

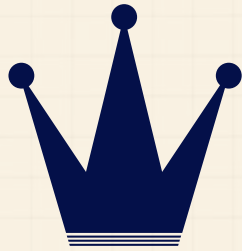
  
**OCEAN KING**  
YACHT EXPLORER  
VENEZIA



**THE BIRTH  
OF A TRUE EXPLORER**  
Notes, ideas, and the genesis  
of the project

By David Ballarin





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## 01. A true explorer is born

Nowadays the market of selling Yachts is in a crisis situation. Many shipyards have found themselves in serious trouble and have tried to position themselves in any niche market that has a positive sales trend. This niche has been identified as low fuel consumption and running costs. In fact, many customers, after trying speed boats have realized it is useless to have a boat that reaches 20 knots cruising speed if that means it has high operating costs, poor seaworthiness, and little on-board comfort, rather than to have a boat do 10 knots with low operating costs and unmatched comfort in cruising. The search for a boat of this type has created a “fashion effect”. This fashion was born overseas a decade ago not so much from the need to be noticed or to be “different” from others, but from the need for owners to navigate safely in rough seas like the open ocean. In Europe, the production of this type of boat was exclusive to Dutch shipyards with centuries-old maritime tradition, where yachts with these features were produced, but they did not meet the aesthetic and functional needs of ship owners in the Mediterranean.

All this changed dramatically a few years ago when some wealthy ship owners began to look for these products and, not finding them “ready to buy”, decided to build themselves by purchasing mostly old tugs and restructuring them at their leisure. But the problem was not completely solved, as the “re-fitting” of these old tugs required several costly resources and the result was not always predictable or satisfactory. In addition, a solution of this kind was the act of a few wealthy owners with capital. This movement was sensed by many sites and the production of yachts nicknamed Explorer, Trawlers, Expedition, etc. began to be a pivotal point in their production. Advertisements of yachts began to appear in the pages of boating magazines, touting their seaworthiness, low running costs, comfort etc....

Aside from the few models notable features, the majority of these boats were and are composed of normal Yachts adapted to go slowly, with superstructures modified and made more angular, the prows made straighter and everything not much else. Very few had the features of a ship, the rest were a multitude of bad products. In 2004, after walking around and boarding these types of yachts at a major boat show with a tug captain and a naval engineer with ex-



And so was born the “King of the Oceans”, named Ocean King.



tensive experience in tug design, we realized that something was wrong. The captain said that with boats made that way, he would not have crossed the lake of Garda, let alone an ocean. The engineer was shocked by what he had seen on deck and in the engine rooms, and by the ludicrous explanations of those who showed and explained the boats. Some solutions adopted by these sites had nothing to do with the sea, indeed some of the details (see unloading large masses) were totally inadequate and in unfavorable conditions they would convey the seawater into the interior of the ship instead of the exterior! In short, the disappointment of those who, like us, thought they were going to visit a “state of the art” boat was great. The years passed and one day we found ourselves engaged in the same activity. In fact, the vicissitudes and the incidentals of life brought us together to work in the Shipyards of Chioggia, a company specializing in the construction of commercial ships, tugs and motorboats.

Mindful of what we discovered that day at the boat show, we decided to take up an old dream that for years had remained in a drawer and to pursue it to fill a void in the market. That’s to say a ship built with the same characteristics and strength of a true

ocean-going tug with extraordinary safety and that can be managed by just a few people, that requires very little maintenance and that is a lasting investment for the owner. Thus was born the Ocean King project, never attempted before, that would give the yachting world a new benchmark on how a true pleasure craft should be built.

Although units less than 24 meters long are called boats, we think that if they are built to the same standards as those of 100 meters, the word ship should be used. We call the Ocean King a ship and we are not afraid that we would be proven wrong. In Anglo-Saxon culture with centuries-old maritime tradition and unique, a ship is compared to a lady and despite being an object, is referred to as a subject (she) instead of “it” as is the case with all other objects and animals. This is a sign of utmost respect for a true ship and all that she represents.

These few pages summarize best what led us to take on this project. Of course do not want to teach anybody anything, indeed, we apologize for the extreme ease with which certain topics are treated, but this is also part of our desire to avoid invading the reader’s head with complicated mathematical formulas. What interests us is that the

concept and the ideal from which we started this ambitious project are understood Let everyone the ability to read, to criticize or to appreciate what we aim to convey in these few words. And if we were able to give you some ideas for choosing your next Yacht, then we have already accomplished something positive. Otherwise, we apologize to all of you.

*And so was born the "King of the Oceans", named "Ocean King".*



Staff C.N.C. Douring the launching of The Bunker "Magic Duba" 1600 Tons

## 2. The shipyards of Chioggia: thirty years of tradition in the construction of commercial vessels

The Ocean King is much more than a yacht! It is a real ship, built with the highest safety and quality standards, the same that apply to commercial ships in accordance with the guidelines of the world's most important naval registers such as RINA (Italian shipping register) and/or Bureau Veritas. The Ocean King is designed and built by those who design, build, and repair real commercial ships that sail around the world in all weather conditions. The Ocean King is designed by a team of experienced people who have worked for years on the design and construction of offshore tugs and commercial vessels. The Cantieri Navali Chioggia have all the know-how necessary to complete each part of the ship, including the hull study (with the help of hydrodynamic tanks), specification of the engine room, and a personalized study of the interior.

Hulls designed by us comply with the commercial standards imposed by the naval registers. We emphasize the word "commercial", considering it far superior to the

word "pleasure" boat or yacht. This means greater care and rigor in the construction technique of thousands of details. It means that our ships are the strongest, most secure most seaworthy of any yacht on the market because they are true ships. We build steel; all our welders are constantly updated with special training and are all in possession of the mini licenses recognized by leading international naval certification bodies and are regularly requalified. The Ocean King can be registered under any of the ranking agencies (RINA, Bureau Veritas, ABS) upon the owner's request. Even if the owner does not make this request, each piece is built as if they had.

The certification adds value and prestige to the boat and provides the owner with constant monitoring by the certification throughout the life of the boat. The certification is not, as many may think, an unnecessary waste of economic resources but is instead an added value for the boat. The certification involves many obligations for the Shipyard without which it could operate based on the concept of "saving" rather than on the future of safety and durability. Every detail of the ship is taken into account and every detail is given much importance. Each installed component is followed by a



Ocean King model in a ship model basin

specific law that provides all the information possible on how to install, mount, and work it. The yard leaves nothing to chance or good faith as it does in other certifications. The only CE certification adopted by many yards is in no way comparable to the “real” marine approvals. We need only take a look at the documentation that the yard is obliged to release. In the case of a CE certification, the producer of the good, or better, the construction site, is required to issue a declaration of conformity (similar to a self-certification) and an owner’s manual: a small volume of a few pages (for example where it says not to smoke when filling or not to dive between the propellers when the boat is in motion!). Almost always kept in the drawer by the ship owner (because nobody reads it) and it all ends there. In the case of a ship class “RINA or other entity classifier”, the documentation that accompanies the ship is completely different. Thousands of sheets containing diagrams, calculations, drawings, photos, and approvals accompany your ship. At any time or for any need, these materials can be referenced and anyone in whichever part of the world you find yourself will be able to resolve the problem. From the simplest electrical wire to motor groups, everything is identifiable with these documents. In addition, all the

components installed on board have passed an audit by the relevant authorities. A bow thruster or a watertight door for example, if constructed according to RINA standards will be very different from those built to CE certificate. The difference between the two standards is profound. The CE is a compulsory trademark in Europe (and only here) that each producer must state on each item marketed and sold whether it be a hat, a pair of slippers, or an outboard motor. Conversely, the RINA certification (or similar) is a certificate issued by an entity that has worked for years in the field of professional ships, which gives precise rules of reference to which manufacturers must comply, and everything is checked prior testing. We are talking about two completely different things. We believe that a shoe from the beach, or a small ski boat can safely “settle” the only CE certificate, while a “real” ship that can sail the oceans must necessarily be placed under the supervision of a ranking entity. In the future sale of the pre-owned ship, you will definitely feel the difference, especially if the buyer decides to take the boat out of the territory where the European CE mark is recognized.. Although the cost of a true marine certification course is high, we believe that a guarantee for the future and for added security is essential. For units





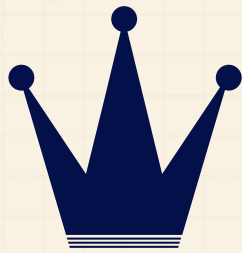
below 24 meters the law provides that they be submitted to oversight by a ranking committee, but we strongly recommend that every owner submit their boat so that every step in the construction of the boat is done by highly skilled people. We work well!

There are many types of marina approvals. Many builders (or better, salespeople) advertise the fact that they possess a “serious” certificate but here we must clarify. To say that a boat is certified by RINA standards for example, means little to nothing. RINA, as an institution certifies a multitude of things. The same RINA may issue a CE certificate or ISO 9000 certification to a company. But RINA may also certify an infinity of details on a real ship and this certification is recognized as one of the most important in the world. RINA certification can therefore be a thousand kinds, and to say that a boat has RINA certification means practically nothing. You should specify which certification and what kind. Some manufacturers are a bit more serious; they write that their boat is in class “RINA MALTA CROSS” and despite the fancy name that evokes medieval chivalry its meaning is much more modest. In the field pleasure boating RINA releases two types of certification: the hull (HULL) and machinery (MACH). These two

classes will then be followed by “DOT” or “MALTA CROSS”. The difference between DOT and MALTA CROSS is profound and lies in the fact that in the DOT, the ranking institution (RINA) issues this as a factory certificate instead of testing, while in the MALTA CROSS, RINA performs tests in the shipyard. In the case of “RINA HULL DOT” RINA monitors only the certificates of factory sheet metal (or copies of the certificates that the site sends to RINA) with which the hull is built, but this does not verify that these sheets do have the mechanical characteristics and corrosion requirements. Same thing in the case of “RINA MACH DOT” the verification body will settle for factory testing of the machines. The engine room, electrical systems and oversight, and the sprinklers are not taken into consideration with this certification. The whole construction of the ship is left to the good faith of the yard, then. We wanted to build a true ship, so we decided to follow the more stringent rules for the “HULL MACH MALTA CROSS” RINA certification.

This particular class is the maximum that the IACS (International Association of Classification Societies) records, that is, the world body that sets the rules in terms of safety, navigation and pollution. Very few

yachts on the market today have this certification, and if an owner was willing to get it, we would have no problem accommodating him. This means that during the construction of the Ocean King the certifying body (RINA) was not satisfied by receiving photocopies of certificates of sheet metal from the shipyard, but performed the actual inspections within the yard; checking the welding, punching the rolling, checking the welder’s design patents, checking technical drawings of the project both in terms of the construction of the hull, as well as those relating to the engine room, the electrical system, safety means, water system and fire system, the plan of moorings, etc. Before the site can commence construction of the ship, the certifying body must approve any technical drawing, and upon this approval will perform the inspections on site to ensure the proper execution of the work. Even the design of the ship is preliminarily approved subject to compliance with the requirements of stability, security and pollution. The difference between the two certifications is profound!



### 3. The unsinkable boat

At the mention of an unsinkable boat people often respond, “Yes ... like the Titanic!” They are right, the Titanic was considered an unsinkable ship and was built in steel. If steel sinks in water then, in theory anything made of steel put into water sinks! A steel vessel can be considered unsinkable but in order to be so must be built according to specific rules. We wondered what would happen if an event similar to that which occurred on the Titanic had affected the Ocean King.

## 4. The titanic versus the Ocean King

Most twenty-first century ships are built from steel: warships, tankers, tugs, fishing vessels on the high seas, passing ships and so on. None of these vessels are built from aluminum or fiberglass. Instead, they are built from naval steel, even when the production costs of fiberglass are significantly lower. Why? Because steel is more resistant, more durable and virtually fireproof. Unfortunately, the steel used at the time of the Titanic was resistant, but a steel that in the cold climates of the North Atlantic became rigid and therefore, fragile. When it hit the iceberg, the hull opened to 100 meters below the waterline and flooded five watertight compartments, raising the water level above the level of the bulkheads through the transfer of water in the other compartments, dooming the ship to sink. The disaster prompted a total rethinking of all naval projects gave impetus to a new construction and design standard that took into account safety in particular. The Ocean King is always made of steel, but of superior quality. Now, vessels must comply with the safety requirements imposed by international shipping registers that they must be constructed of steel with a naval degree 36 or higher. Ocean

King is constructed of shipbuilding steel RINA Grade A, coefficient 43! This steel is adequately elastic even in the harsh climate of the North Atlantic and maintains its properties even below 30 degrees Celsius! As did the Titanic, the Ocean King also adopts watertight bulkheads. The difference is that in the Titanic, the upper deck in the hull were continuously welded to both sides of the steel plate. Therefore, if water enters there, there is no way to flush it out, soaking the other compartments and saving the ship from sinking. In addition, the "lame" steel that runs from the deck to the hull, gives extreme strength and rigidity to the hull structure. Each step between bulkheads is maintained "pond" with the aid of special-tight doors and passage ponds for the piping. You would be able to return home even if the breach had affected the engine room and the water had affected the area motors. Your ship would remain afloat and you would surely be more visible and safer even in this unfortunate situation than you would be in a small raft in the ocean. A steel boat is always visible to the radar of potential rescuers even if the relief request systems are not functioning. However, finding a flaw in the Ocean King is not a simple undertaking. 12 mm FE 430 Grade A naval steel is not exactly easy to perforate (even armed with a good drill and lots of patience). In addition, even managing to pierce the hard shell of steel, the damage would affect only some boxes placed in the false bottom. Of course, there



Propellers in the Ocean King are protected by skeg to avoid accidental injury with submerged objects



would be the ecological damage caused by a few tons of diesel spilling, but the water would still be outside of the hull, absolutely unable to enter. To enter it would have to permeate the second line of defense: another hard steel sheet placed above the first at a distance of about 1 meter, and that isolates the ship from the fuel coffers and water. The damage wouldn't even compromise your autonomy, as the boxes containing the fuel are located in the bottom of the ship and cover almost the whole volume of double bottoms, so even losing one or two there would be no damage that could risk your return home. A fiberglass boat without these measures would sink in a few minutes! The only other water could enter the Ocean King is through the windows or portholes on the lower deck in the event that the glass breaks. Apart from the fact that 15 mm tempered glass is not easily broken, should this actually occur, the water would enter and flood part of the cabin, but the bilge pumps would be able to quietly stem the situation and allow you to run for cover. In fact, in all the portholes below the freeboard deck, as per regulation, there is armored closing. Returning to the Titanic, there is another factor to keep in mind. The Titanic was traveling at about 2 or 3 times the speed of the Ocean King. The Ocean King's prow is reinforced and in addition to a large slab of steel keel, employs a collision bulkhead that isolates it from the rest of the boat's bow. Even if the collision occurs along

the side, the energy absorbed by the prow on impact would slow down and stop the boat before the ice could cause substantial damage. In addition, if the modern Azimuth propulsion (optional) is adopted, it would stop the boat in a considerably reduced distance. Tests carried out at a steady pace of 10 knots measured a stopping space of just 20 meters! Although we are aware that a yacht can hardly meet an iceberg on its way, it is useful to point out that the Mediterranean has become a dangerous sea. Certainly not for icebergs, but for the half-submerged tree trunks and containers that have now become a nightmare sailors. The damage inflicted by a semi-submerged container impacting a light fiberglass boat would certainly would be far more severe than the damage to a boat with a solid steel hull!

Moreover, if this were to happen, the large skeg protection under the hull constructed of rugged steel 20-25mm thick, which serves as protection over the hull and propellers, would overcome the obstacle without major issues, sustaining only slight bruising and a few scrapes to the paint. I'll leave you to imagine the results if this situation were to happen in a fiberglass boat.

## 5. Steel versus marine fiberglass

We have already said that a serious ship that sails in all weather conditions, at all latitudes, and in every season must be made of steel.

Why?

Fiberglass, if hit hard will break or delaminate.

It is strongly affected by the outside temperature (stiffening at low temperatures and softening at high temperatures),

It catches fire easily, emitting toxic gases.

It absorbs moisture, is not waterproof, and if not carefully treated, will stain easily.

It becomes "sick", deteriorating with age.

It is easily scratched.

If not worked on in a controlled environment with maximum attention, it presents irremediable defects that lead to the unfortunate owner having to spend great deal of money to repair damages and a subsequent lawsuit against the yard.

The magic of steel is this:

It absorbs a huge amount of energy during impact.

It's very abrasion resistant and will not burn.

