

# Investigation of the Luxury Yachts Condition and their Maintenance

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*Abstract. Surveying the condition of yachts and their maintenance is of great importance for their functionality and efficiency. Finding the right approaches, expertise at different levels, design benchmarking are essential for all yacht maintenance and security, resulting in crew and passenger safety. This report presents an evaluation and expertise in a real environment and documentation of decision-makers for the strength and functionality of a luxury motor yacht. For a good understanding of the problem, detailed photographic material has been documented showing in detail the required technical corrections. The research would be of interest to a wide range of yacht design and industry professionals, academic and research representatives, yacht users and all interested stakeholders.*

*Keywords: yacht, design, maintenance, condition*

## Introduction

The design of yachts (motor and sailing) is specific in its essence [1-3]. In addition to the geometric differences and three-dimensional volumes according to the mechanics, the materials that are used to make the components and details must have the necessary qualities of strength, corrosion and wear resistance [4-6]. After the completion of the design stage and the actual construction of the vessel (type of motor or sailing yacht), it undergoes initial testing and registration, after which it goes into operation in a real environment. Unlike most vehicles (e.g. land vehicles), yachts are often found in an aggressive marine (or oceanic) environment where, in addition to the direct influence of natural forces, contact with seawater itself leads to certain corrosive, wear-and-tear effects and material fatigue on the hull of the yachts [7-9]. These influences are of a permanent nature, and in certain cases they can cause serious damage, which leads to the need for preventive inspections of the condition of the yachts. Depending on the protocol, they can be annual (for example, with the onset of an active sailing period) or periodic depending on regional, managerial and other leadership decisions. It should be noted that in the class of luxury yachts, carrying out periodic technical inspections is an expensive process, which in addition to financial resources, costs and time resources. This is due not only to the nature of the built-in expensive materials in the luxury yacht, but mostly to the size of the yacht itself. For these and other reasons (for example, the yacht is located in a region where it cannot be towed ashore), sometimes a targeted survey of the condition of the luxury yacht in a real water (sea) environment is required [10, 11].

## 1. Scope of the study

The scope of this research is aimed at inspecting the design and material quality in a direct aquatic environment. The vessel (motor yacht / luxury class) was inspected while at berth as well as while on the water.

The underwater hull is inspected through underwater surveillance and testing.

- Internal inspection is limited to areas normally accessible directly or through lockers, inspection hatches, removable panels, etc. No part of the ship should be dismantled; as well as not removing inspection bolts or shims. Consequently, any part of the vessel, its equipment or fittings which was unexposed or unavailable shall not be subject to inspection for confirmation or absence of defects, but shall remain under consideration. They are noted in the final document-protocol, which is provided to the owners and all stakeholders.

The following important points are noted for the expert inspection

- Structures or other parts of the structure that are covered, unexposed or inaccessible and therefore cannot be tested for reliability are reported.
- The yacht is active and is in active operation mode, regardless of whether maintenance or timely replacement of certain components and details is required by the time of the examination.

The purpose of the research is to note important and critical points of design compromise (material wear, corrosion or mechanical damage or technical problems) of a luxury motor yacht in active operational mode of operation.

## 2. Investigation and testing of the luxury yacht's condition and its maintenance - real example

Researching the quality and condition of luxury yacht (Figure 1) is carried out with the assistance of an expert interdisciplinary team, specially selected for a visit to Tanzania. In addition to the purely technical part of the work, the expert team undergoes special instruction and training (including diving). Sampling and testing equipment is pre-selected for the conditions.

Before starting the tests and studies, the technical documentation (main and specification) of the yacht is carefully read (Table 1). All currently available data and information from a previous period are taken into account and the practical work of researching the design and condition of the yacht is moved on.

The tests and studies are graded according to the seriousness of the problems due to exploitation [15-17], the human factor [18, 19] and/or external environmental influences [20].

The recommendations detailed within the body of this report are presented in five categories and are classified as follows:

Type A1: Structural, mechanical or other defects requiring IMMEDIATE

attention i.e. those affecting structural strength, seaworthiness or safety which **MUST** be repaired **BEFORE** the vessel is relaunched at this time.

Type A2: Structural, mechanical or other defects affecting strength, seaworthiness or safety which may be repaired after the vessel is relaunched but **MUST** be repaired before the vessel is cruised.

Type B: Defects not affecting strength, seaworthiness or safety but which, by their nature, should be dealt with before putting the vessel afloat.

Type C: Structural, mechanical or other defects **NOT** requiring immediate attention but are to be dealt with within a specified time period.

Type D: Non-essential or cosmetic defects whose repair may be left to the Owner's convenience. All suggestions are, unless noted otherwise, of this type.



