofouling can include microfouling and macrofouling.

Calcareous Deposit: The accumulation of unwanted non-living substances (inorganic and/or organic) on solid surfaces.

Client: A person or company who engage a service supplier for the undertaking an underwater inspection.

Diver: A person who is trained and certified to perform work underwater using commercial diving breathing equipment.

Hard Biofouling: Usually referred to as hard calcareous fouling, considered to be macrofouling as the hard calcareous form is visible to the human eye. Typical organisms classed as hard fouling are barnacles, mussels, tube worms and bryozoan.

Impressed Current Cathodic Protection (ICCP): A corrosion protection system consisting of an arrangement of hull mounted anodes and reference electrodes wired to a thyristor control panel, designed to protect the wetted surface of the hull against corrosion.

In-water Cleaning¹: The physical removal of biofouling from a ship while in the water.

Invasive Aquatic Species (IAS): Species that may pose threats to human, animal and plant life, economic and cultural activities, and the aquatic environment. This also includes those organisms (micro and macro), which if introduced into an area including ports, port areas, rivers, estuaries, or into freshwater courses, may create hazards to the environment, human health, property and/or resources, impair biological diversity or interfere with other legitimate uses of such areas.

Marine Growth Prevention System (MGPS)¹: An AFS used for the prevention of biofouling accumulation in internal seawater cooling systems and sea chests and can include the use of anodes, injection systems, electrolysis, or other methods.

Microfouling¹: Microscopic organisms including bacteria and diatoms and the slimy substances that they produce. Biofouling comprised of only microfouling is commonly referred to as a slime layer.

Macrofouling: Large, distinct multicellular organisms that are visible to the human eye, including filamentous algae and fronding seaweeds, hydroids, and anemones (types of soft coral), sea mosses (bryozoans), tube worms, barnacles, mussels, oysters, sea squirts and sponges.

Niche Areas¹: Areas on a ship that may be more susceptible to biofouling due to different hydrodynamic forces, susceptibility to coating system wear or damage, or being inadequately, or not, painted, e.g., sea chests, bow thrusters,

propeller shafts, inlet gratings, dry-dock support strips, etc.

Reference Area: A designated area on the ship's underwater surface for the purpose of monitoring the AFS performance or the effectiveness of a previous in-water cleaning operation. Each area may be a square or rectangle approximately 1 m², marked with contrasting paint or unmarked. The number and location of reference areas is determined by the owner or other entity responsible for the ship and it would ideally not change between underwater inspections within the lifecycle of the AFS.

Remotely Operated Vehicle (ROV): A subsea vehicle, capable of inspecting the underwater surfaces or specific parts of a ship. It may be a part of a cleaning unit.

Service Supplier: A person or company that provides services for a ship or a mobile offshore unit that comprises underwater inspections conducted by divers and/or ROVs involving visual inspection (photographs, video), measurements, tests or maintenance of safety systems and equipment.

Service Supplier Supervisor²: A person who, through training, experience, demonstrated competency, and certification, is appointed as the person responsible for managing the operation, ensuring that all control measures identified through the risk assessment process are implemented and ensuring the overall safety of the operation.

Ship¹: A vessel of any type whatsoever that operates in the aquatic environment including air-cushion vehicles, inland waterways vessel, barges and other floating non-propelled or self-propelled craft, hydrofoils, pontoons, submersibles, fixed or floating platforms, floating liquefied natural gas units (FLNGs), floating production storage and off-loading units (FPSOs) and floating storage units (FSUs).

Soft Macrofouling: It consists of large, distinct multicellular organisms, plants, and animals, without calcareous shells or tubes, visible to the human eye such as soft corals, sponges, hydroids, anemones, algae, and tunicates.

Stakeholder: A person, company, group or organization with an interest or concern in the content of the UWI report. Examples of stakeholders are shipowners, ship operators, ship managers, charterers, class societies, service suppliers, port authorities, local regulator agency, AFS manufacturers and others.

Underwater Hull: Areas of a ship's hull and its associated systems that extends from the keel to the water line, including the bow, stern, flat bottom and vertical sides, the rudder, propeller, the niche areas, and hull appendages. These areas are always or periodically immersed in an aquatic environment and are subject to biofouling accumulation.