It does not absorb water and oil and is virtually unassailable.

Climate and temperature do not affect any of its properties.

Can endure impact, deforming considerably but without breaking.

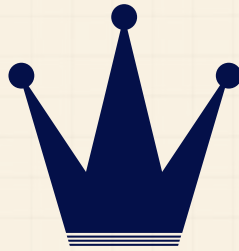
Even drilled retains most of its properties and the size of the hole does not enlarge.

The repairs are quite simple (in every corner of the world there is a welder with a pair of electrodes able to do the repair).

Although if folded it fails to return to its original shape, the recovery job is not expensive.

It has a virtually eternal life (for commercial use is talking around at least 60 years).

No material that you could potential collide with at sea has a greater hardness.



## 6. Fiberglass has none of these properties

The abrasion and thermal properties are not to be underestimated. Try this experiment and you will understand: take a piece of fiberglass and rub it against a rock or an iron point or against a concrete block for a few minutes, or try to pierce it with a drill or scratch it with a file. Then try to do the same thing with a piece of 10 mm steel. (Note that the tools used for the experiment are made of steel, not aluminum or fiberglass!) Heat the fiberglass with a flame or put it in the oven for a few minutes at a temperature of 50 degrees. Or put it in their freezer for a while and repeat the test of abrasion and puncture. You will realize how light and insubstantial are both the GRP materials. Now think about you and your family going through a stretch of sea, unfortunately colliding with a rock outcropping, a semi submerged container, or a trunk of solid oak wood. What would you rather have under your feet? The material glitters, treated with abrasive paste but with a simple iron tool will crumble, or will melt at high enough temperatures. We believe that all of us would choose the second option, namely that of steel, but unfortunately by sales figures of recreational crafts, this is not so. We

wondered why? Why in commercial vessels, where human life at sea must be safeguarded at all costs, are boats built mainly of steel with precise rules observed, while in pleasure boats almost no rules have been considered while you and your family are at sea? We are in favor of the recreational boating and construction fiberglass construction, but we consider this material only suitable for the construction of small boats without big navigating ambitions, like small summer boats or for inshore coastal sailing. A motor boat of considerable size (20 meters up) in our opinion should be built with the same safety and seaworthiness standards of 100 meter ships. These are the principles and the philosophy that led us to conceive the Ocean King.



## 7. Construction quality control

It's important to realize and understand that your boat and the keel carry the most precious thing you have, your life and the lives of your loved ones, it is built by humans, and the human factor is very important in the construction of a "serious" boat ". The success of a fiberglass construction is highly dependent on the human factor. Once the hull is laminated and glued together at the pool, any mistake, bubble, or defect is impossible to trace. Even if it were found before assembling, who can assure that the yard did not assemble the same and leave everything as it is, counting on the fact that the defect would be "invisible" and that if it were found, the warranty would not have already expired? To be absolutely sure of quality workmanship, the owner should constantly oversee or inspect the progress of the work and all the various stages of processing and preparation. The relative humidity, temperature, and cleanliness of the premises have a major impact on the quality of the work and life of the boat. However, we have little doubt that a yard accepts this type of control by the owner, however common it might be in the professional realm. In any case, the ranking institute (RINA or BUREAU VERITAS or ABS) will ensure

the success of the process by filling out a manual with all the tests carried out. Many workers do not pay as much attention to the work as they do the time before work is over. In fact, many workers spray fiberglass with such speed and nonchalance that the result is often below the minimum accepted level. But we know that the work must be finished before the resin dries and on Monday, what was done the week before does not matter anymore. Just go to any website that contains a discussion forum on boating to figure out how many owners of fiberglass boats discover, in spite of themselves, seemingly improbable issues appeared on their boat and no one can give them explanation. Steel, however, can be controlled by checking each welding at any time. Each box or tank has an access door where an inspector may at any time enter and verify the correct execution of the weld. The agencies do routinely, but the same thing can be done by the owner at any time during the life of the ship and can detect a defect even without special education or experience. For greater peace of mind, construction in the class of chemical tankers, LNG, oil tankers, etc. welds are radiographed. Any concerned ship owner can have this extra security. CNC still provides accurate quality control on the welding and the materials used. The owner may request

certification of each steel plate used or even each electrode used in the hull and, in most every case (ballast, oil and water) is tested before being painted by filling it with pressurized water.

## 8. Bullet proof

Acts of piracy involving commercial vessels are increasingly common. In some parts of the world this phenomenon is becoming an urgent matter that no one seems to be able to put an end. A yacht could be a "tidbit" dish for piracy worldwide. The word yacht by definition implies a luxury object, inhabited by wealthy people, in which you can find many precious objects and little treasures, and that looks much more helpless than a normal commercial ship populated by sailors ready to do anything to defend themselves. Many owners are terrified to explore certain areas of the world for fear of jeopardizing their own and others' safety. The global economic situation, however, has made many poorer countries and areas that were once safe and welcomed tourists have today become risk areas. Even in the Mediterranean there are areas that could pose a threat to anyone who approached without the proper precautions. Do not forget that you do not need to storm a yacht with military vehicles or special vehicles, a simple boat with good engines and a couple of people armed can easily create a lot of problems for anyone who has the misfortune to cross it, and now this can take place anywhere. In a ship like the Ocean King traveling at

11 knots this could pose a problem as well as any other boat or ship on the market. For this reason, we tried to create a series of defenses that could prove vital in such conditions. The high thickness of the plates of the hull made us think that with a few modifications and the addition of some other details could make the bulletproof Ocean King the first boat of its kind, so we have tried to study a possible solution. Aided by experience from the military sector we have created an optional defense system. In addition to increasing the thickness of the sides of the steel from 8 to 10mm, we decided to put a pillow between the Kevlar sheet structures and the internal insulation. This system adopted by Navy patrol vessels protects the occupants from machine guns. The portholes are fitted with bulletproof glass and armor increased steel, the windows of the hall will be reduced in size and have the same glass and armor, and the windows of the bridge equipped with armor and a slit for visibility. The doors will be reinforced lock from the inside so the king and all permit crew can shut themselves inside and wait for rescue. Finally, a series of 4 water cannons driven by pumps dragged from the main engines, motorized and controlled from the bridge via a joystick of the bridge, will allow the captain to keep whatever threat at bay. Recall that



Fire hydrant



in the famous fire that destroyed the Molino Stucky factory in Venice during the renovation to a hotel, they used water cannons of this type operated by powerful pumps connected to the main engines. With enormous pressure and engine power, water jets shot down the walls of brick and concrete as if they were paper and caused more damage to the structure than the flames of the fire did. A dinghy or small boat hit by one of these jets would overturn and sink in a few moments. A man would be thrown into the water as if he were a billiard ball. Desperate times call for extreme measures!





## 9. Steel versus aluminum

Aluminum is not as strong and as hard as steel, but it is better than fiberglass although it burns. For example, the British Navy warships sunk during the Falklands War sunk when water entered the hull, but because they were dissolved by heat from fires caused by the explosion of the bombs. The advantage of aluminum of the same thickness is definitely the weight. Aluminum weighs almost 3 times less than steel. In the construction of the hull of a product like the Ocean King, as with all tugs in the world, weight is not a problem but instead an advantage. The aluminum superstructure is one option and a good one, although no real tug in the world employs the aluminum superstructure. We adopt both solutions. In fact, in real tugs superstructures are small and therefore the weight of the superstructure has no effect on the stability of the ship. The Ocean King superstructures are considerably sized and the accessories in them (marble, fine materials, Jacuzzi etc.) greatly affect the weight in critical areas for stability, then in the full cabin versions the adoption of aluminum is recommended as a material for the upper. Aluminum still requires technical measures for correct installation on a steel hull. The adoption of profiles of bimetal

in the junctions between the two materials becomes indispensable for the durability of the construction. CNC adopts many other measures to prevent the formation of corrosive galvanic currents created by the contact of the two metals. An anecdote is often told by captains of fast ships built in aluminum. An anecdote is often told by captains of fast ships made of aluminum. It is said that persons with access to the engine room or cargo holds may be asked to empty their pockets of iron coins because, if one of these end up in the bilge, with time it would cause a hole the same size as the coin. For the construction and joining of these two metals, CNC refers to the specifications required by the certification bodies (RINA etc.) and is supervised by the same in each phase of work. The aluminum hull instead is not in our interest as regards the construction of unit displacement means and intended for heavy use for all the reasons listed above. The hull of steel with its weight helps the vessel to have a relatively low center of gravity and increases stability.

## 10. Structure as ballast and ballast as structure

Displacement vessels and tugs in general need a ballast. Although it seems silly to carry around unnecessary weight, vessels of this type use the weight of the structure as a ballast and as security. Using a high plate thickness and decrease in the hull above the waterline is a great ploy to increase the security and stability. Despite the international shipping registers for commercial vessels under 50 meters that impose sheet thicknesses much smaller than those used by us in the construction of the Ocean King series, we think that for added security, strength, and durability of our boats, it is necessary to use greater thicknesses.



*Skeg hull protection:* 20 mm sheet

*Opera viva:* 10 to 12 mm (minimum 5)

*Topsides:* 8 mm (minimum 4)

*Superstructure:* 6 mm (minimum 4)

*Aluminum superstructure:* 6mm (minimum 4)

Someone who saw our project accused us of being “exaggerated” and said that a yacht does not need all that strength and structure. Well, our response is simply “why’?” We all buy a car based on safety features and then we go to sea choosing products only for aesthetics and do not consider security? We tried to answer these questions in the completion of the Ocean King.

## 11. Lightning at sea

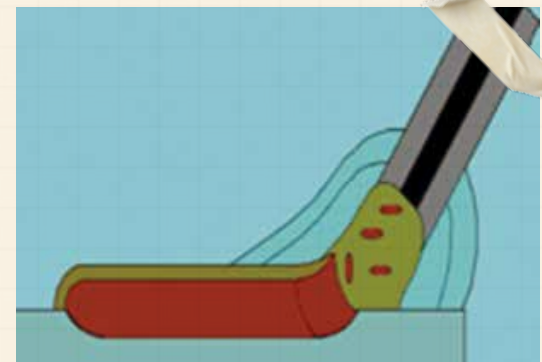
If your boat is at sea during a storm with lightning, being the tallest object in the area, there is some chance of it being struck by lightning. While in port, however, there are real chances of being struck by lightning. In a steel boat, this possibility is not considered to be particularly dangerous. The electrical discharge would likely hit the door post lanterns and discharge its energy to the water by finding the road outside the structure without compromising the internal integrity. The Faraday cage is a school memory that inspired us to understand the electrical effect. In a fiberglass boat however, this effect is not entirely predictable and many times the electrical discharge takes the shortest route to the water, which in a yacht would be through the electric cables or internal iron structures. No one can predict exactly what will happen, but the end result could be catastrophic. All around the world fiberglass boats have sunk for this reason. Even the iron chains that many sailboat owners make sure to shaft down into the water from the sides, do not guarantee an entirely safe solution against lightning. In fact, the electric discharge can take completely different and unpredictable paths to the water. Being in this situation is by no means desirable. But steel also wins in this situation.



## 12. Fiberglass has relatively low production costs

The reason why the most yards use fiberglass as material for building a yacht is the great ease of processing, the possibility of higher productivity, lower manufacturing costs and more the final look is more pleasing. A yard that works fiberglass boats can produce more with considerably lower production costs. A steel site cannot have an industrial production scale and therefore produces very few custom units per year. Ask yourself why there are no tugs, passenger ships, work vehicles, warships (except maybe a few minesweepers), or deep sea fishing boats built of fiberglass despite the fact that this material is much cheaper and of a larger scale. If fiberglass had the strength and durability of steel, every yard would build from fiberglass to reduce costs of production. Once the mold is done to produce a fiberglass hull, it takes a few hundred hours of labor as opposed to the thousands of hours that it takes to build a steel hull. In the production of steel, the only possible automation is the cutting of sheet metal by means of computerized machines (CAM), but the assembly of the cut pieces and their welding is all manual labor guaranteed by highly qualified professionals and

is constantly controlled by various certification bodies. Each new hull is like a unique piece, a specimen completely different from the previous ones and the economy of scale is a particular issue in this type of construction. According to commercial standards, each piece of sheet metal is welded and controlled as required by the classification societies, and the welding must comply with specific technical requirements that the site must follow. The penetration of the weld in the steel must be guaranteed in the hull's coffers, bulkheads and in the shell. Is performed continuously on the two sides of the sheet so as to ensure maximum strength and the maximum possible duration. It is necessary to weld a plate to penetrate the electrode welding or continuous thread up in the depth of the slab to be welded, as shown in Figure 3 in the following drawing. All this is unthinkable in a fiberglass hull and is prepared in little time with few personnel rolling a swab soaked in resin over a fiberglass mat! The amount of resin used, the temperature, the air humidity, and care in following the mold are all left to the good faith or the ability of the worker and once the hull is completed, no one can control the quality of their work.



Stages of fiberglass working

### 13. Fiberglass bends and de-laminates, not steel

To produce a fiberglass boat, you have to build several pieces that are then assembled with glue and rivets. With molds we produce the boat in several pieces: the hull, the deck, the internal bulkheads and the superstructure. All of these pieces are extracted from the molds, then assembled together with the aid of glue and rivets or screws. On the amount of glue used or the number of rivets and screws used, no one will ever give an explanation. Everything is delegated to the work of the workers involved in the operation (remember the talk on Friday afternoon). Once assembled and submitted to the Marine Forces, the various pieces assembled and glued behave differently, flexing and downloading some of their energy on the piece below. All these forces produce push-ups that often cause de-lamination, micro-cracks or fractures in the structure. Just look at the cobwebs that form on a gelcoat fiberglass boat to figure out what it is. The boat does not have to suffer harsh elements or face stormy seas to present these effects. Sometimes, new boats have suffered these features only to be raised by the straps of the port crane! At a trade show, for example, a salesperson told us about how he faced the

sea with a 27-meter yacht built in fiberglass with a value of several million euros to go from Rome to Genoa to attend the fair. It is amazing how the yacht emerged unscathed and, in his words, did not have internal damage of marble, stained glass, mirrors, cabinets and so on, as if this sort of damage were a common thing to happen in a yacht. We do not care to imagine what would have happened during a storm in the North Atlantic. Surely the damage would be much more serious as the sea that day was only force five and the 250 miles route was not 2,500! A steel vessel constructed according to the international rules is to be considered as a single piece of steel! Although flexibility is still present, the ship behaves almost like a monolith and after a serious storm, the structure will remain intact and the interior will not suffer at all, which is impossible in a flexible fiberglass boat. When a fiberglass boat returns to port after sailing in bad seas, the interior furnishings are often a clear example of what happened. The interior doors do not close, the marble floors in the bathrooms cracked, mirrors or windows are broken. Sometimes you will find the same problems after the boat has been for some time resting on the stands of some yard for storage or prolonged stay. None of this would happen in a solid steel boat.



Delamination of a fiberglass hull



Delaminated boat



## 14. Grout and paint

Ship steel is not, as is often the case in the collective imagination, a piece of iron rust intended for use by sailors of the third world. Steel, thanks to new products on the market, can possess the same degree of beauty and luster that was traditionally reserved for fiberglass boats. The welds in plates and some distortions due to heat generated by welding may not be pleasing to the recreational ship owner accustomed to the gloss gelcoat of fiberglass boats. Steel, if filled and treated properly can compete in the beauty department with just a finish of gelcoat. Of course, this solution is very expensive and also requires some care on the part of the owner, requiring the same maintenance of a fiberglass boat. The filler and finish are similar to those used on cars. In fact, even the welds and the grout used on cars can be covered to make them invisible. The filler used is a marine grade epoxy grout that is spread on the plate to a certain thickness, is then sanded, then another layer applied and so on until you get the desired thickness that completely covers the welds. This operation is time consuming and requires a highly qualified staff, not to mention the high cost to the owner, but the result is the same as a shiny car. In

contrast, a fiberglass boat does not need this treatment, since the gelcoat is sprayed first in the mold, has the same characteristics of gloss, and does not require a specific job in the production phase. A few hours with a polishing pad with a little polishing paste and the job is done. For the owner who absolutely requires a shiny boat and therefore higher cost is not an issue, CNC also offers this solution not only on the superstructures (standard version full cabin aluminum) but also in the hull. We feel for many reasons that we cannot recommend this option, however we respect the points of view different from our own. Thus, we propose two solutions. The Ocean King concept was born to guarantee the ship owner the least maintenance possible and the grouting solution is costlier in terms of not only purchase but also of future maintenance. The look is similar to a tugboat, the use of flat surfaces, the chine bottom, and the large side fenders hide the welds. The commercial look that results should not be viewed as a savings by the ship owner, but as a look that is more aggressive and less delicate than a traditional boat. They say that the Ocean King looks like a boat with “muscles” and should be left a little rude and not “rigged”, that is, made delicate. A tank it is because it’s strong like a tank. No one would like



to see it painted and shiny like a Ferrari! It has become customary to see the real tugs moored in marinas next to yachts, and they all have the characteristic of having the hulls intact as in the original models, complete with visible welding. Indeed, for many it is an advantage compared to the other boats, and gives a touch of elegance and strength at the same time, something that many owners have become a must. The Ocean King was born from this concept. Furthermore, the use of sheets of higher thickness leads to more accurate welding. The problems of deformation due to the heat of welding has a greater effect the lesser the thickness of the steel to be welded. A sheet of 4-5 mm is normally used in steel yachts, but curls badly once welded and therefore requires grouting. An 8-12 mm sheet as on the Ocean King will retain the original shape even after welding.