*Figure 1. Luxury yacht*

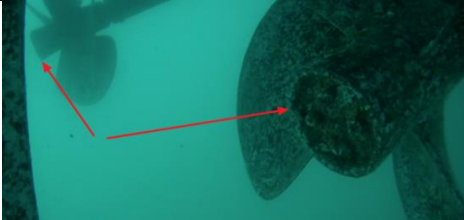
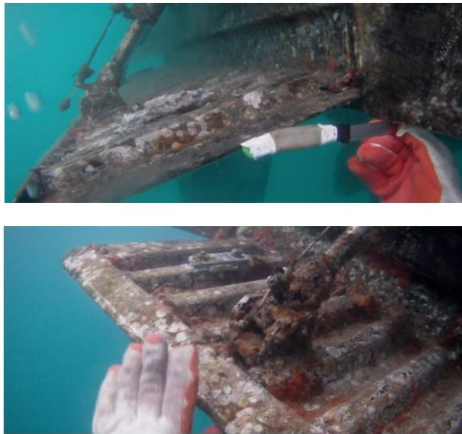
<b>SPECIFICATIONS</b>	
L.O.A. : 26m	Beam :6.40 m
Draught :1.9m	Ballast : N/A
Displacement : 130	Hull type : GRP



*Table 1. Luxury yacht: General information and specifications*

The yacht vessel was inspected while at berth and also while afloat in Dar es Salaam, Tanzania on The survey was conducted in accordance with the agreed terms and conditions and according to the practice published by the International Institute of Marine Exploration.


### 3. Results

dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

<p>CORROSION PROTECTION</p>		<p>Anodes: the situation with the anodes is not good. The anodes of the boutruster propellers are completely missing.</p> <p>RECOMMENDED (type A) The situation is similar with the trims – 1 out of 4 is missing, immediate installation of anode protectors in missing places is recommended</p> <p>Keel/hull joint : no deformities detected</p> <p>Hull to deck joint : no deformities detected</p> <p>Cockpit: good condition</p>
<p>TRIM TABS PORT AND STARBOARD</p>		<p>–do not move do not work is not an unknown cause</p> <p>–both Stern Flaps are in place. No leakage noted around the hydraulic system, fixed in place by wires. Both flaps are fixed at 10 degrees to the waterline.</p> <p>– RECOMMENDED (type A2) quick repair is recommended. Nonfunctional trimmers significantly deteriorate the boat's seaworthiness to DANGEROUS levels in high winds and waves. They significantly reduce engine efficiency and increase fuel consumption.</p> <p>Anode protectors are missing and trimmers are highly at risk of rapid corrosion RECOMMENDED (type A2) quick installation of anodes is recommended - 4 pcs</p>

<p>ENGINE</p>		<p>Engine panel upper : MTU 16v 1850 hp</p> <p>Engine hours : Port : 870h -</p> <p>Starboard : 870h</p> <ul style="list-style-type: none"> <li>- left engine dashboard does not work</li> </ul> <p>RECOMMENDED (type A2) quick replacement with a new one is recommended</p> <ul style="list-style-type: none"> <li>- the right panel is in good condition</li> <li>- Engine beds: good condition.</li> <li>- Engine mounts Port and Starboard: good condition.</li> </ul>
<p>COOLING SYSTEM : PORT AND STARBOARD</p>		<ul style="list-style-type: none"> <li>- Basically the system is in good condition and the engines cool well</li> <li>- There is a disturbing leakage of salt water from a pipe which is part of (engine heat exchanger) is located between the engine and the exhaust transom outlet of the boat. RECOMMENDED (type A1)</li> <li>- Unacceptable corrosion, as the outlet is part of the bottom fittings and is actually below the waterline, and its failure makes it extremely DANGEROUS for the buoyancy of the boat, immediate troubleshooting is recommended.</li> <li>- Photos attached. The right engine system has the same problem.</li> </ul> <p>Exhaust system Port and Starboard: good condition</p> <p>Ventilation Port and Starboard: good condition</p>