Underwater Inspection (UWI): A method of surveying the underwater surfaces and ship's systems while the ship it is still afloat.

Underwater Inspection In Lieu of Dry-Docking (UWILD): A method of surveying the underwater parts of a ship while it is still afloat that should provide the information normally obtained from a docking Survey. Typically, the measurements of the rudder bearing and stern bush clearances are given special considerations and are agreed upon with the classification society.

Section 3: General Safety and Environmental Considerations

- 3.1** All stakeholders involved with planning, approving, and carrying out an underwater inspection shall ensure the activity is conducted in a safe and environmentally friendly manner.
- 3.2** A UWI shall be carried out at an agreed geographical location in safe waters with suitable tidal streams, waves, and currents, and when the ship is at a suitable draft.
- 3.3** When planning a UWI, conditions such as sea state, wind, tide and currents, water temperature, water visibility, presence of traffic in the area, any scheduled simultaneous ship operations (e.g., bunkering, supplies, lifting of loads, or any work over the side shell) shall be taken into consideration.
- 3.4** The service supplier shall ensure that the personnel and equipment involved in UWI are suitably prepared and certified as per any statutory regulations regarding safe practices applicable to the survey. Such certificates are dependent on local regulations, thus are outside the scope of this standard.
- 3.5** A UWI is usually conducted under the permit to work system. When applicable a permit/permission shall be obtained from the Port and/or Terminal authorities prior to commencement.
- 3.6** For any type of UWI the service supplier shall have in place as a minimum the following: Diving operation manual (company procedures), a dive plan, risk assessments and job hazard analysis relevant to the inspection. Consideration should be given to provisions of checklists and protocols for ship's equipment and machinery in relation to Lockout-Tagout (LOTO) safety procedures. LOTO is a safety procedure that is used in the commercial diving and maritime industry to ensure that potentially hazardous machines (thrusters, intakes, rudders, propellers, ICCP systems) are properly shut off and not able to be started up again prior to the completion of maintenance or repair work.²
- 3.7** Further information on underwater operations, procedures and checklists can be found in relevant industry standards and guidelines⁽¹⁾ such as the "International Consensus Standards for Commercial Diving and Underwater Operations"² by ADCI⁽²⁾, the SS 511:20183 by the Singapore Standards Council⁽³⁾ and other organizations that publish standards.

Section 4: Underwater Inspection Methodology

- 4.1** Planning and Preparation
- 4.1.1** When arranging a UWI, the Client shall liaise with the appointed service supplier to ensure that all relevant requirements set by the local port authority or pertinent agency are met.
- 4.1.2** The Client shall specify the type and scope of the UWI, so the operation is planned accordingly, and the reporting completed as required.
- 4.1.3** The work Scope provided by the Client, should clearly state the underwater hull areas and systems that should be inspected, any additional tasks that this may entail (e.g., opening gratings and covers), the use of specialized equipment required (e.g., underwater gauges for paint film thickness measurement, borescope cameras for pipe inspection, etc.), any other relevant information that the service supplier should be aware of when planning the UWI.
- 4.1.4** The work scope must state the Client and should specify the procedure for disclosing the service report, final report, and all media (visual data) between parties.

⁽¹⁾ In 2020, the IMO Sub-Committee on Ship Systems and Equipment (SSE) endorsed the establishment of an intersessional Correspondence Group to progress the revision and update of the IMO Code of Safety for Diving Systems (Resolution A.831 [19]), and the Guidelines and Specifications for Hyperbaric Evacuation Systems (resolution A.692 [17]).

⁽²⁾ Association of Diving Contractors International (ADCI), 5206 Cypress Creek Parkway Ste. 202, Houston, TX 77069.

⁽³⁾ Singapore Standards Council, 1 Kim Seng Promenade, #18-01 Great World City East Tower, Singapore 237994.