## 15. Fiberglass is not water repellent and has problems of osmosis

Fiberglass suffers from osmosis, which absorbs water and moisture if not carefully protected by the gelcoat. If this happens, a series of bubbles can irreparably compromise the structure of the hull. In addition to the financial loss (the value of the boat collapses immediately and reselling is compromised by this event) there is also the structural damage may lead to the total loss of the boat. Visit any site anywhere in the world where maintenance work is done to understand how widespread this event is. For this reason, when buying a used boat, the first request of the buyer should be the state of the hull to see if there is this ongoing process of osmosis. A problem can manifest in the structure, and then appear on the surface. To overcome these problems, the majority of yacht owners put their boat in dry storage during the winter, which is an added economic commitment. A real steel ship fears nothing if well designed and if the surfaces are treated with the appropriate paint systems. Fiberglass is absorbent like a sponge. The proliferation of bubbles occurs when water or moisture gets inside the

gelcoat and comes in contact with the glass fibers that absorb it. This occurs not only with the gelcoat, but also infiltrates from the deck a hole if not sealed properly (perhaps because the work was done that fateful Friday afternoon just before the sound of the bell). It can also penetrate the hull, perhaps because without realizing it, we hit a submerged object that caused a crack in the gelcoat, allowing water to seep below. Let us not forget, however, that the barrier gelcoat to which we entrust the salvation and the longevity of our boat does not exceed 2 mm of thickness and being sprayed before starting the resin lamination, no one ensures the uniformity of its thickness throughout the surface of the boat. The layer of gelcoat sprayed by hand is not a steel sheet with a thickness certificate. Instead, it is left to the ability of the worker on duty. So, steel also wins in this case.



Osmosis bubbles in a fiberglass hull

## 16. Iron, steel, stainless steel

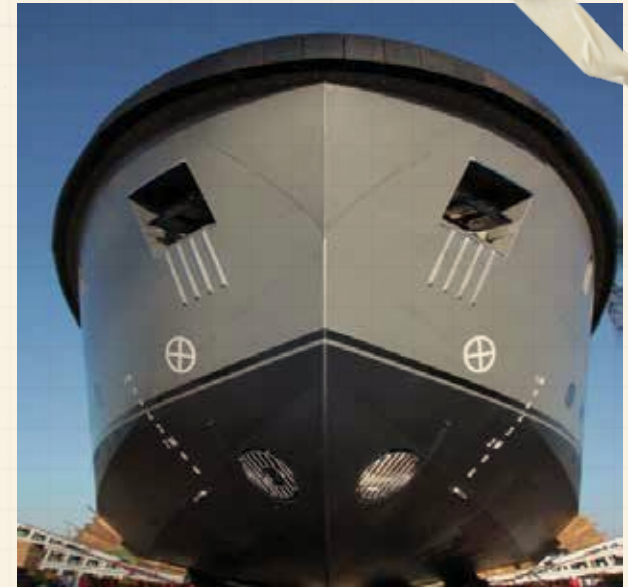


As already mentioned, a true ship is built of steel. We often hear people say (even those involved in the work and between sailors) that a ship is built of iron. Some boat owners use the term steel to refer to the metal parts of the boat that are resistant to rust. For this reason, we decided to clarify the subject. First let's start with iron. It is the element from which all other metals, steel and stainless naval steel are derived. Let's say that a vessel is made of iron. It's just a figure of speech, as pure iron is absolutely not a material for use in construction. Iron is a chemical element, atomic number 26 and symbol Fe. It is the most common metal on earth, and is extracted from other minerals. Steel is an alloy based on iron, carbon and other elements, and is the main element in all modern construction (bridges, skyscrapers, etc.) as well as naval vessels. So when we talk about iron, in reality we are referring to carbon steel. As we said, we use a naval steel Certificate RINA grade Fe 430. This term defines the qualities and characteristics of the steel used. RINA is the certification body that controls the quality of the steel. Grade A indicates the degree of resiliency or toughness of the steel. Resiliency is the ability of a metal to withstand certain temperatures and describes the behavior of the steel's propensity to rupture by calculating its plasticity. In an icebreaker for example, the degree of resiliency is well

above Grade D just because the continuous rubbing with ice at very low temperatures requires the use of a more resistant steel. The Grade D has the same characteristics even at  $-40^{\circ}$ . For those who have intentions of navigating to extreme latitudes in cold climates like Alaska or Antarctica, you can also request Ice Class on the Ocean King.

Fe430 indicates the steel's strength. 430 means that the yield stress is 430 Newtons per square millimeter (4.3 tons per square centimeter or 43,000 tons per square meter!). This type of steel is used for the construction of vessels, due to its elasticity and high strength, even if it is not absolutely immune to rust if not properly treated. Stainless steel or stainless steel alloy instead is that containing chromium and nickel molybdenum. Chromium in contact with oxygen will oxidize (becoming  $CrO_2$ ) forming a very hard surface layer virtually immune to atmospheric agents. This type of steel, despite its ability to resist rust, cannot be used in shipbuilding, although alternatively, can be used as material in the construction of the superstructure but never for hull construction. It is not very common in professional use, but is in pleasure particularly where painting to prevent rust cannot be worked for both aesthetics and functionality. There

are different types of stainless steel. They are distinguished by the initials AISI (American Iron and Steel Institute) followed by a 3-digit number. Most commonly used in the marine industry are AISI 304 and 316. The 316 definitely has the best features even if the cost is higher. The 316 is more resistant to weathering and requires less maintenance, while weathered 304 tends to form a surface layer similar to rust, which is the biggest nightmare of every owner. The AISI 316 stainless steel is the steel used in the deck of the Ocean King.



A real Northern Ice Breaker: Bow is the same of O.K bow

## 17. Avoiding rust: surface preparation and painting are the secret

Painting a steel vessel is the secret to his longevity. Tug boats or ships belonging to the period of the Titanic are still sailing the seas in many of the world despite the heavy use to which they are subjected, 365 days a year.

Of course, if water comes in contact with the steel it oxidizes and rust forms and although this not as aesthetically beautiful, this does not in any way compromise the structure of the sheet concerned. Additionally, the problem remains localized and easily found and remedied. Years must pass before the rust starts to affect the steel plate. The Titanic is proof. When a sample of steel was taken from the hull to study and understand the dynamics of the accident, it was realized that although the sample had remained immersed in sea water for nearly 100 years, for the most part its thickness was still intact. Of course, at that depth dissolved oxygen in water is significantly lower than that present on the surface, hence the phenomenon of iron oxidation slows down a lot. But, think of the docks of commercial ports that are made with steel sheet pile without treatment

and paint, that last at least 40 years before they deteriorate. Consider the "Mose" project to protect Venice from high water; the gates that rise from the sea to block the entry of water into the Venetian lagoon are built in stainless Naval RINA Class A FE430, just the same steel utilized for the Ocean King. These gates remain underwater for years with guaranteed durability and a lifetime of at least 100 years! If steel was not the best material from which to build them, do you think they would have chosen it?

In order to preserve the ship from rusting, the secret is a barrier of paint to protect it from the effects of iron oxidation due to contact with air and water. CNC uses a very accurate technique for painting of the Ocean King, using high quality primers and enamels from leading chemical companies. This process can be summarized as follows:

1. The steel, despite being of excellent quality is purchased from the yard into slabs already primed so that oxidation will not occur even during the production phase.
2. Although the primer is ruined during processing from the cuts, welds, and grindings, a primer is immediately stretched out on the welds made.
3. Once all the welds are made, the holes in the hull have been done, windows and port-



An Old Tug "XX" Century: If a boat is well painted it is practically eternal.



A well-maintained steel ship is practically eternal

holes installed, details such as the thru-hull, handrails, bollards, etc. are mounted, everything is removed and prepared for the next phase.

4. All surfaces are sandblasted to SA 2.5 and immediately treated by spraying with a primer. In the hull for example, at least 3 coats of primer + one coat of epoxy primer area applied before moving on enamel finish.

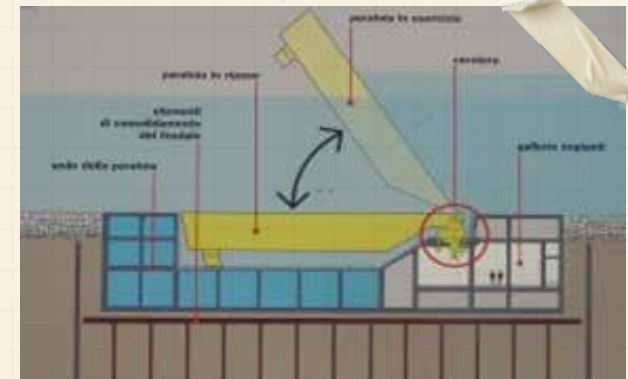
5. After, the surfaces are treated with the application of 2 coats of finishing enamel. This paint sticks strongly to the previous layer and produces a barrier against anything.

6. Above and below the waterline, two coats of antifouling paint for commercial shipping (the best currently on the market) are applied. This prevents marine growth for at least two years.

For those interested, there is the option to apply antifouling silicone that will ensure a life of at least 4-5 years. This coating system of course will not have the look of stucco finish; the welds are still visible, but for the reasons listed above we do not believe this to be a problem nor a negative factor. Many ship owners around the world are proud to have a boat with a less delicate commercial look. We agree with this view, which is the point from which we started to realize the Ocean King is a real ship in

which an owner can easily decide to circumnavigate the globe without any problems. We think having a boat that requires little maintenance and is rugged enough for daily use a must for every owner. In many parts of the world, equipped marinas are few or nonexistent and we must often be content to stay engaged in the mooring quays of commercial vehicles. With a commercial standard finish, there is no risk of scratching or damaging the finish on the sides with stucco work even leaning on the big Fender-going ships. If scratched, the use of a simple touch-up brush immediately removes the blemish-- and this can be performed in every corner of the world even by the owner himself. A stucco finish can be restored only by highly qualified personnel, nor can it be installed by the owner. In fact, it is necessary to dry the boat and work on a building site. If the owner has serious intentions to navigate the most remote corners of the globe, the look of a standard commercial is indispensable. A first aid kit to repair your boat in an emergency can be requested at the shipyard. The choice of color of course influence the aesthetics of the boat. Dark, opaque colors help remove weld lines and decrease the need for maintenance and cleaning. Light colors increase the visibility of welds and the berth at a commercial dock

or a work boat will leave the classic black mark on the side of the tire. Dark colors also increase the evaporation speed of surface water, meaning eventual corrosion decreases considerably. The colors used in the commercial sector from ships, tugs, etc. are for the most part dark, and we think the reasons are easily understandable.



Metal gates' operating diagram of the of "Mose" project



## 18. Galvanic current & problems of electrolysis

Two different metals in contact with sea water causing a flow of current causes corrosion of one of the two. Two different metals + sea water = a battery, as one becomes an anode and the other becomes the cathode. Best case scenario, a galvanic current can result in aesthetic damage such as cracked paint. Worst case scenario, corrosion with a puncture of the hull. This is an issue to keep in mind if using different metals such as aluminum and steel, in the design and construction of the boat. Where the aluminum meets the steel, a possible solution is to use a bimetallic material to be inserted between the two metals so as to be separated and isolated from each other. CNC employs this measure in every detail of construction. Even a simple screw fixed between the two metals is isolated beforehand with the aid of plastic washers and chemical material sealants. Fiberglass does not present these problems and does not suffer from electrolytic currents but it must still be protected from galvanic currents by means of appropriate zincs secured to the hull to prevent the corrosion of all metal parts on board. The steel hull requires the same system to be protected from this type of electric current. A

quantity of zinc sufficient enough to ensure at least two years of life will be provided on the hull of the Ocean King. Moreover, there is a solution that completely or partially replaces the classic zinc anodes making it so the owner will not have dry the boat for the maintenance. In this respect, fiberglass and steel are comparable.



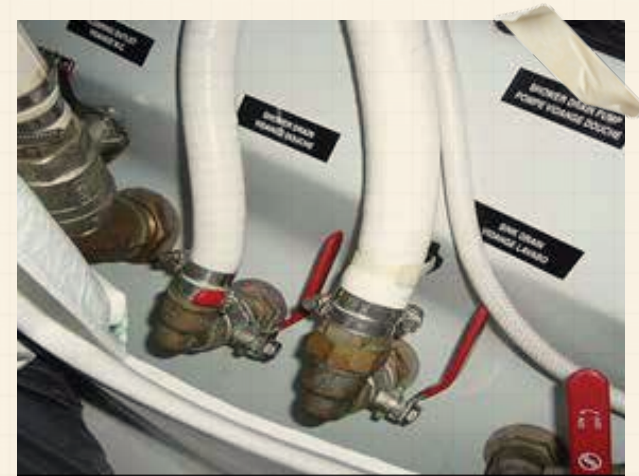
How the System works

## 19. Seacocks and exhaust

A hole in the hull is never desirable, but is essential to be able to feed a lot of equipment on board: motors, generators, fire pumps, sockets for salt water, etc. These holes, or seacocks, are often the major cause of sinking. Although it seems incredible, it is often due to a faulty or rusty tie breaking, allowing water to enter the hull and possibly engine room, causing the boat to sink in a such a short time it wouldn't even leave time for someone to intervene. This happens even when the boat is moored at the dock with no one on board or even worse, sometimes it happens that the people on board, while realizing the impending disaster are not able to run for cover and turn the shut-off valve because of the oxidation and poor maintenance of the latter. This happens not only in small pleasure crafts, but also in large yachts built by renowned sites that adopt the same criteria for small pleasure craft. Even in this case the Ocean King adopts the commercial standard imposed by international registers, much more restrictive and secure than that used in conventional craft. A tugboat lunges for a cable route or the breaking of a ball valve has never happened and probably will never happen. Completely different criteria is used in ensuring the safety of life at sea

and every possible cause of problems is taken into serious consideration.

In the Ocean King, seacocks and consequently, the holes in the hull are fewest in number as possible. On the Ocean King, there is only the use of an outlet to the sea. The main engines are not picking up from the sea but have internal circuit boards with a closed cooling hull called a "KEEL COOLER". The vast majority of commercial units adopt this system. The advantages are numerous: there are no inputs of salt water, (in some cold climates the proliferation of plankton is so high that an open-circuit system with classic sea filters clogs within a few minutes, compromising the integrity of the engines. This could also happen with Mediterranean algae, mucilage, nylon bags, etc., clogging the filters and the cool water intake to the point of impairing the necessary cooling of the engine and resulting in overheating of the same. The unloading of the generators is through this system. A closed-loop system with box cooler cooling, in the Ocean King guarantees the total absence of these issues. Every modern tugboat uses the same system. The outlet to the sea instead is at the service of other utilities, fire pump, cooling, air conditioning, salt water board etc. It consists of a large butterfly valve with hand



Seacocks used in pleasure boats. A simple break in a hose clamp can sink your boat

wheel, a large filter inspection, and everything connected with steel welded pipes, not the clamped plastic tubing as is found in the majority of fiberglass yachts. A big manifold or clarinet downstream of the valve, ensures the distribution to the various users.. A powerful jet of compressed air connected to the air compressor keeps the system clean by expelling anything that may have entered back into the sea, just like in true ships. This system, which is adopted by every commercial vessel on the ship registry ensures a life of many years without the need for major maintenance. The use of a valve electrically controlled by a remote control on the bridge with possible alarm of water in the bilge can be mounted even if we do not consider it necessary for safety purposes. The Ocean King project complies with the international pollution guidelines MARPOL (Marine Pollution), which provide for the exclusion of direct discharges to the sea and the presence of grey tanks for water and black tanks for water bilge water and waste oil.