<p>FUEL SYSTEM</p>		<p>Fuel lines(s): good condition. No corrosion, folding or crushing are observed</p> <ul style="list-style-type: none"><li>- Fuel filters: the presence of water in most separating water-fuel filters.</li></ul> <p>RECOMMENDED (type A2) it is recommended to drain the water from the filters periodically. Prevention of filters as well as of the entire fuel system, including drainage of fuel tanks and treatment with residual moisture detergent.</p> <ul style="list-style-type: none"><li>- Tanks: RECOMMENDED (type A2) Prevention of filters as well as of the entire fuel system, including drainage of fuel tanks and treatment with residual moisture detergent. Including anti-bacterial drug in fuel.</li><li>- Ground: there is no indication that the system is working properly. Many of the system cables are disconnected or incorrectly attached where they were visibly connected in places. RECOMMENDED (type A2) they must be grasped in places correctly - the overall protection of the boat, all metal parts, including the inside of the hull depend on it.</li></ul> <p>Ventilation : good condition</p> <p>Anti-siphon: Not detected any anti-siphon</p> <ul style="list-style-type: none"><li>- Fuel overflow: there are fuel overflows on the left side for the left tank and on the right side for the right tank. They can be used as one tank together and as two separately. RECOMMENDED (type D) on the left side the fuel overflow and the water tank vents are very close and there is a danger of one fluid pouring into the other tank, which causes a lot of trouble. Crew instruction and more vigilance by the Captain is recommended.</li></ul> <p>Shut-off valves /manifold: in good condition.</p> <ul style="list-style-type: none"><li>- It seems that they are not functioning and do not undergo regular prophylaxis</li></ul>
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		<p>(closing and opening inspection), many taps were moved (with difficulty) during the inspection, including the two main seawater valves cooling the engines. By all accounts, it appeared that the large filters of both engines had not been closed for a very long time. The handle of one of the valves was also missing.</p> <p>RECOMMENDED (type C) to seek and move all valves (fuel, water and others), to change if necessary.</p>
<p>AIR CONDITIONING</p>		<p>The air conditioner starts but it doesn't work.</p> <ul style="list-style-type: none"> <li>- All four compressors cool. The tank that holds the fluid that is supposed to transport the cold water to each convector is LEAKY and does not hold fluid.</li> </ul> <p>Because of this, we could not make further tests on the convectors and the serviceability. RECOMMENDED (type B) sticking or replacing the tank!</p> <ul style="list-style-type: none"> <li>- Extremely dangerous hose in the air-conditioning system, located below the waterline before and after the coarse particles filter. The hose is with a metal coil, BUT it is already cracked and is very DANGEROUS. RECOMMENDED</li> </ul> <p>(type A1 ) as soon as possible the replacement of this hose must be arranged</p>
<p>ADDITIONAL EQUIPMENT</p>		<ul style="list-style-type: none"> <li>- Dinghy boat with engine – good condition</li> <li>- Jet ski sea doo with engine or turbine problem. RECOMMENDED (type B) computer diagnostics at a specialized service!</li> <li>- Diving equipment</li> <li>- Crane mounted on the fly breach for lifting and lowering (dinghy boat and jet-ski) - good condition</li> <li>- Cameras - there are three surveillance cameras and none of them work</li> </ul>

		<ul style="list-style-type: none"> <li>- Speakerphone – 1 out of 4 does work</li> <li>- Re-boarding ladder : there is one, BUT the hydraulic lowering and lifting system does not work RECOMMENDED (tipe B)</li> <li>- Other checked systems, parts and details - Type D / or everything is well.</li> </ul>
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Table 2. Results obtained and recommendations

## 4. General areas and discussion

### 4.1. Topside

The hull was sighted from a distance fore and aft and visually inspected all round.

Her lines were symmetrical, fair and true, with no signs of distortion or deformation.

- There are numerous scratches and blows to the bow of the boat, caused by blows of the anchor and iron barrel of the mooring in front of the boat. RECOMMENDED (type C) for damage repair and inspection for cracks and flakes from the gelcoat.
- No major structural defects due to collisions are observed.
- The state of the gelcoat is currently satisfactory but with signs of serious aging of the material (a light grinding of the burnt and yellowed surface layer and polishing is envisaged to restore the functionality of the gel, namely protection of the hull of the boat from the aggressive marine environment).
- Slight cracks are observed in the area of the base of the tube lears and railings made of stainless steel.

### 4.2. Transom

- The stern of the boat is in good condition.
- The stern door closes well.
- The lettering of the name of the boat does not work RECOMMENDED (type D)
- The platform is covered with teak wood (the condition is not good - maybe the next grinder will be the last for the platform decking).
- There are numerous traces of light bumps and scratches on the platform's topsides RECOMMENDED (type C).

### 4.3. Bottom

- Since the view of the underwater hull is done while the boat is in the water without being dry and can be inspected in the finest detail. The view is made according to the capabilities and visibility of this type of inspection. There was no evidence of distortion or impact damage. After the inspection, it was established:



- The examinations were directed along the waterline and under the bottom in areas where the maximum corrosion may be expected.
- Antifouling is very worn and does not work repeatedly, the boat is scraped with solid objects, but satisfactory cleaning is not possible. Both the hull and the entire screw-steering group (which significantly increases the cost of cleaning and replacing antifouling on the next dock). It also significantly degrades the seaworthiness of the boat and significantly increases its fuel consumption, as well as significantly increases the RISK of hull osmosis occurring underwater.
- RECOMMENDED (type A1)
- Diver inspection and tests at several locations from the bottom shows the presence of at least two hands anti-osmosis body protection, primer and antifouling (nonfunctional).
- There is significant overgrowth of the hard moss at the bottom that is visible in the attached photos and videos.
- The divers' inspection does not report any bumps or deformations at the bottom.

## 5. Conclusion

The present study summarizes in a combined report the theoretical and practical importance of quality control in yacht design and materials. This applies not only to the luxury class of yachts, but also to the widely used yachts for mass use (motor and sailing).

Regarding the specific case of research, important data were obtained about the condition of the researched object (luxury yacht) in a real water environment, and certain tests of strength, wear and corrosion of the materials were made. Devices and applications ensuring the proper functioning of the yacht have been studied and tested in detail.

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