- 4.1.5** A Work Scope template document, which comprises relevant ship information and a list of areas to be inspected, is provided in [Appendix A](#). The template provided in Appendix A, or a document, containing the information required for planning a UWI, should be prepared by the Client and provided to the Service Provider during the early communication stage.
 - 4.1.6** The Work Scope template provided in Appendix A can be used for other types of UWI (e.g., UWILD) and also contains a list of possible work associated with the inspection (e.g., in-water cleaning, propeller polishing, other repairs, etc.).
 - 4.1.7** Once the UWI is confirmed, the service supplier shall ensure that the appointed service supplier supervisor is aware of the agreed Work Scope and any other information relevant to the ship such as, but not limited to, class requirements, AFS manufacturer's instructions, requirements by local port authorities or pertinent agencies.
 - 4.1.8** The service supplier supervisor shall liaise with the agent appointed by the Client or other relevant parties for ship specific information such as anchorage location, actual ship's draft, other simultaneous planned operations, etc.
 - 4.1.9** In case of third party inspections, where the service supplier has been nominated to carry out the UWI on behalf of a party other than the ship owner and/or ship manager; the Work Scope should form part of the service agreement. The level of inspection findings to be disclosed and to whom should be agreed between the parties (Client/Ship/service supplier) during the planning stage, to ensure that such operations are carried out in a transparent manner.
 - 4.1.10** The service supplier shall prepare a Dive Plan based on the agreed Work Scope and the additional information relevant to the UWI. The Dive Plan shall be approved by the Client and/or the relevant Ship personnel prior to the work commencing.
 - 4.1.11** The content of the Dive Plan is not within the scope of this standard practice, however, some of the critical components that should be included are the Work Scope, any applicable permits by local authorities, relevant risk assessments and job hazard analysis, emergency procedures, etc.
- 4.2** Conducting the Underwater Inspection (Onsite)
- 4.2.1** Pre-dive meeting
 - 4.2.1.1** A Pre-Dive meeting shall be held onboard the ship prior to commencement of the underwater inspection. The ship's Master, Chief Engineer and the service supplier's supervisor shall be in attendance. Other relevant parties such as, but not limited to, vessel manager, classification society or AFS manufacturer representatives may also be present.
 - 4.2.1.2** During the Pre-Dive meeting, the Dive Plan is to be reviewed taking into consideration the specific purpose of the inspection. Any limitations associated with performing the work are to be highlighted and discussed.
 - 4.2.1.3** The service supplier's supervisor shall review the list of areas to be inspected and shall discuss the recommended route to be followed based on site and operation specific circumstances.
 - 4.2.1.4** Other aspects to be confirmed during the Pre-Dive meeting should include roles and responsibilities, communication channels, identification of ship's equipment and machinery to be isolated and LOTO arrangements, relevant environmental considerations as well as establishing what assistance may be required from the ship in order to optimize the operation.

4.2.1.5 There may be cases where certain aspects of the Work Scope may be confirmed on site, for example the extent of a potential in-water cleaning operation may be confirmed only as a result of an initial hull inspection. (e.g., if the cleaning of a Flat Bottom area is required or not. Any such potential changes to the Work Scope shall be discussed by the parties during the Pre-dive meeting and a method of confirming the final Work Scope shall be agreed.

4.2.1.6 For in-water cleaning operations, typically, an initial UWI will take place. A pre-assessment of hull condition shall be communicated to the Client and the Master in order to confirm the Work Scope with regards the in-water cleaning operation (e.g., extent of areas to be cleaned, methods of cleaning- brushes or water jetting pressure, etc.).

NOTE: Associated in-water cleaning work may be carried out on the same occasion or during a subsequent event. Guidelines and examples on condition assessment reporting before in-water cleaning and additional information relevant to the in-water cleaning operation can be found in industry practices, guidelines, and standards, such as the upcoming “industry standard on in-water cleaning with capture,”⁴ by BIMCO,⁽⁴⁾ et al.

4.2.2 Inspection Equipment

The equipment required for carrying out the work and any additional tasks in terms of inspecting and reporting should be agreed between the stakeholders on site.

NOTE: Where specialized equipment may be required, the availability and readiness of the equipment should be confirmed. To ensure the reliability of measurements or data collected as part of the UWI, calibration tests or certificates may be required.