Professional Manifold



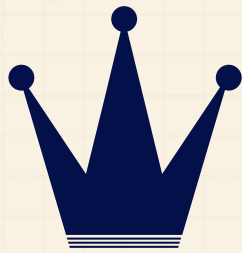
## 20. Fire safety: steel does not burn, fiberglass does

Fiberglass loses its strength with heat, softening as the temperature rises and burns at relatively low temperatures ranging from 120 to 250 degrees. If the fibers are exposed, one need only a match to start a fire as the fiber itself is an excellent fuel. Once a small fire is started, the structure of the fiberglass boat acts as a great kindling and in a few minutes the whole thing burns and collapses without the possibility of remedy. Fires at sea are a catastrophic event and can be triggered by various events, from lightning touch during a storm, or from the spark caused by a live wire, or an electrical short circuit. Often, the electric cables and some electrical outlets are placed behind bulkheads or accesses and it is often impossible to inspect the insides, where debris or remnants of machining including glass fibers are in direct contact with the electrical cables. Just the bite of a mouse, or the overloading of an electrical cord could cause disaster. Aluminum melts at about 650 degrees, already much better than fiberglass, but still below 1500 degrees melting point of steel. Although predicting a fire on board is a difficult thing to do, we believe that if a fire were break out, anyone would prefer to

be on board a steel ship steel than one made of fiberglass or aluminum. Before the steel begins to break down and catch fire, the fire can be contained and limited to clearly defined areas. Once closed, the watertight doors negate the possibility of entry of air (thanks to the fire dampers). This should curtail any disaster or destruction before it compromises the rest of the ship. A fire in a commercial ship is definitely an undesirable event, but in the vast majority of cases, the damage is contained and the fire extinguished without the loss of the ship. Once a fire is started in a fiberglass boat nothing can stop it. The Ocean King however, exhibits a sophisticated fire detection system and an automatic fire extinguishing system with CO2 in the engine room. In addition to this, there is a system shutdown to seawater equipped with a fixed steel pipe and a pump to 50 cubic meters per hour (50,000 Liters / Hr.). A system consisting of several water cannons like the Uni 45 guarantees the extinguishing of a fire before it can spread to the entire ship. Watertight doors, compartmentalized areas, boxes integrated into the fuel hull, electric cooking and gas, the engine room with adequate forced ventilation system and intercepted in case of fire from fire dampers, plenty of space between the engines, heat and smoke detection in each

local plant, shutdown of CO2 and large-scale saltwater hydrants form an effective line of defense against fire. With the system in large-scale fire hydrants, you can also give assistance to anyone in need by acting as a real fire truck.





## 21. A true tug

In today's market manufacturers or designers dub their boats with epithets or even more pompously, as Expedition Vessel or Trawler or Explorer. Let's say that the current trend is that of Explorer or Expedition or tug. Many manufacturers, however, as often happens when riding the wave of fashion, use existing normal boat designs, change the deck or the bow lines, then rename the simple and honest pleasure boats. Unfortunately, no one can avoid this and no law prevents a site designer from naming his boat what he wishes. Many even resort to names like Fast Displacement Trawler Shuttle that any marine engineering student would find absurd. To make things clear, a boat is a displacement boat or a planing boat, and a fast displacement boat cannot exist and will never exist. A quick tug will never exist and anyone who purports so has the wrong notion. We would like to clarify the concepts on which "good" is based. These need to be understood so as not to confuse the primary characteristics that differentiate various projects. As there are no laws that forbid whatever one desires to misrepresent, we believe that a potential owner should be educated on the various differences between the boats and decide freely if they

want to invest or throw away their money. We define a tug as a boat having the same hull characteristics and construction of a real work tugboat. More specifically, the Ocean King stems from the hull of a typical supply vessel or Escort Tug.

There are different types of tugs:

### 21a. The pusher

Limited size and reach, pushes barges and help ships maneuver using the bow as a push point.



**21b. The tractor**

Tugs usually offer service in the ports and have great maneuverability, but are usually not suitable for use offshore. These tugs usually use a transmission “Voith” in the bow with long helices that descend perpendicularly from the hull and that, by varying their pitch, can easily move the vehicle in any direction. Although this type of transmission displays high maneuverability, the draft requires considerable propellers combined with a low yield and a configuration of the engine room located at Bow, which undermines its use for the pleasure navigator, but remains very valid for use in professional arenas.



“VOITH” system with bow helices

**21c**

The ASD, or Azimuth Stern Drive, are typically used instead in the deep sea trailers and thanks to their propulsion (from which they are named as the propellers rotate 360 degrees) have outstanding maneuverability in a variety of sea conditions. From this type of hull and propulsion is the idea of the Ocean King was born. Escort tugs and supply vessel are in this category of boats with innate seaworthiness Suffice it to say that this type of vessel is typically used to provide assistance during storms in the North Atlantic, or they are used as an aid to oil rigs in oceans around the world, or for deep-sea towing without limits of distance from the coast. These type of hulls and hulls are the best that exist in terms of safety and seaworthiness, and represent a point of inspiration for any naval engineer. The Ocean King is born from this concept. The only difference between these boats is length, with a Supply Vessel reaching twice the average length of his younger brother the Ocean King

Boats of the same size of the Ocean King, however, serve as an escort tugs anywhere in the world from the North Atlantic to the Tasman Sea. The width in these boats is crucial to its stability and seaworthiness. The

only way to counter a towing ship which is pushed by wind or current in the direction opposite the one chosen by the captain, is to use the tugboat as a brake, positioning it perpendicular to the direction of the ship. A little instability would result in the overthrow of the medium. This does not happen due to great width and considerable immersion in addition to mass and displacement. The 1:3 ratio between length and width is standard in tugs of this type, also reaching 1:2 in the tractor tugs. This means that a boat of 24 meters must have a beam of at least 8 meters to be considered as such. A tug 24 meters long and wide 5 or 6 meters wide does not exist and therefore cannot be anything other than a false tug. The tug captains, when asked which boat they would prefer at sea, they respond that there is no news of a sunken tugboat. The trawler or vessel is instead always a displacement hull, but lighter in construction than the tug, less immersed and narrower.

A trawler is still a big boat. It is safe and reliable, with displacement as its strength. A fast trawler does not exist, but a trawler from 10 knots is a serious trawler that can go to sea in complete safety. However, a trawler is not a tug, does not require the same structure, the metal sheet do not need

to be so over-sized, and often it is equipped with a single engine and maneuverability is certainly not that of the tug. The hull of a trawler can also be round (we will resume this discussion on hulls later) and will not have the same degree of stability as the tug. For Explorer or Expedition Vessel this means vessels which in theory should allow us to navigate all over the world. At a commercial level, such a product might look like Supply Vessel and thus closer to the Ocean King than any other boat in circulation, but a good trawler might also have the same characteristics. Any Explorer or Expedition that does not have the same characteristics as said first for a tug or a trawler cannot therefore be defined as such. Therefore, we consider it a misuse of terms by anyone who gives such names to barges for coastal recreational use, as often happens. The same applies to the catamarans. A trawler catamaran does not exist as a concept. Although the catamaran is a beautiful boat with great advantages in terms of speed, fuel consumption and transverse stability, it cannot be considered neither a trawler now an Explorer. An Explorer is an Explorer and a catamaran is a catamaran. The proliferation of commercial offers, which each year fill the boat shows of every nation, greatly confuse customers who are uneducated about the



Supply vessel = a true Explorer



qualities and characteristics vessel construction of this kind. At each fair in fact, there are many new features offered in the “shuttle” sector that attract many onlookers and fans of the genre, but with a more experienced eye they just smile. Give it a try, take a true captain of a ship or real commercial tug with you to a fair and encourage him to freely express his opinion on what is being proposed, not only as it concerns furniture, marble bathrooms or woodwork, but also the engine room, plant engineering, the displacement of the hull, the construction material, stability, etc. You’ll be disappointed or surprised by the answer that you feel that the much-vaunted Shuttle or that a superb Explorer is actually defined by the term “boat” or “iron” or even worse “bathtub”! We agree with this view and simply say that just because it looks like a tug does not make it a tug. Just because a boat may look like a trawler does not make it a trawler. A true trawler or a true Explorer has a pure displacement motor, with a certain depth of the hull, large fuel tanks, ballast tanks, a low center of gravity, a large displacement, a large load capacity, a suitable ratio of length to width, a working engine and possibly a steel hull. It must be designed with a high degree of autonomy for the year, and economy in consumption and absolutely must have a hull adapted to be able to face any sea conditions. Trawler or Explorer boats are built with the same concept as commercial vessels; must be able to stay at

sea for days, if not months, without compromising the health of the sailors on board, shall be provided with redundancy so you do not have failures and blackouts in the open sea, must be able to deal with all attacks that the sea presents with extreme safety and most importantly, they should always be able to return home! The bridge must be very spacious and have good visibility, possibly 360 degrees, and must be able to accommodate a bed or even a cabin for the captain who during breaks can still access the commands in extreme speed. Corridors and passageways must be sufficiently wide to allow the crew an adequate maneuvering speed. For boats that remain at sea for long periods, the crew must be able to face the worst weather conditions possible (recall the famous movie *The Perfect Storm* as an example).

The hull of these boats must only be fully displacement. Planing or semi-displacement hulls cannot be used for boats like that. A separate chapter on hulls will explain why, and how to recognize a hull of this type simply by the speed). Therefore, these boats take this kind of bottom edge and rarely the round type. None has the stabilizing furniture fins but rather the welded blades hull that dampen rolling motions (more about that later). The large width helps to maintain good stability even when stationary. The large capacity of the tanks in the lower part of the hull also provide for a very low center of



gravity. The Ocean King is a true Explorer not only for its look but because it possesses all these features and many more. The enormous width (8 meters about 88 feet), the double-hull edge, the remarkable diving, large capacity tanks (about 40,000 liters on the Ocean King 88), the largest reserve of fresh water, and ballast construction in heavy gauge steel, the steel structure of large scope, the heavy duty engine work, the center of gravity relatively low, Azimuth transmission (optional), the redundancy, the advanced pilothouse with excellent visibility, an engine room of enormous size that allows convenient access to all the systems on board without one having to be a contortionist to access the facilities, and crew area (where required) of considerable size (the crew area on the Ocean King is equivalent to the guest area on a normal yacht) makes us proud to call the Ocean King a true Explorer without fear of contradiction. We ourselves visited most of the boats named this way at the various boat shows. It has shown us that for the most part they are just yachts with the style and look of an Explorer, for the hybrids between an Explorer and a speedboat, the majority employ a semi-displacement hull, have a range of a few hundred miles, are built from fiberglass or aluminum, or in rare cases steel of a few millimeters

thick (4-6) which have a width too narrow a draft by speedboat, axes and propellers in many cases protected from the hull have great finishes in the interior but not in the engine room. Unfortunate sailors or crew members dealing with cramped work areas are often the reason for mutinies during the summer. Some ship owners' holidays are compromised because they find themselves without crew in the summer months due to the inability to "survive" on board due to stability issues and weights cannot load large dinghys on board and certainly cannot place them in the upper decks. Often times to lower the weights the dinghys are put in the garage limiting the size of the Tender to insert. About the garage, have you ever wondered why the most beautiful and livable part of the boat and the stern that are "disfigured" with the construction of this hangar? Have you ever seen a trawler or Explorer have the open stern near the water with a plastic or iron cube called a garage?

Well, it is constructed that way for more space in the engine room (usually positioned behind) since in these types of boats there is not enough space in the hull to put the engines. Shallow draft = little stability and little space for the engines. So they invented this horrendous solution that pleases every-



one and that is often passed off as a technical solution, a marvel of naval engineering! You will find that the stern of the Ocean King is exactly the same as the hull of a true tug-boat. They have the same height of the main deck from the water level and even if that of the Ocean King seems higher, in fact the measurement is the same, 1.20 meters from the sea surface. The difference lies in the fact that the Ocean King, having a high water aft platform of only 50 Inches needs 3 steps to allow the ascent or descent from the platform to the main deck with just 70 cm difference in height. Then compare it with that of one of these yachts (calling it an Explorer seems like a misuse of the term). Imagine navigating or simply find yourself at anchor and being able to walk a few inches from the water without obstacles. On the Ocean King it is possible to walk across the surface of the stern unimpeded, watching the sea you have under your feet a few inches away. Think of doing the same thing on one of these garages 3 meters from the sea! Which do you think is better as a technical solution? Yet in our project we have not invented anything different, we only did the simplest thing in the world- made a real stern. For the garage I assume that we should address a course for surveyors and architects. Here is how a design defect (a hull without sufficient

volumes) is passed off as a great technical solution. With the Ocean King there's no need to put the dinghy in the garage or invent anything, the great stability and high-volume hull allow us to place a heavy 8 meter 1900 KG tender on the '88's on the upper deck without any problem, and the engine room can contain numerous engines and systems simply because of its significant size and large available volume. No garage or attic are needed to correct design flaws, you just choose the right hull and use the solutions adopted by those who build true ships that every day sail the seas around the world.



Garage in a Yacht



"Open Stern" in a real Explorer

## 22. Speed from the hull, not by propulsive force

We talked before about displacement hulls as well as semi-displacement hulls and planing hulls. For the Ocean King we chose (the decision was mandatory if we wanted to build a true Explorer) a pure displacement hull like all true Explorer or tugs in the world. People who would like more speed often ask us how fast our boat goes. We simply respond that if they want to want to “run” they should buy a planing boat (and not think of having an Explorer). We don’t decide this, physics does! A displacement of 22 meters will have to settle for an honest speed of around 9 to 10 knots, if you want a displacement of 30 knots, an aircraft carrier or oil tanker of 300 meters can be the right solution. The maximum speed of a displacement hull is governed purely by physical laws that cannot be changed by adding an infinity more engine power. The limit of each hull is identified by the so-called Froude number (William Froude was an English engineer who first studied these phenomena) that determines the speed limit for each hull. A simple mathematical formula can help anyone to control the speed limit of each hull without having to be engineers. Data that is  $V =$  speed of ship in meters per

second (for simplicity just think that one meter per second is about 2 knots)  $G =$  the coefficient of acceleration of gravity (9.81)  $L =$  waterline length of the ship expressed in meters.

The formula to be applied is this:

The number you get will be the Froude number and should be less than 0.4, which is the limit for displacement hulls. Above 0.4 the hull will no longer be semi displacement or planing. Reversing the formula, you will get the maximum speed of a displacement hull that is:

$Froude = V *$ , then on a 30-meter-long hull value will be  $V = 0.4 * = 6.86 \text{ m / s} =$  about 13.7 knots.

Enormous engine power is a prerogative of tugs, not to increase speed, but for the shooting power. A 24 meter such as the tugboat Ocean King 88 with 4000 Kw of brute power (same as in work), will reach 1-2 knots higher speed than the standard 1000 Kw. If the aim of the ship owner is to burn 800 liters of diesel per hour, reaching more than 2 knots in speed, and leaving a monstrous wave trailing behind, we are ready to please him but strongly do not recommend it. In an





Explorer, the power used is, for obvious reasons, very low compared to that of a planing boat of equal measure. An Explorer reaches its speed limit using relatively little power. The Ocean King with 1000 Kw of power available in reality needs only half that to reach its limit, the extra power is saved as a spare in case of need when the sea is rough or when there is mechanical failure. With the Ocean King 88 you can also safely tow a 100-meter vessel without problems. Without dwelling too much on mathematical formulas or in engineering terminology, we say that theoretical speed in a pure hull displacement (therefore suitable for any navigation) is identified by the distance from the point where the bow wave forms to the point where the next wave forms. The simple empirical formula that anyone can instantly calculate (for example, while you're at a trade show and some vendor is speaking) is:

Hull speed (expressed in knots) = square root of the waterline length (in feet) multiplied by 1.34 (On an 88 foot it will be 11.98 knots).