4.2.3 List of documents

The following non-exhaustive list of documents may be made available to the service supplier either prior to or during the Pre-Dive meeting if applicable and/or available:

- a) Arrangement for In Water survey by builder
- b) Shell expansion drawing
- c) Arrangement plan of the impressed current system
- d) Date of last drydock and date of last AFS application/installation if different
- e) AFS type/s and respective underwater hull area/s
- f) Ship's Biofouling Management Plan and Record book.
- g) Exact number, location, and any additional information relevant to test patches
- h) Specific procedures for AFS failure investigation including the collection of samples.
- i) Exact number, location, and any additional information relevant to reference areas, if any, such as ship's drawings and photographs at drydock or before/after any other relevant bio-fouling management actions. For more information on reference areas see Paragraph 4.2.5.

4.2.4 Underwater Hull Areas

4.2.4.1 For ease of inspection and reporting, the underwater hull shall be divided into main component areas. Examples of such areas are shown in Figure 2.

⁽⁴⁾BIMCO, Bagsvaerdvej 161, 2880 Bagsvaerd, Denmark.

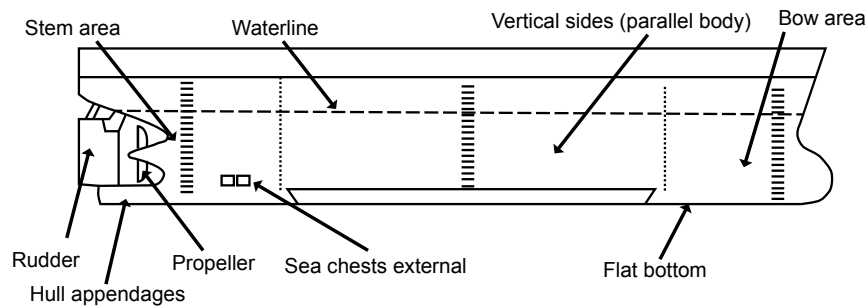


Figure 2: Main Component Areas

- 4.2.4.2** Each main component area may be split into ship's specific sub-components. The sub-components specified in the Work Scope shall be closely inspected and included in the report. List of main component areas and examples of sub-components is showed in Table 2.
- 4.2.4.3** Some of the sub-components listed above are considered "niche areas"¹, however, the list of examples in Table 2 is not exhaustive. Ship-specific niche areas shall be identified by the relevant party and shall be listed in the ship's Biofouling Management Plan.

Table 1
Main Component Areas and Associated Sub-Components

Main Component Area	Sub-Components (typical)
1. Water Line	1.1. Draft marks above water line 1.2. Hull area above water line
2. Bow area (forward of parallel middle body)	2.1. Bow thruster(s)/tunnels 2.2. Forward Draft Marks below Water 2.3. Emergency Fire Pump sea chest 2.4. Forward Cathodic protection/ICCP
3. Vertical Sides (parallel middle body)	3.1. Vertical Sides transversal sections 3.2. Bilge keels 3.3. Midship draft marks below water line 3.4. Hull anodes
4. Stern area (aft of parallel middle body)	4.1. Aft draft marks below water 4.2. Sea inlet pipes and overboard discharges/Scrubber ^(A) outlet 4.3. Cathodic protection/ICCP 4.4. Stern thruster(s)/tunnels
5. Flat Bottom	5.1. Transducers 5.2. Dry-dock support strips
6. Sea chest	6.1. Gratings general 6.2. Close up of gratings 6.3. Sea chest internal, Box coolers
7. Propeller(s)	7.1. Blades 7.2. Boss cone 7.3. Rope guard 7.4. Propeller Boss Cap Fin (PBCF), Shafts 7.5. Stern tube seal
8. Rudder(s)	8.1. Rudder leading edge 8.2. Rudder hinge 8.3. Rudder pintle box/access cover 8.4. Rudder base plate/plugs 8.5. Rudder horn edge 8.6. Anodes
9. Hull Appendages	9.1. Ducts 9.2. Fins 9.3. Stabilizers 9.4. A-brackets, ^(B) V-brackets, I-brackets 9.5. Azipod thruster (Forward/Aft), Propulsors
^(A) Exhaust Gas Cleaning Systems (EGCS) are often referred to as 'scrubbers'	
^(B) Includes struts, bearing housing, fairings	

4.2.5 Reference areas

4.2.5.1 Biofouling and AFS condition associated with reference areas shall always be reported unless otherwise stated in the *Work Scope*. The findings related to reference areas shall always be reported separately from any other areas.

4.2.5.2 It should be noted that reporting only the condition of reference areas may not satisfy regulatory requirements related to biofouling risk management.

4.2.5.3 The number and location of reference areas are ship-specific, assigned by the Client and ideally do not vary between UWI. Figure 3 shows a typical example set based on ten reference areas. The suggested location of each reference area is described in Table 3. The number of reference areas may increase with ship size (see **NOTE** below).

NOTE: Example of increased number of reference areas, basis ship's draft:

1. For draft <5 m, one (1) reference area halfway of the load line.
2. For draft >5 and <15 m, two reference areas at one-third and two-thirds of the depth.
3. For draft > 15 m, three reference areas at one-fourth, one-half, and three-quarters of the depth.

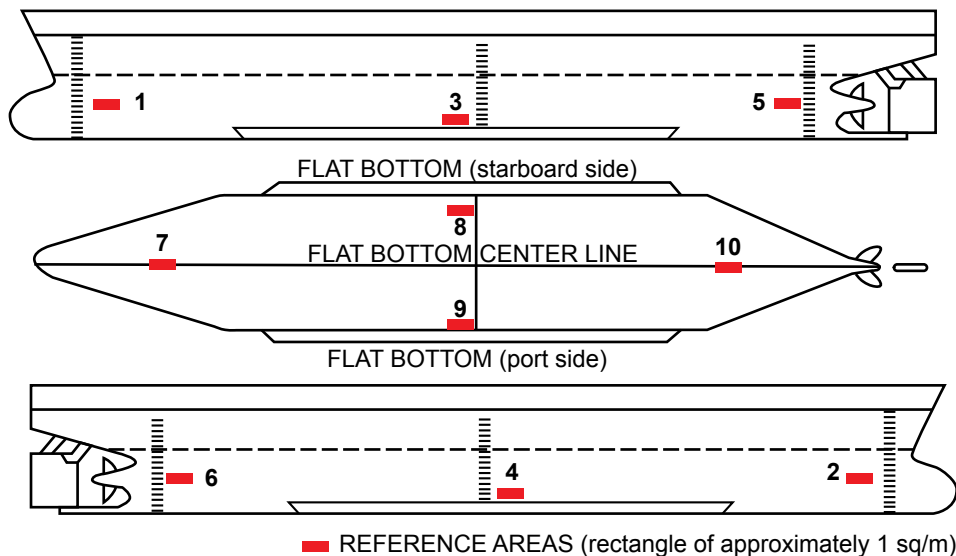


Figure 3: Example of 10 Reference Areas

Table 2
Reference Areas Suggested Locations

Main Component	Location	Reference Area No.	Total
Vertical Sides, Port and Starboard (P&S)	About 1 m aft the Fore Draft (P&S), halfway the load line draft forward.	#1, #2	6 ^(A)
	About 1 m in front the Midship draft marks (P&S) at about 2 m draft.	#3, #4	
	About 1m in front the Aft Draft (P&S), halfway the load line draft aft.	#5, #6	
Flat Bottom	At the Center line near the Forepeak tank drain plug or the forward echosounder	#7	4
	Under the Turn of Bilge P&S in way of Midship Draft	#8, #9	
	At the Center line of the ER bulkhead	#10	

^(A) Three reference areas per side (P&S)

4.2.6 Communication between parties

4.2.6.1 Once the UWI has commenced, the service supplier supervisor shall provide regular updates to the ship personnel and the Client on issues such as delays, limited ability to carry out inspections due to operational or weather conditions, delays, and technical issues.

4.2.6.2 Inspections performed by divers shall have surface to diver communication to allow for topside personnel to direct inspection and record results throughout the UWI.

4.2.7 Biofouling inspection

4.2.7.1 Biofouling inspection is the core of the underwater inspections described in this standard practice. The type of information and recommendations on format, the level of detail required as well as any additional relevant observations to be included in the final report, are described in this section.

4.2.7.2 The type of AFS may differ across hull components and sub-components or not be present at all, therefore biofouling type, extent and severity may vary significantly between areas. A robust approach is to report biofouling condition independently for each area being inspected in accordance with the agreed *Work Scope*.