For this reason, the higher the waterline length, the faster. This rule applies well to any vessel with a hull displacement. If a sell-

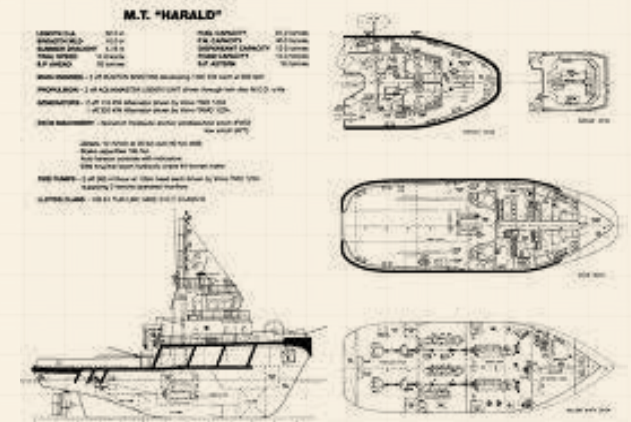
er tells you a 70-80 foot Explorer reaches 15-16 knots, know that you are being cheated, or at least he is using inappropriate terms. 15-16 knots at the Froude number in a 70-80 footer will be about 0.5-0.55, well beyond the maximum limit of 0.4, which is impossible in a displacement hull. A displacement hull 70-80 foot Explorer or trawler cannot exceed 11-12 knots. An 80-90 footer can reach 13 to 14 knots, not 18! This is the first rule to be able to determine if you are being propositioned a true Explorer or if they are impersonating the means used for coastal navigation for a ship crossing the ocean. Although you can cross the ocean rowing in a kayak, this kind of boat cannot be regarded as a great seaworthy boat, just simply a means of coastal navigation. This concept should be quite clear when one buys a boat. When you invest a large sum in a boat of this type, you need to know exactly what you are buying and the intent of the boat. If the ship owner's desire is simply to have the look of workboat or Explorer, and not to navigate potentially dangerous remote places like Alaska or Tierra del Fuego, but only to show off their boat among the thousands of others massed in the Sardinian sea in mid-August, then any type of boat or yacht is fine. If the intent is instead to have a true vessel recognizable to everyone that it can

be navigated, even if only with the crew in any corner of the world, then it is obligatory to buy a real Explorer. We realized then that a fast hull can only be planing, while an average speed of an 80-90 footer semi-displacement hull is about 16-18 knots. We also realized that hulls of this type do not guarantee seaworthiness and which are not suitable for long routes away from the coast. For this type of navigation there are displacement hulls, the same utilized in work boats, tugs ships, etc. The Ocean King employs one of these hulls. Even here there are different types of displacement hulls, some more effective, some safer, and some more comfortable. We did not have any doubts in choosing this hull. We considered which guarantees the most seaworthiness, and did research by identifying the safest professional and commercial boats and the typical service providers in the parts of the world where the sea is really dangerous. From the coast of Labrador to Newfoundland, from the coast of Maine to Normandy, from the famous harbor of Brest (the famous book Storm Chasers by Hervé Hamon set aboard the deep sea tug Abeille Flander) to the North Sea, the rescue or work boats that must guarantee service 24/7 in all weather conditions have a unique type of hull that we adopted in designing the Ocean King.

As you can see from the photos, the same hull design is taken from both boats. This is what



best ensures the safety and comfort of navigation in all weather. As can be seen from the drawings, the hull enters powerfully from bow immediately touching its maximum depth, it remains constant up to three-quarters in the stern greatly flattening the boat leaving sufficient water to the outlet of the propellers. The flattening and edges form considerable resistance to transverse motion and significantly attenuate the roll.



## 23. Round bildge and hard chines hull

The first wind surfboards were built in the shape of ironing boards-- flat on the bottom. The first thing that struck a chord was their stability. Mounting a board a few inches wide was not easy, but once standing one did not need to be an acrobat to avoid falling. In the first lesson, instructors had students climbing on a table without a sail to get them used to balancing. Years passed and one day came the round bottom board. It was like stepping onto one of those floating bins that are seen in obstacle courses on TV . Yet the two boards were almost identical in length, weight and width, the singular difference being that one had a flat bottom while the other had a round bottom.

A flat bottom is a chine very pronounced. From that experience everyone understood that a flat bottom is stable while a round bottom rolls. A flat boat exists and is called a pontoon or barge but it is not a boat capable of maneuvering stormy oceans. It is a river or a coastal boat that has great stability and very large flow rates but is not suitable to face the open sea. In many parts of the world, often the traditional round bottom was the only possible solution. The wood

was easier to fold and to waterproof if worked in curves instead of corners, and a chine hull made of wood with lots of beams and planking was very difficult to achieve. Some designers and ship owners still use both round type hulls for aesthetic tradition, but never for reasons related to physics. However, we are willing to use any type of hull its superiority over ours can be proved.

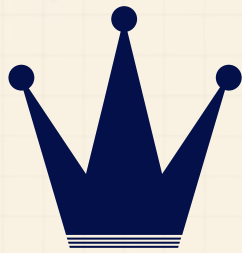
Many yachts on the market adopt hulls of this type. Conversely, most of the oceanic tugs or supply vessels have chine hulls. Why?

1. ANTI-ROLL: as we said before in the windsurfing experiment, hard chine hulls have a lower roll of the round. A boat with a nice, smooth, round bottom rolls more easily than a chine with the same length, width, and weight. Because at the moment of the roll, the edges of the hull create more turbulence and turbulence is a force that opposes the roll. Turbulence is a force that significantly counters the rolling. A round bottom produces little or no turbulence and counteracts the force of the roll. A simple experiment you can do is to take a bottle of water and a container like a squared milk carton. Take the bottle and let it float in water. Notice it rotates by turning it on its longitu-



Hard chines hull used on Ocean King





dinal axis. The bottle will stop turning after a while, will not create waves, and will seem to turn like a spinning top. Try repeating the experiment with the milk carton or TetraPak. It will not turn and the splashing waves will immediately stop its motion. In our opinion, rolling is one of the most annoying motions that you can get in a boat. Seasickness is one of the most immediate consequences due to the sense of instability and loss of balance. Every movement becomes impossible in a boat that rolls. The working boats that have to be at sea and provide a service cannot make these movements. Although professional seamen have a higher resistance to seasickness than the rest of us, even they not would be able to work in a boat at the mercy of the roll. The effect of seasickness is more or less the direct result of a rolling ship. Human tolerance is 6-8 seconds between one roll and the next. A round bottom is rarely able to maintain these parameters, while it is the norm for a chine. The chine helps to significantly reduce this movement. To overcome this problem in a round bottom, anti-roll fins become an essential accessory. These are considered an active defense. The chine is instead a passive defense to rolling. It requires no maintenance, is always on, does not need to be installed, and costs nothing. It does not create noise, works both at

sea and at anchor and at any speed. It does not consume fuel or electricity, is not worn down over the years, does not break, and does not create problems with breaks in the pipeline in launching maneuvers.

2. STABILITY: the width of the boat at the waterline is a variable that determines stability. The equal width chine bottom increases the stability of the ship. This is because the sides of the hull rise a straight edge on the side while maintaining the same measurement of the bridge below the waterline for many centimeters in order to ensure the same measure under different load and immersion situations. A round bottom descends gently from the walled water at a constant angle which greatly reduces the width at the waterline especially in conditions of low or medium load. The stability is a fundamental characteristic of a ship or boat. The proof of stability in all new construction is mandatory for all shipping registers in the world. The stability of a vessel is therefore one of the most important factors regarding both safety that comfort on board. High stability increases the possibility of increasing the transportable weight by placing it in high areas. We are willing to compare the stability data of our products to those of any other manufacturer in the

world. The questions about how this or that boat rolls asked to sellers at boat shows as if they were experts make us smile. In fact, the answers make us smile even more. Very infrequently does an answer include a unit of measurement or objective data to compare with other products! The bad thing is that many in the market for a boat do not follow these buying even though it would be easier to decide on a boat with objective data, mathematical numbers or a ladder to follow. How many would buy a diamond if the seller couldn't tell them how many carats it is. No one! Maybe because a diamond costs thousands of euros? Why then for a yacht that costs millions of euro are unempirical answers accepted as if it were the norm? A thorough evaluation of a ship's characteristics and features is a must. We offer specific calculations that we develop collaborating with the best universities. Stability, as seen below, is measured in meters and is equivalent to the GM. In the Ocean King this measure is between 1.4M (vacuum condition) and 1.8M (at full load), the very same values that are found in real offshore tugs. To understand what these numbers mean, just think that to cause a slip of only 1.5 degrees in the Ocean King 88 force of about 4 tons must be applied all on one side at the level of the top deck calculated with

the ship completely drained of fuel (having 30 tons under the hull would lower the center of gravity significantly and the list would be halved!). Basically, it's like having 40 people on the upper deck all on one side and the boat would lean just 10cm! Compare this data to any other yacht on the market, provided that the other builders are able to provide it! The tank tests provide us with every detail about the Ocean King and how it will behave in rough sea.



A real hard chines hull in a real Tug, the same hull of Ocean King

## 24. Notes on the buoyancy and stability of the boats

The stability of a vessel is an important element of safety, since it is nothing other than the ability to oppose the overturning (transverse stability). In other words, stability is the ability of a hull to resume its trim balance after oscillations (pitch and roll) \*, caused by wind and wave action. It has shape stability (hull forms with full, rounded) and weight stability, as obtained on medium to large sailing vessels using appropriate weights placed in the keel to balance the slippages and make the boat stable. In both cases the stability depends on the position of two particular points and characteristics of the craft, which are:

The center of gravity (G), the point of application of the resultant consists of various weights that make up the ship and cargo; The thrust center (or bottom) (C), point of application of the resultant of all the forces that the thrust of the water exerts on the hull.

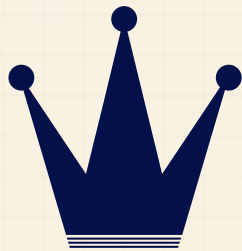
A vessel when floating in calm water assumes a balance due to two equal and opposite forces lying on the same vertical:

(P) the weight of the boat and push (S) that keeps her afloat (Fig. 1). The weight always acts on the center of gravity (G), while the thrust always passes through the center of the hull (C)

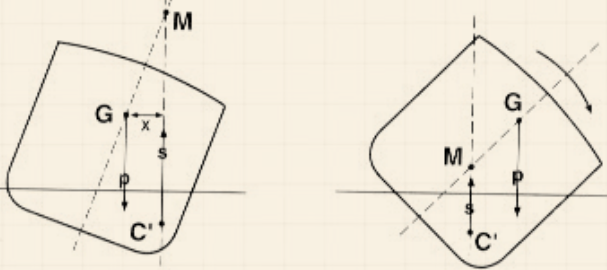
Buoyancy (SA): A body immersed in water receives an upward boost from the bottom (SA) applied to the center of the hull (C) equal to the weight (P) (applied to the center of gravity (G)) of the volume of water displaced.

Reserve buoyancy: The difference between the thrust relative to the whole volume of the hull, and that relative to the hull in full load conditions. The position of (C) varies in relation to the vessel heeling (because it changes the shape of the submerged part of the hull) while (G) remains always on the same point, even at ship heeled (only if we add or move a weight from top to bottom, the value of (G) is lower).

Aligning torque: heeling the boat, and thus varying the shape of the hull immersed, hull center © will move to (C'); giving rise to a new vertical thrust (S) raised from (C'), by the action of the force of weight P (always facing downwards) and the thrust S (always facing upward) arises the pair of forces (X), a pair of transverse stability which tends to straighten the hull, acting until (G) and C will not be to reposition itself on same vertical.



Metacentre (M): It's the point of intersection of the vertical thrust (S), built from (C'), with the longitudinal plane of symmetry. (M) represents the limit of the ship's stability and it will not always dominate (G) to reverse the trend of the pair of forces, which would involve turning in the opposite direction, namely a tendency to the hull overturning.



Metacentric height: is the distance measured in meters between points (M) and (G). The higher the metacentric height and the greater the aligning torque (X), the more stable the boat. Some examples of values of metacentric height of military ships: Aircraft carrier - 2.5 to 3.0m (the most stable ship in the world).

Oceanic tug: .5 to 2.5 m.

The Ocean King: 1.4 to 1.8 m.

Cruisers: 1.0 to 1.6 m.

Frigates: 0.7 to 1.5 m.

Yachts: 0.3 to 0.8 m.

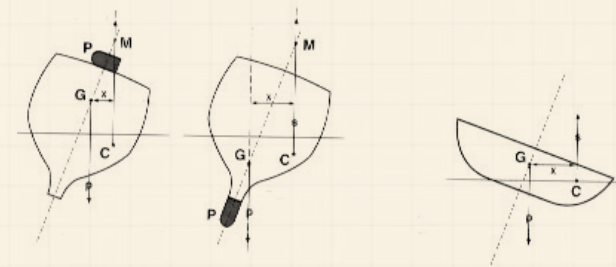
It follows that a metacentric height with too high a value, like that of an aircraft carrier, makes a ship "hard" in choppy water, holding the vessel to maintain the bridges parallel to the wave profile (in sailing jargon "riding the wave"). If the value is low it will be less stable and will roll in very rough seas (called "cut the wave") and is said to be "pliable". For the welfare of the crew a value of metacentric height from 0.8 to 1.8 meters as in cruisers and frigates would be desirable (but almost never achievable) on all recreational craft! The Ocean King has a value in this range!

Established weight: when a hull ballasted keel tends to skid, (C) moves slightly, (G) is lowered considerably and increases the distance (X) between the two vertical (G) and (C), you have such a strong increase in righting moment and great dimensional stability. Conversely, in a large section hull, small skids cause large shifts in (C) and substantial increases in righting moment due to the increase of (X).

Factors affecting stability: because the center of gravity and stability of the original features remain unchanged it is necessary to: insert heavy weights that are arranged symmetrically with respect to the longitudi-

nal and transversal axes of the hull, the deck placed as low as possible, water does not stagnate in the bilge, which, if in quantity, acts as a heavy iron ball that moves crazily about the hull causing abnormal dangerous careening.

\*It has roll when the hull oscillates around its longitudinal axis and pitching when it oscillates around its vertical axis. As an example, we take two boats of equal length, one 7 meters wide and the other 8 meters. The stability as we have said is very dependent on the width and is proportional to its square. Comparing the two boats then, although there is only a meter difference in width, the value of the stability of the 8 meter will be 25-30% higher than that of 7 meters! That's why in the Ocean King the breadth of the hull is much higher than any other boat on the market.



**3. Draft and immersion:** since the chine hull is able to have greater volume below the water level, for the same displacement volume the tendency is to float more and then the draft may be less of the same which would have the ship if equipped with a round bottom. The lower draft really is not absolutely what we intended when we designed and developed the Ocean King. The draft and, consequently, the hull of ship are the most important for its seaworthiness. A shallower draft often implies little seaworthiness. Also in this case we have not “invented” anything new, we only observed what happens in the professional sector and, more specifically, in the field of a true supply vessel or oceanic tug. Taking these as a reference we noticed that a 24 meter cannot have a dive boat (propellers are often not calculated as the draft in many yachts) of at least 2 or 3 meters. If it was a 60 meter it would have 5 meters of draft as in a true supply vessel. So if the chine tends to have more volume in a round bottom and therefore more hydrodynamic thrust that makes it float more, how can we ensure the same draft if not more? Simply by using more and more ballast weight (both static and dynamic). That’s why it is important that we use a heavy steel structure without sinking the boat. The displacement and diving are essential for a

boat or ship that will sail in all conditions. A low center of gravity as we said increases stability considerably. Furthermore, the high dive helps to position the machine room in the lower part of the hull, leaving the cockpit free. In addition, and not to be underestimated, having a lot of volume in the hull and a lot of depth, we were able to considerably lower the height of the building and to adopt internal volumes significantly higher than any other yacht. Suffice it to say that the Ocean King 88’s the three bridges have a livable height (including floors and ceilings, and insulations) of 2.15 meters respectively in the lower deck (one of the cabins) 2.40 meters and 2.20 meters in the main deck and command bridge! All without compromising the total height of the immersed part, which remains lower than that of any 3 bridges present on the market (and bridges that do not exceed a height of 2.00 meters!). In this case the chine employed wins over any other.

**4. Efficiency and consumption:** many agree that such large volumes, exaggerated width and a such a high dive have several advantages, but as we have seen in terms of consumption this solution is her Achilles heel and it is preferable to use a leaner and more efficient hull. We also are aware of this, but we consider it a small token to pay for having many advantages. Of course, a round shuttle stern of 60-70 years, 24 meters long and 5 meters wide, with a dip of 1.80 meters with a sleek bow and round bottom, definitely consume less than an The Ocean King 88 8 meters wide with a massive bow and little, slender, square stern, chine and immersion of 2.50 meters with about 3 times the displacement of the other, but we wondered, how much fuel are we talking about? The 88 foot Ocean King at 9 knots consumes about 90 liters which is equivalent to the gasoline consumption in his tender by 8 meters with a 200 hp traveling at 20 knots, and weighs 250 times less! A round shuttle stern that rolls just by looking at it, consumes about 70 liters at the same speed! These 20 liters compared to the average annual engine hours, 300-400 max (though in pleasure, the average is even lower, about 100-200 hours per year) is approximately equivalent to 6,000 liters! Subsidized diesel in Italy costs about 80 cents / euro, so we’re



talking a maximum of 5,000 euros in annual savings! This is equal to the monthly cost of a crew member or the cost of a launching operation in a shipyard! We respect every idea and choice of course, but we consider that kind of money paltry when compared to all the other benefits that comes with it. In the calculation we have deliberately considered only recreational use. Also on consumption, let's talk solutions and concrete proposals. Why not instead of filling of your ship with 40,000 liters of fuel in Italy, where it is very expensive, do so in Turkey, or Libya or Morocco where it costs just a few cents per gallon? This way the cost of fuel will be a negligible factor you will enjoy all the benefits of a real and serious ocean hull Ocean for the cost of your Tender. Think about it!

**5. Fuel economy:** We just discussed consumption but want to expand further because it is a very sensitive topic for many owners. First of all, let's say that compared to the planing yacht or semi-planing of the same size, our consumption is negligible. To reach 8 knots, for example, uses about 200 Kw. The consumption of a diesel engine is about 200/220 gram to kilowatt per hour, and it follows that at that speed we consume about 60 liters, 9 nodes will consume 60. A planing yacht of the same size at 20 knots consumes about 500 liters! Comparing the

consumption in miles, it follows that despite the 250 tons of ship against the 50 of a planing yacht, the ship consumes about 3.5 times less !!against the 50 tons of a planing yacht, we consume about 3 times less! We have said that the same length, we carry an amount of fuel we consume incredibly high despite lot less. A 24 meter planing yacht carries around 4,000 to 6,000 liters of diesel against our 45,000! A planing yacht may have a range of about 300-400 miles but in many cases even less, while we arrive safely at 3000 to 4000 miles! This means many advantages, from the absolute freedom to refuel where we want to and where it costs less, and with less frequency. Many cruisers have learned and perhaps have resigned themselves to the boring and irritating necessity to refuel in the middle of the summer. Hours in the hot August sun with the engine running and inverters under stress, the smell of diesel, waiting for our turn at the pump among other boats, jet skis passing in front, and when miraculously our turn comes we are told that we must return to the pump later because they do not have that kind of fuel available. With the Ocean King this is just a memory, since the supplies can be planned and acquired well in advance. Moreover, thanks to the system of boarding a professional and quick hitches UNI, and thanks

to the large piping size and vent boarding, tankage is done with enough pressure to reduce refueling times to less than half. We believe that for many owners who intend to use the Ocean King strictly recreationally (summer cruises limited to a few months), the supply will be once a year! For this type of use all 40,000 liters are not necessary; a few thousand will suffice. Even in this case the ship will not undergo variations in trim, a fuel transfer system through pumps will allow you to trim the boat without problems and to distribute the fuel where preferred. This system is also valid in the case of severe storms in which you need to give your ship a different setting. In short, everything as it happens in commercial vessels on the high seas.

## 25. Tipping and self righting

At offshore sailing events around the world as you can often see yacht straighten up quickly after being turned upside down because of the waves or the wind. This factor for sailboats seems to be essential but in motor boat does not seem to exist. Apart from some special means the Coast Guard has of self-righting after being turned upside down by the wave, it seems that no boat, ship, or yacht has these features. Our engineers asked themselves this question hoping to find a solution. Let's say, however, that this event is to be considered decidedly fortuitous and the probability of that happening is really very low, but still must be taken into account. The factors that determine the possibility of self-straightening are many and on a boat like that are unpredictable. No one can calculate with 100% certainty how the superstructure, windows, and interior furnishings will react and not knowing how much fuel will be there in that moment how it will behavior in various situations. One fact all agree on is that flipping a ship like the Ocean King is no easy task, there would have to be a mix of human error and unpredicted bad weather conditions. Those of you who saw the movie "The Perfect Storm" will understand the reference. Although it

is virtually impossible to overturn, sometimes even the impossible can happen at sea. Throughout, we have calculated a capacity for self-righting a heel angle of 90 degrees! The secret is the steel superstructure of 6 mm in the standard model and marine aluminum of 6 mm full model cabin. A superstructure is stronger than the normal hull of a yacht. Most windows and doors are sized to withstand the tons of pressure exerted by the waves and the water without breaking.

The glass in the windows of the bridge is high-strength tempered glass 15 mm thick, with tempered glass portholes to have armor protection. The watertight doors are made of steel and can withstand dozens of tons of force. The volume of the superstructure will act as a large airbag that will again push upward and straighten the ship. The test in towing tank will also address this question even if in reality the variables involved are different. Similarly, the overthrow along the vertical axis that might occur when a wave of monstrous proportions strikes the ship bow, raising it and inverting pivoting on the stern, could be an event that the ship, with a little luck, would survive unscathed.



## 26. Bulb bow

Anyone who has the chance to go to a commercial dock will notice that many of the moored ships have a projection at the waterline called the bulbous bow. Boats can often be seen employing this solution. Many customers that have viewed our project ask for explanations on this solution, and we invariably wonder why we did not anticipate it. Hearing these questions, we realized that often times customers may be “educated” by some unprepared seller that associates the bulb with “true ships” (pretty accurate) and the “true ships” to the bulb (not quite accurate). The bulb is not a “real ship” and a “real ship” may not even have the bulb if it is not needed or if its use does not lead to objective advantages. We would also like to give explanations in this case with the hope not to disappoint anyone on the actual functionality of this appendix. First, we say that the bulb bow is favorable and effective only if carefully designed. Its function is to favorably alter the wave profile generated by the ship. On fast or narrow ships its use is widely recommended. A commercial ship, even if it seems large and stocky, has a much higher ratio of length to width than that of a tug. A 300 meter long container that is 40 meters wide has a ratio between length and

width of 17.5. As said before, in an Explorer like the Ocean King, the ratio is 1:3 (24 meters long and 8 meters wide. If a container had the same proportions, it would be 100 meters wide!). So a commercial vessel can be considered a fine ship and the bulb in the bow will definitely have a positive effect. In a large ship, its effect is not lessened and can indeed be ineffective and impractical. The only way to tell if the bulb positively or negatively influences the resistance of a ship’s hull is to do extensive tank-testing. There are in fact reliable calculation procedures and reliable mathematical models to follow. We believe it unlikely that a yard that produces pleasure boats, or that has limited production (something common to all sites), may engage in such extensive and demanding design of the dynamics of the hull towing tank.

Recall that only one test in a real towing tank costs thousands of euros per hour and to achieve a truly effective bulb in a vessel, takes many hours. A true study of a container or cruise ship hull can cost hundreds of millions of euros, (where even a gain of 0.5 knots and less resistance mean a savings of several million euro during the lifetime of the ship) is feasible and desirable, and data collected from it will be used in the design



Bulbous bow



Tests in a ship model basin

and implementation of many other sister ships, while the study of a yacht hull, intended for a market infinitely more modest (and less pretentious), is absolutely logical and feasible especially for the benefits that may ensue such as less wave resistance and perhaps a speed increase of a few fractions of a mile! So often we believe that this solution is adopted in the name of fashion rather than real necessity. A bow with a bulb can be a good deal for commercial use and may make a good impression at a boat show rather than really increase the performance of the hull. Any boat that has this bulge in the bow can be offered to customers as if it were a “real ship” and this will certainly be a positive factor to trade and exploit more than could be done by showing the objective evidence of the improvements. One example is the adoption of the bulb in the faster semi-displacement type hulls where its application only depends on the subjective opinion of the designer that has nothing to do with physics. Before we discard a priori the option, we seriously considered it but we found more disadvantages than real advantages. Having a ledge at the buoyancy level that reaches the pack size of the bow is not a good thing for us. Indeed, shocks and collisions may occur because of this maneuver in prominence (do not forget that hitting a

normal boat in a marina with a 250-ton ship with a steel “beak” bow protruding under the water would cause a sudden sinking of the normal boat), as well as cables and ropes that could get caught in that area. In a real tug, it does not make sense to use a bulb as the disadvantages outweigh the advantages (which however are not demonstrable). Some say that adopting it would increase the waterline length and therefore you would also have a small reduction in wave resistance and consequently a higher speed. We take the view that reducing the wave resistance, the speed would not be significantly increased and would not be affected at all by this option. The higher design and build costs outweigh the minimum amount of benefits it would bring. If you want to run, the adoption of the bulb is not the right solution. Instead, buy a longer boat without getting illusions that those few decimeters of bulb will make you arrive earlier at port!



Bows of “true tugs”, without bulb bow like on Ocean King

## 27. Engines: a choice without doubt



Many owners of yachts often discuss amongst themselves the choice of engine to be installed or that has already been installed on their boats. Everyone would like to be told which is the best to install. On this subject, we would like to offer clarification. First of all, let's say that just as the best engine in the world does not exist, nor the worst. Today all the engine manufacturers in the world of engines produce good engines and none of the bad. It depends on the use to which an engine is intended. The selection of engine depends on its intended use. If the purpose is to surf for a few hours per year along the coast or just use the boat as a house "forgetting" to have a motor on board, then you do not need to invest so much in buying a high-performance engine. If instead the aim is to navigate seriously, visiting remote corners of the globe, then the choice should be more accurate. The brand under consideration must guarantee to have service centers all over the world if you can have an emergency at any time. In addition to simple speech on the brand and its service network, the choice must also be based on the type of motor to be used. A motor craft is different from the engine

of a tugboat and this is different from the engine of a ship. Each brand of engine has to list a series of power, and the differences in weight and performance between brands are significant. So it is said that in choosing the best engine of a given brand for a 500 KW, the same brand also has a 700 KW with the same characteristics. So the choice must be made by comparing so many factors and so many variables. To summarize, we listed the main types of engines available on the market so as to choose one that best suits the needs of both the ship owner and the boat on which it will be installed. First of all, the most important manufacturers divide engines into two broad categories: recreation boating (REC) and commercial. In the pleasure or REC category are engines with a very thorough power/weight/displacement ratio, motors intended for use restricted to a few hours of continuous use, engines that need to stay under a couple to express their power and bearing faults and malfunctions due to stresses due to speed schemes outside this range. Often some yachts suffer damage, not only for prolonged periods of activity at high rpm, but often even at low engine speeds. The least of these engines is very high and the power discharged at idle is very high (think that many yachts only engage the gear reach 7 knots). The advantage



of these motors is in the weight content and great power committed, however it is to the detriment of reliability and there is the high cost of continuous maintenance.

REC = RECREATIONAL In the REC category belong those engines usually installed as auxiliaries in small work boats or placed on the small fishing boats and work vehicles that provide support services in port areas or on tourist boats and pleasure boats and where maximum power is required for periods of 1 hour for every 12 hours of use, and where the mode of work must not exceed 70% of the power. The usage time is around 500 hours per year. This type of motor is absolutely not suitable for an Explorer. Instead, in the commercial series there are different types according to the use for which the ship is intended.

CON = CONTINUOUS DUTY This group of high-performance engines, usually installed on commercial ships, ocean fishing, offshore tugs provide continuous service. Even large power generators that require continuous service belong to this group. This category of engines is divided into three groups that depend on the power and the number of revolutions at work. There are the slow or low motors (rpm from 90 to 200 revolutions per minute) that are normally installed on

large ships such as oil tankers, container ships and cruise ships. These motors start at 4-5000 Kw of power up to 80 to 85,000 KW and a weight of 2,300 tons. The Wartsila RTA96 is one example. These engines adopt different diesel fuels found "at the pump", and have relatively low consumption at 170 grams per Kw / hr.) Then there are the Medium. These engines have a large mass, very low power to weight ratio, work at a low speed (800 to 1200 rotations) the minimum power from which is 800-1000 Kw. These motors are intended for use in heavy large supply vessels, oceanic tugs, cargo ships etc. Finally, there are the quick where the engine speed reaches to 1800 RPM. This type of motor is installed on fishing boats, tugs, and work vehicles. All three types are designed for heavy use in which there is provided use at maximum power 24 hours a day, 7 days a week. They have a very long life and maintenance intervals of up to 24,000 hours. The CON is the engine that has been chosen for the Ocean King project and is the best in terms of reliability, safety and durability.

HD = HEAVY DUTY The engines usually installed on high seas vessels, ships, small vessels, work boats, etc. where the maximum engine power is no longer required for uninterrupted periods of time as in the



CON, but instead for periods of 8 hours for every 10 hours of use. The continuous use is not 100% of the power but about 200 rpm less. The usage time is around 5000 hours per year and a complete overhaul occurs on average around 15,000 engine hours..

MCD = MEDIUM CONTINUOUS DUTY Or heavy to intermittent use. To this group belong those engines usually installed on fishing boats, work vehicles, and passenger boats where maximum power is required for periods not longer than 6 hours after 12 hours of use. Continued use is limited to time and must be maintained at 200-300 rpm lower than the maximum. The usage time is around 1,500 hours per year and a full revision surgery occurs within 10,000 hours of use.

INT = INTERMITTENT DUTY These engines are usually installed on small coastal vessels, work vehicles that provide light services, port boats, passenger boats, Coast Guard, etc. where maximum power is required for a period not exceeding 2 hours in every 8 of use. Continued use is limited to time and must be maintained at 200-300 rpm lower than the maximum. The usage time is around 1000 hours per year and a full revision surgery occurs within the 5,000

hours of use. To simplify things, we will make a comparison between the various types of engines with reference to a CAT Model C18 ACERT engine with a power of 454 hp 18-cylinder CC 18,100 and 1,905 KG of weight in continuous duty (CON) of up to 1136 hp in the recreational (REC) version for the same displacement and weight.

From this table, one can easily imagine the difference between the various engines and why the Ocean King project selected the best possible engine. In the Ocean King project, this factor was not underestimated. Indeed, engines of this type can be considered exaggerated for a ship that will be used for recreational use, but we believe that an engine of this kind would allow the owner to have the utmost security and the least possible risk in circumnavigate the globe. But if a ship owner is undecided and wants even more, and had a couple million euros available, we can install an Wartsila 6L20 engine 1000 kW at 900 RPM, a 10 ton engine that is usually mounted on large offshore tugs or commercial ships. In this case the owner could definitely say without fear of being denied, that they have the most beautiful engine in the world!

## 28. Wellhouse-pilothouse or control cabin



If the heart of a ship is the engine room, the brain, the nervous system, and decision-making is the console, or Pilothouse. It is here that all the controls, electronic instruments, and ship's navigation are located. This area along with the engine room is the most important part and as such must be designed and constructed in the best way. A real ship is recognized from this area and although this argument may seem obvious, it really does not seem so and you just have a look around at some yachts to realize this. Many in fact have dashboards worthy of a small boat from the lagoon or a motorboat from the lake. Let's see why and how a real bridge should be built. First, in a real dashboard there should be room for all the equipment on board.. There must be the highest possible visibility and a considerable amount of space for the people who operate the ship, and should be easily accessible from all parts of the ship via doors or stairs. Each control panel must be visible and able to be inspected by the captain at any time. For this reason, we believe that in a real ship the dashboard must be unique and not in other areas such as the flybridge. We believe it useless or at least unprofessional to use

the flybridge as a second control station. Of course, we understand very well that in the summer with the nice weather and the sun it is preferable to remain in the open air and operate your boat or ship from the flybridge, but we consider it a bad habit. Often "ghost" boats which proceed to sea on autopilot intersect. If you look more closely, you can see that the cockpit is completely empty. The same goes for the flybridge. It's most probable that the captain has submerged himself in the Jacuzzi or is lounging in the sun while every so often (at least when he remembers being on a moving boat) seems to scan the horizon in search of some obstacle.