4.2.7.3 This standard practice proposes two levels of biofouling reporting typically associated with different types of underwater inspections in terms of intended purpose. The reporting levels differ in terms of the quantitative and qualitative data and supporting visual materials required. As a result, inspections which aim to satisfy the detailed reporting may require additional time and resources. Table 4 describes the levels of reporting.

Table 3
Biofouling Reporting Levels

Level I Biofouling Reporting	A <u>simplified method</u>, where biofouling type shall be reported as slime, algae (weed) and the predominant types of hard macrofouling. Representative photographs and video recording, including their location, shall be provided in order to give a general overview of the biofouling and AFS condition of the inspected areas. Typically, this level of detail is associated with the following operations: • Hull inspection (Non-Class) • UWI carried out in parallel or as part of planned propeller polishing • occasional surveys for an underwater repair work • initial inspection prior to in-water cleaning • UWILD
Level II Biofouling Reporting	A method that requires the biofouling type to be reported in <u>greater detail</u> in terms of species, color, etc.; it involves an <u>increased level</u> of photographs and detailed video recording. To gather the data required, such inspection may take longer than one associated with Level I Biofouling reporting and multiple divers may be required to survey the ship simultaneously. Typically, this level of detail is associated with the following operations: • UWI requested by AFS manufacturers • UWI for regulatory compliance • UWI for other purposes.

4.2.7.4 Regardless of the type of UWI or the level of biofouling reporting, the report shall include information on the following:

- a) biofouling type
- b) biofouling extent
- c) biofouling severity
- d) biofouling location

4.2.7.5 Biofouling Type

4.2.7.5.1 Information on biofouling composition shall be reported as part of any type of underwater inspection.

4.2.7.5.2 For a Level I Biofouling reporting, as a minimum, the presence of microfouling (slime), algae (weed) and the predominant types of hard macrofouling shall be recorded. For UWI where a Level II Biofouling reporting has been requested, all types of biofouling present on the underwater surfaces shall be reported. Table 5 provides a summary of the types of biofouling and the reporting requirements.

Table 4
Biofouling Type Reporting Requirements

Biofouling Type		Level I	Level II
Micro		Slime	Slime
Macro	Soft	Algae (weed)	Algae (weed) ^(A) Soft Corals, Sponges, Hydroids, Anemones, Tunicates
	Hard	<i>Predominant types of:</i> Barnacles, Mussels, Tubeworms, Bryozoans, Other (specify)	Barnacles, Mussels, Tubeworms, Bryozoans, Oysters, Other (specify)

^(A) Color (e.g., green/brown/red) shall be reported.

NOTES:

1. Service suppliers are advised to keep informed about species classed as high risk by relevant local authorities and to report the presence of such species where applicable.
2. Photographic examples of common biofouling organisms found on ships' hull surfaces are available in industry guidelines and standards such as NACE SP21421,⁵ the Naval Ships' Technical Manual (NSTM)⁶ and other publications.⁷

4.2.7.6 Biofouling Extent

4.2.7.6.1 Recording the extent of biofouling coverage is one of the most important elements of an underwater inspection, therefore the Diver and the service supplier supervisor shall aim to include estimates as accurate as practically possible.

4.2.7.6.2 Biofouling coverage shall be expressed as a percentage of the area being inspected and / or in square meters where practical.

4.2.7.6.3 Extent diagrams included in industry practices, guidelines and standards are frequently used for estimating the biofouling coverage as training materials, during the UWI and/or as a reference when reviewing photographic or video evidence. Their use on site may be restricted due to water visibility or ship's size.

NOTE: Examples of extent diagram can be found in ASTM⁽⁵⁾ F1130-99,⁸ the "Industry standard on in water cleaning with capture" by BIMCO et al,⁴ industry practices developed by paint manufacturers and other publications.

4.2.7.6.4 An alternative method for establishing the biofouling extent may be to divide relevant components into smaller areas. For example, flat bottom and vertical sides may be divided based on tank or frame markings on the hull, or by using the welding seams of ship's hull plating. Biofouling extent for that hull component shall be given as the average of the smaller areas.

4.2.7.6.5 The sum of reported percentages of different biofouling types should not exceed 100% of the area being inspected. Diver Supervisor may use this as a self-verification method.

⁽⁵⁾ ASTM International (ASTM), 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.