In every sea in the world we've seen scenes like this, although it is more frequent among small boats (where perhaps there is no real captain on board, and the role is left to the owner). Although a ship or boat traveling at 10 knots is easier to control than one that is traveling at 30, we believe that any sailing, even if coastal, should be planned and carried out with the utmost care and attention, with safety being a concern. A constantly manned plank needs to be the norm in every ship and should be a rule to which every good owner adheres. Accidents at sea occur due to a captain's carelessness, often in the form of distraction, especially during the



summer. Leaving the dashboard, distracted by other things with the conviction that in the end, at that speed, there is no risk.. Given the possibility to have a dual station flybridge where, by force of circumstance, the ship's electronics cannot be located for us is a mistake. Bring simple commands in the "fly" and leaving the rest of the alarms, monitors, cameras, diagnostic, and so on the main deck for us is not cost effective nor is it secure. If we analyze the actual days of the possible use of an external location, we see that during the year the usability is very low. Even in the middle of August in fact, the days of optimal conditions where you can stay outside to command are very few and for a few hours a day. The sun, the heat, or the wind are not always a pleasure. We think that a beautiful air conditioned dashboard with comfortable seating and equipped with every navigation tool is definitely more comfortable than the classic leatherette seat mounted on the flybridge under the blazing sun. In addition to conditions where the sun reflects off the LCD monitor on the navigation tools, who will guarantee the safety of navigation if you cannot even see the tools? For this and other reasons, we have preferred to eliminate this solution. For those wishing to devote themselves to sunbathing while the ship is at sea, a service of turns at

the helm as in all true ships is highly recommended. In a true Explorer the cockpit is unique and should be so in all other ships with the prerogatives. Another very important factor that differentiates a serious dashboard from a simple cabin used for the same purpose is its shape and size. In fact, all you will have seen a real ship and all of you will have seen that the bridge seems to have the same form in all ships.. A real bridge should be placed in an elevated position compared to the other bridges, must be of good size and must ensure optimum visibility possibly to 360 degrees. In many cases, especially in large vessels for greater visibility there are two side wings that allow the captain to see the sides when turning the berth. In an Explorer like a tugboat, the cockpit must have an extreme 360-degree visibility so as to enable the captain to be able to match with other ships or oil platforms in any position to the front and side and stern. With the Ocean the project we tried to create higher visibility on the bridge, and visibility is good for more than 180 degrees in full-cabin version and up to 360 standard version. In the full-cabin 360-degree visibility is only possible with the help of rear cameras due to the massive Pilothouse superstructure. While in the standard version, a large glazed opening placed behind the driver's seat allows the

captain to have everything under control with only two points of shadow caused by pack size of the smoke stacks. Another very important characteristic of a true Pilothouse is the inclination of the front windows as in the real ships, which must have at least an inclination of 20 degrees opening upwards and never closed, as occurs in automobiles. A ship is not traveling at 200 miles per hour and has no need of window streamers for aerodynamics. In many yachts you see slanted windows as if they were race cars, and often the size is so large (probably because they were designed by interior designers rather than engineers) that we wonder what would happen if a big wave, having tons of thrust were to stroke above. Many times you will also see windows so inclined, that despite the considerable dimensions, come up to the captain of the eyes. No one is disputing the degree of aesthetic but from the practical point of view, and especially the marine point of view, it's questionable. "Perfection" is reached, however, in some ways with sunroof, where you often see the captain's head, who without adequate visibility was forced pop his head out. We do not adopt these solutions! For us (and for all those who are really there in the sea) a right angle of the glass is important for several reasons. First of all, the inconve-

nience caused by the reflection from the sun are surely be mitigated by tilting the glass, or by the shadow caused by the wheelhouse protruding from the glass that protects it from direct sunlight and rainwater. A window tilted in the right direction as in a real ship helps visibility at night and during the day, avoiding any glare from the sun and does not limit visibility due to the moisture that is deposited (especially in the morning). It is not soiled by birds excrement and in case of severe storms, it does not retain water. The visibility from the windows must be perfect and the furniture that contains the electronic instrumentation must find its place under the windows, never in the middle or above them as is the case in many yachts. In addition, a dashboard must have professional wiper systems and at least one clear view screen for better visibility even under extreme conditions. A real dashboard must have an opening on the side to allow the captain to get out in case of operation or to control the sea below. Another aspect not to be underestimated is the ease of cleaning. There should be no obstacles so as to permit window cleaning or any maintenance even in rough stormy seas. A stained glass window that breaks down during a strong storm can cause serious damage to the ship because of the water that enters the bridge,

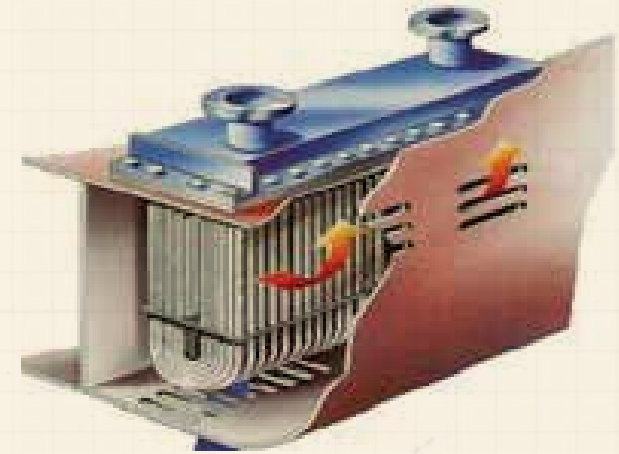
flooding electronic equipment. This can cause blackouts and loss of control of the ship. You should be able to run for cover in this unfortunate situation. Who can guarantee a quick accommodation of the damage in extremely adverse conditions, such as those that occur during a storm, if already in port while standing still it is almost impossible to get close to the glass without climbing to reach it as is the case in many yachts? Suffice it to observe the yachts being washed on a Sunday in the summer in any marina to understand how difficult it is for many operators to approach the windows. Often you see the employees climb on the windows to do the cleaning while maintaining an unstable equilibrium and slipping on the wet surface. Imagine the same scene during a winter storm with the boat moving and waves crashing over. Who could take action to remedy a broken window? In the Ocean King (even though the windows are made of tempered glass and are extremely resistant to the sea, in some rare cases the large breaking waves bring with them debris such as tree trunks or barrels of oil and with enough force if thrown against the windows can cause breakage) this can be done by anyone, safely, and without risks. A more robust handrail can allow the anchoring of the safety belt. In addition, the rooms on the

bulwark bow help to deflect the big waves breaking on it without directly hitting the Pilothouse. The thickness of sheet metal and glass is deliberately kept high in order to withstand blow from the sea. In the Ocean King the thickness of the dashboard walls are 6mm, much higher than that used by many yachts in the construction of the hull!

## 29. Engine cooling: box cooler and keel cooler - a professional solution

Each engine produces heat during operation. The heat must be dissipated naturally and in boats this occurs by cooling with sea water. This is the simplest and most economical way to cool a marine engine, but it does have major drawbacks. The sea water contains salt and in fact these salts corrode the inside of the engine. So a closed-loop system is now present in all units of all sizes. It consists of a closed circuit containing fresh water or a liquid refrigerant which is cooled with sea water. This system is better than those utilized in many yachts and on almost all pleasure boats. The salt water is drawn from a water intake located under the hull, is directed to the heat exchanger of the engine and then put back into the sea via special mufflers. The disadvantage is that it takes an outlet to the sea with its filter. We have seen a yacht sink due to the rupture of one of these pipes or to a broken or loose metal band that was to establish the suction pipe. A rubber hose and a drain in the hull (often under certain conditions in order to port with power off as several boats were found with the engine room flooded by water coming from the muffler). The filter (if present) must

also be kept clean, maintenance must be done and the water deposited on the circuit in time creates limestone formations and salt crust. The filter reduces considerably the passage of water, with consequent reduction of the cooling properties. This (optional) system on the Ocean King is the 'Keel Cooler' and it is the best system currently on the market for cooling the engine. Although a bit more expensive than the previous systems, it is present in almost all professional units. It works via a heat exchanger (Keel Cooler) housed in a space formed in the submerged part of the hull (Box Cooler). A coolant circulates in the engine, that passing through this Keel Cooler, heats the surrounding water without ever coming in contact with it. The result? Excellent refrigeration in all weather conditions. With this system you will not have problems due to clogging of the filter outlet to the sea or due to algae, plankton or nylon bags that are commonly sucked into the water intake. The same system has also been adopted to cool the generators. With this system you can turn on the main engines for a few tens of minutes even in a dry boat out of the water, making it possible to perform switching even with the boat in the yard. Once again, the best system is used to give the owner an absolute guarantee of safety and low maintenance.



Box cooler operation



Keel Cooler

### 30. Exhaust and exhaust gas



One of the most annoying things aboard a boat, whether it is pleasure or work, is the smell engine gas and exhaust. Unfortunately, nothing can prevent exhaust gas from exiting and nothing can stop the annoying smell from coming into contact with people on board. The Ocean King provides a solution that is not effective enough to permanently delete the fumes, but at least capable of preventing the annoying smell as much as possible. The system provides the underwater exhaust, one minimum speed placed close to the surface of the water and one maximum speed placed in the hull. This system ensures that before the smoke rises it is immersed in water to cool and consequently takes longer to rise to the surface, and then can be transported by the wind. This system covers the main engines and generators during the motion of the boat. But when the boat thrusters are off, for example while anchored, the exhaust gas generators could be heard to those who are at that time in the cockpit (main deck) or who might be going to the bathroom next to the boat. This drawback in the Ocean King is solved by diverting the exhaust flow directly up in one of the two funnels. The operation is very simple and provides for the manual by-pass or

through electric mechanism of a 3-way valve that diverts exhaust from one part to another without the need for any other intervention. Your guests will thank you.

### 31. Transmission: shaft and azimuth

A boat needs a driving force to move. In the case of motor boats the driving force is the propeller (or in some cases by Idro-jet). To transmit the power of the engine to the propeller there are many more or less functional systems. The classic solution is simple, and the so-called axis line, that is, an axis that starts from the engine, rather than an inverter coupled to the engine and the propeller coming through the hull. There are many systems to achieve a linear axis, from one described above to a bit more serious or professional which provides the axis in a closed case lubricated in an oil bath. All systems are still commonly used, the first in pleasure while in the second professional. This system is effective but it has disadvantages. The first is that the axis must protrude from the hull through a hole that inevitably will be subject to infiltration of water. Although today there are systems of keeping more or less effective and the tow used in the past is only a memory, this area will always be subject to maintenance and checking. In most professional systems where the axis is enclosed in a tin box filled with oil, there is no problem but the oil seal must be checked. Another feature that has

the traditional shafting is its alignment with the engine. For a correct thrust and efficiency, the real work ships have the engine more possibly in line with the axis, and then with the propeller. Plus, if the angle between the axis and the motor is high, you will have more power loss in the transmission, it will have more vibration and more problems will result in the future. Ships have the real axis and motor perfectly aligned and horizontal to the waterline. In pleasure boats, even in prestigious yachts, this is almost never (if ever). The engine is found to be on a very raised plane with respect to the propeller plane, and the angle of inclination between the two is often very high. Many times, for reasons of space, the engine must be inserted in to spaces too far back or too high and in this case different transmission systems are used where the classic straight axis is formed differently. The V drive is one example. The engine is set back from the inverter that is put towards the prow and this starts the axis back to the stern. We do not want to question the various systems, we just want to say that in real tugs the line shaft is horizontal, aligned with the motor, and the inverter is perfectly aligned between the motor and axis, and in addition is protected by a casing in an oil bath and oil water as in pleasure boats. Everyone can draw their



Tug with axis line in an oil bath.



Tug with Azimuth transmission

own conclusions. Another disadvantage of the drive shaft is in maneuverability. The engines transmit power to the propellers which have only two rotational movements, namely forwards and backwards. The evolution of the vessel must always be entrusted to the combination of these two factors. If the ship has two engines and two propellers, maneuverability increases. Working with one forward propeller and one back propeller you are able to obtain good lateral movement of the bow or the stern. But this movement, especially in adverse weather conditions like crosswind, requires considerable skill of the captain and often the result of the maneuver is not exciting and the use of the bow and stern thrusters become indispensable to avoid any mistakes. Imagine a tug serving in a crowded harbor: wind at 30 knots on the beam, with a ship on the hook that requires a margin of error close to zero, as it could guarantee the service and how it could it gently approach with drivability problems? At one time the captain of those ships were "Supermen" in the maneuvers, now times have changed and technology has come- came to their aid. More so than helping them look good in front of colleagues, it prevents disastrous accidents to ships and the resulting expenditure to restore them. Now times have changed and technology

has intervened. Nowadays, even the managers on oil platforms or offshore installations require charterers to have a service supply vessel with a different transmission from the traditional. Many cable ships and vessels for oil exploration need a margin of maneuver of a few centimeters in all weather conditions, they can never serve with a system of shafting. Even the cruise ships that each of us has seen moor with incredible accuracy in most cases do not adopt the axis line transmission.

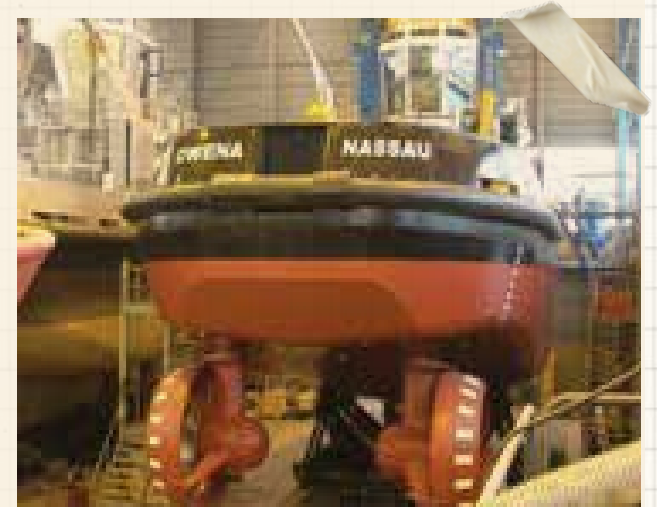
Why not then use all of them? The answer is simple: the Azimuth transmission. This type of transmission is no more than a system coupled to the main motor where the propeller is to be positioned on a foot attached to the hull with a rotating system and connected to the motor axis with gimbals or directly powered by an electric motor instead of this foot. There are now several manufactures of this system. AZIPOD, Shottel, and ZF are among the most common and popular. While AZIPOD is a system designed for large ships, Shottel and ZF are the most versatile and adopted by the vast majority of tugs, supply vessels, ferry boats, and merchant ships.

As an option to the traditional shafting, the Ocean King adopts the Azimuth Profession-

al system from Shottel or ZF. Maneuvering with this system will become a game for the owner. The ship will become a toy and the amazement of the people onboard will be total. With this system, the ship can move in any direction without problem and without weather conditions affecting the maneuvers. In fact, the strength and the propulsive thrust of the engines acts throughout, allowing the propeller to have the full power of the engine in any position, with the bow and stern thrusters acting at the same time. Total ease of maneuver is guaranteed by this system. A berth in a few centimeters per minute is normal with this solution regardless of wind or current. And with this solution there is also the option of "dynamic position" or "dynamic positioning". This system has never been used before in a pleasure yacht and is intended only for professional vessels. It is the same system that is used on cruise ships, cable-laying ships and other ships that require highly reliable maneuvering. Many of you will have seen some cruise ship stop at a roadstead or port and remain stationary without the need to anchor, even in a strong crosswind. A powerful computer with dedicated software (MTCS Multi Thruster Control System), simultaneously controls the two Azimuth thrusters and bow thruster automatically and in the most

appropriate way to perform a particular operation, regardless of wind and current. With this system, the captain may decide to “curb” the ship and leave it without dealing with marine weather phenomena. With a simple joystick, the captain may direct the ship to any position and direction without having to deal with operating the bow thruster and Azimuth groups. The computer will do without error and with a precision of a few centimeters. Berthing in a crowded marina with adverse conditions of wind and current, will be a breeze. Imagine yourself in Sardinia on a classic day of strong wind, all the boats are moored and you are assigned a cramped and difficult to reach place to berth without causing damage (especially to others since you have a ship). Imagine you position yourself in the vicinity of the mooring, lock the ship while you or your captain take time to plan the maneuver. Then you decide to begin the maneuver. Through the great screen you will see your ship positioned at the center and with the joystick you just “drag” on a monitor that reproduces the space. You just have to decide the speed with which to perform the operation. The computer will begin to work by giving power to the main propellers, rotating independently of each other and acting simultaneously on the bow thruster, exerting

power to turn the ship. The amazement of the people watching will be total. At any time with just the push of a button, the ship will stop as if it had a parking brake like a car. You can then resume the interrupted maneuver or change it without the ship moving a single meter. In short, for those who want amaze or just have fun in the maneuvers, this option is for him. The Azimuth solution also recovers much space in the engine room, since the propeller shaft does not need to be aligned with the motor. It also dramatically reduces noise and vibration. The maintenance is very simple and the time interval of the various cycles of maintenance is extremely long, around 15,000 hours. This solution also increases safety considerably. In fact, even at full speed, reversing a 90 or 180 degree propeller, the stopping distance is a few tens of meters! Compared to other solutions in the leisure realm, the Shottel or ZF solutions are definitely more professional and intended for heavy-duty, prolonged use. Just one of these transmissions weighs almost 4 tons. Which means that a pair of engines and transmissions, including Azimuth propellers and gimbals has a weight of about 14 tons! It is as if an entire 13-meter yacht were attached under the hull! We challenge any other yacht of the same size to install such a system without sinking! Only



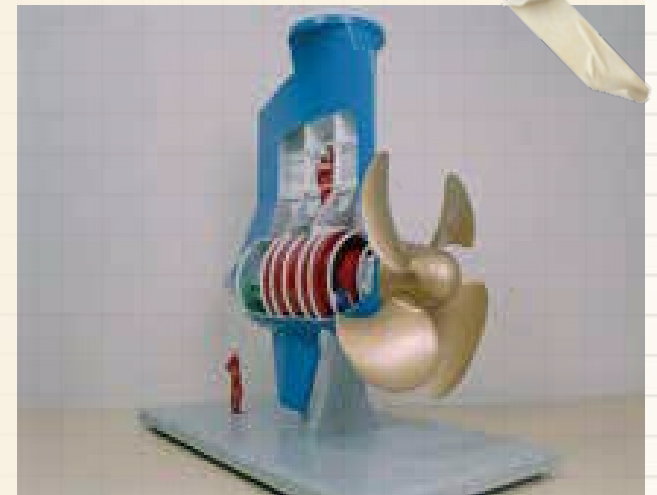
Shottel-ZF system



Azipod system

a large hull with a considerable width and a highly resistant structure can ensure the use of such systems without compromising the integrity of the boat. Even in this case the technical choice of adopting a real tug hull was not a whim of the designer or a fashion factor, but an essential element of a real ship. The propeller can also be protected by a cloak (optional) as well as the shape of the hull and the large SKEG stern. The mantle (as in real tugs and supply vessels) increases thrust and the ability to pull the ship. In the Ocean King 88 shot power or continuous Bollard Pull is about 28 tons, the equivalent of a good port tugboat. Even if the shot is not an indispensable element in recreational use, the primary function of the coat is to greatly reduce vibration inside the ship. Indeed, water is pushed out from the hull and conveyed in a pipe and therefore does not impact on the hull, eliminates noise and vibration. A sea trial will surely remove any doubt you might have. The considerable width of the Ocean King. (8 meters on a '88) also helps a lot in terms of maneuverability. The propellers may in fact be positioned further out and more space between them greatly increases their performance. Two propellers placed a short distance from one another lowers their output because they "steal" the water from one another. Two

broader screw propellers work better, as they are able to convey water independently without interfering with each other. This happens both in maneuvering at low speeds when it reverses the direction of travel of one of the propellers. Also in this situation, when an engine works in one direction and the other in the opposite, the greater distance helps to make a more advantageous lever and accordingly has better maneuverability. In short, even in this case the width is superior to any other yacht and has considerable advantages from all points of view.



Azipod operation: electric engine inserted in the foot.



Propellers with Azimuth transmission





## 32. Hybrid propulsion and alternative diesel systems

The yachting world is experiencing a period brainstorming due to the need to present new offerings to consumers with the hope of overcoming the current market crisis. As happened years ago in the automotive world, also in yachting ideas have focused on the search for a new propulsion system that excludes the normal diesel propulsion with higher yields and lower fuel consumption and emissions. Assuming that we are in favor of innovation and the search for solutions to eliminate or reduce harmful emissions into the atmosphere, we are also aware that nowadays there is still nothing really feasible to achieve this, not for lack of a series of attempts more or less fanciful by some shipyards to achieve a propulsion system alternative to the traditional internal combustion diesel engine. We also say that the ship industry does have the economic resources to devote to research and development, unlike the automotive industry that is able to invent effective and innovative propulsion systems. We must be content to use what was already “discovered” by others and adapt it to better suit your needs. The only ones who have the resources for research and innovation are militaries but

they reserve truly effective systems, which involve the use of nuclear energy or hydrogen systems, for their exclusive use. Even in this case, there are limits. The AIP to fuel cell technology that some new Navy submarines are equipped with, in which the hydrogen combines with the oxygen to generate electrical energy that powers the motors cannot operate independently and must be combined with the classic diesel engine. This system is prohibitively expensive and has some disadvantages. It's hydrogen supply can be dangerous, it has a lack of autonomy, limited speed, and presents difficulties in obtaining hydrogen and stocking in the tanks (to avoid containing hydrogen in large capacity tanks, the plants provide reservoirs formed by metal hydrides that by acting as sponges retain the particles of hydrogen, ensuring greater security). Still in the military, another solution is used in the nuclear-powered warships where the nuclear reactors generate a huge amount of energy that allows the ship to have a virtually limitless source of energy. These systems are adopted for military use not because of an environmental discourse or to reduce consumption, but for strategic reasons and war such as in-class submarines U212 for their lower noise and difficulty of being discovered by the enemy. These systems are profes-

sional systems, reliable and very expensive, not to mention exclusive to the military, and therefore cannot be offered to equip commercial or private vehicles. In the realm of civilian use, there are currently no propulsion systems that do not exclude the combination with the classic diesel engine. For pleasure boats there are much simpler and much less functional systems, defined as "Hybrid Propulsion" (a name taken from the automotive world). These systems involve the use of an electric motor with a few KW of power (20-30) that works together with a dedicated battery group. Someone has also proposed the use of solar panels to produce electricity. Many sites now adopt these solutions. Engines navigate off and in absolute silence thanks to electric propulsion. This has now become a fact of life and no boat can be exempt from this technology. The truth is unfortunately not as idyllic as the designers might suggest. If someone truly believes he can navigate this way they are wrong. The only effective way to go to sea in silence and in an environmentally friendly way is to buy a nice sail boat and to use the sails as an engine, everything else is just a more or less advertising disguised to sell more. Mind you, we know what systems work and that the boats in which they are installed actually move, but to "move" and

to navigate seriously are very different! The problem is that navigating on stored electrical energy on batteries has many limitations. The main limitations (in addition to the cost of the batteries and the amount of space they take up in the engine room) are very limited autonomy and power engaged. Furthermore, it must be accompanied by a diesel group to recharge the batteries. In fact, the boats that adopt these electric propulsion systems, mount electric propulsion groups of a few kilowatts of power, 20-30 kw with which you can move for a few miles to a few knots of speed. Also during these journeys, the various onboard systems including air conditioning, various pumps, refrigerators, etc. require the use of the generators, so even using the electric propulsion generators allow the utilities on board to function and also to charge the batteries intended to propel. A 20-meter boat on average consumes about 20-30 kw of electric power only for the passengers on board, and we believe that 30 kW of propulsive power is extremely insufficient to make any journey. We honestly cannot understand what the point is to have a system that's sole use is to be able to leave the marina at 2 knots to stop a mile away without turning on the main thrusters. A boat is not a car that weighs 1,000 kg that with 20 kw can travel at 100 km per hour. A

boat needs a lot of power and the only solution to produce that much power is a diesel engine. A diesel engine has an efficiency of around 40%, so when you burn 100 kg of diesel fuel, in reality only 40 kg are transformed into mechanical energy, while the other 60 kg are "wasted" in heat (exhaust gas, cooling water, irradiation thermal and thermal conduction in the engine room). Electric propulsion instead produces electricity by a generator coupled to an electric motor for propulsion, with a yield of 20%. So of the 100 kg of initial diesel, 60 for the performance of the diesel generator + 8 for the transformation into electrical energy via the alternator + 6 for the performance of the electric motor = a total of 74 Kg wasted! More precisely, classic diesel propulsion combined with a centerline will be the total return of 0.4 to 0.55 for the engine and the propeller shaft, so a total of 0.22 (meaning the propeller will come on 100 yield only 22% of the rated power). With electric propulsion the return will be 0.4 for the diesel engine generator alternator + 0.8 + 0.8 + for the electric motor 0.55 per transmission shaft for a total yield of 0.14! So if 100 is the nominal yield 100 gallons of diesel fuel produced by the initial propeller comes only a 14%. 86% is wasted! Using the power transformed by the generator does not save

as much as is purported, and is ultimately a waste of energy, consequently further increasing fuel consumption. The underlying concept is that every energy conversion (from mechanical energy to electrical energy, and electrical energy to mechanical energy) implies a loss of performance! Solar panels can be used without the need to use clean energy generators, but to produce 1 kw nominal power you need to install about 5 square meters of photovoltaic panels. The rated power produced by photovoltaic panels is not available, but as a rule the power available from this source of energy is about 30% to 40% of rated power. Therefore, to obtain sufficient enough energy move the boat, say 20 kw, about 200 square meters of solar panels would have to be installed! A regular boat does not have this kind of area available to devote to the solar panels. Even if hypothetically you were able to install 200 square meters of photovoltaic panels, weighing about 250 tons, the 20 kw of power that is produced, would not serve even to un-moor since the bow thruster absorbs 75 kw! We realized that most of those who adopt the hybrid are forced to use the special features that allow these boats to move with very little added advantage of the available propulsive power. The solutions used do not allow these boats to be called a true Explorer

precisely for all the factors mentioned previously. The lightweight fiberglass construction, semi-planing hulls, and lightweight structures (a 24 meter weighs an average of 60 tons, has a width of less than 6 meters and has a dip of 1.5 meters), the narrow width, the slender and sleek hull, combined with a thousand other details mean these boats are not suited for the adverse weather conditions that may be encountered at sea. For those who have intentions to navigate seriously, these boats are not suitable and you should consider other solutions. Recall also that an electric motor coupled to a current diesel generator is not an absolutely innovative idea. Just think that in Venice, the classic "Steamers", 15 years ago had mounted electric motors combined with diesel engines but this system was abandoned in favor of the classic diesel powered, the only propulsion system that currently can be installed in a boat or ship. The reason why still today the modern cruise ships utilize electric motors combined with diesel generators is due to the fact that the demand for electricity on board for ship services (air conditioning, lighting, kitchens, guest entertainment systems board, etc.) is greater than the amount of energy required for propulsion. It is more convenient to transform electrical energy into mechanical

energy, being that most of the power on-board is used as electrical energy. In short, we believe that an owner should keep several factors in mind before buying their next boat to avoid being blinded by miraculous commercial proposals. The real miracle, or mystery perhaps, lies in how a banal idea that it does not benefit the objective can be transformed into a revolutionary and innovative idea by good marketing. Posterity will judge.

### 33. Propellers

As we have already mentioned, the propeller is the organ that rotates with a driving force from the ship. There are an infinite number of types of propellers, and all more or less should be designed before being installed in any given ship. As often happens, however, especially in the world of pleasure boating, this is not always true. Many yacht owners have had a bad experience having had to struggle to find the propeller best suited to their boat. A wrong propeller creates significant problems as it may cause damage to the engine and produce vibrations, or simply do not reach the preset speed. This happens especially in fast boats, which are more “delicate” and affected by several variables, such as weight onboard or dirtiness of the hull. Some owners purchase a boat after trying it completely drained and with a perfectly clean hull and realize that once set up with everything needed for cruising, and after that the hull is fouled staying in the water for a long period, the boat no longer glides or reaches the speed reached during the tests. The only solution then is to intervene by changing the propeller pitch or diameter. In a boat or ship the displacement effect is less visible but always present and worthy of much attention. The

factors that determine the choice of one propeller over another are numerous and impossible to generalize, but the use for which it was designed is especially important. A fast ship will have a different propeller than a slow ship or a shooting ship. The factors that determine and differentiate the various propellers are the shape (area of the disc, area expanded), the number of blades, the pitch and diameter. All things being equal, the fewer blades you have, the less friction you have, but this increases the chance of cavitation, as it decreases the exposed surface of the propeller. Similarly, increasing the pitch increases the risk of cavitation and the speed at which it will be working less, so as not to strain the engine. A large diameter helps the performance significantly but likewise will decrease the pitch and/or increase the number of blades. In principle (but not as a rule) a fast boat will have 3 or 4 blades and a small diameter while a displacement will have 4-5 blades of a larger diameter. All these factors must be studied, calculated and correlated with each other as early on in the design phase in order to avoid unpleasant and expensive “experiments” after. By changing one factor you have to change the other if you want to maintain an acceptable return. In the Ocean King project we have relied on experience gained in



Pitch Blades Propeller



the professional world that guarantees the proper execution of work. We say that a real tug usually mounts very large propellers with a diameter of 4-5 variable pitch blades. This means that the motor is always calibrated to an optimal number of revolutions and constant and acting on the propeller pitch will have more or less thrust, and then more or less speed. Adjusting the diesel fuel injection makes up for differences in load at a constant speed, the engine is delegated to self-control and is always calibrated to optimal rpm. Even the U-turn is controlled and executed by reversing the pitch of the helix rather than acting on a classic inverter. With this system, the speed variations, and thrust direction can be performed with extreme precision and speed. A rotation reversal from forward to backward (as normally happens in normal boats) will no longer be required since the propeller will rotate in the same direction as the blades which are oriented in the opposite direction. All this will happen in a few seconds without having to work on the machine and on the inverter as once was the case. With this solution, you can directly adjust the amount of propeller power by changing the pitch. You will be able to switch from completely neutral to slightly positive or negative, or you can simply give it all up and express the full power

of the engine in a very short time without having to wait for the engine torque or lower the engine speed. The inverter changes the direction of rotation. Imagine having to stop or start a propeller that is 3 or more feet in diameter and weights tons. To reverse the direction of rotation, having thousands of kilowatts of power to be controlled mechanically. With the adoption of a variable pitch this will not be a problem. This coupled with an Azimuth transmission system, you will get the best possible result in terms of performance and maneuverability. In addition to the tug boats, this variable pitch system is also used on supply vessels and other large ships. For the Ocean King project, we wanted to adopt a variable pitch system but the high cost made us opt for the classic solution to fixed blades. The important thing to remember is that we followed "professional" principles in choosing the most suitable propeller. We chose a large diameter propeller in order to obtain maximum possible performance. The propellers are very large (in the '88 exceeds 1.5 meters, nearly double that of a normal yacht on the market) and the first to be chosen for ad hoc projects are drawn from the information provided by the tank test and the cavitation tunnel.

### 34. Oil filter system

Diesel engines are very simple and very reliable (especially the professional models) and work even without electricity. They do however need two basic elements; clean diesel a good amount of fresh air. If dirt, water, or air bubbles reach the engine, it stops. Failure due to problems associated with the quality of diesel fuel are very common. Restoration is not an easy task and often the owners are forced to call for service to purge the engine and restart it. Even if you have an auxiliary engine or you have a double motor vessel, the problem could be repeated and also affect the second motor generators or even if suck fuel from both the tanks. generators, even if they both suck the fuel from the same tank. This problem can occur not only due to contaminated diesel fuel from some rundown service area, but also the same fuel left in the tanks for too much time produces algae, bacteria, condensation and paraffin. Even when the engine is exceptional you can do nothing if the oil is bad. Dirty diesel fuel is the primary cause of downtime in a diesel engine. A ship that has ambitions to explore the globe cannot afford this problem. A good filtration system is therefore essential to avoid all this. There are many diesel filters and filter systems, some simple, inexpen-

sive, and often ineffective (they are simple filter cartridges and water separator diesel) others more expensive and professional. Our system filters the oil for 4 times before it enters the engine to a particle size of 1 micron so that even bacteria are eliminated. The system works in this way: oil coffer placed in the hull, a pumping system sends the fuel to a first bank filter that purifies it. A dual pump (always a spare as in all other onboard systems) picks up the oil from the speakers and sends it to a centrifugal filter ALFA-LAVAL that purifies it completely from every particle of water and sends it to a DAY TANK (daily service tank that serves to accumulate a quantity of fuel required to use at least 24 continuous hours).

This tank remains above the level of the engine so the diesel flows to the engine without the need for pumps. If a failure stopped the transfer pumps, you would always have at least 24 hours of battery life and you would still have time to fill the chest by operating a manual pump. The Day Tank also presents the level visually so the fuel level can be inspected even if the digital level goes out. From the Day Tank, the diesel arrives next to a cartridge filter that purifies it by removing any foreign particles up to 1 micron in size (like bacteria and algae) and



Fuel tank "Day Tank" with level indicator  
Day Tank



then sends it to the engine. Filtering also occurs during the transfer of fuel from the various tanks. From the dashboard with simple commands you can transfer the fuel from one to the other and decides which tank to fill or empty. Putting approximately 7 cases and 49, 000 liters is essential to have a system to ensure proper filling of the crates. This system also comes in useful in the event of rough seas, that is, when the captain needs to “trim” the ship in order to choose the best set of possible navigation. The diesel crates as well as all other boxes are placed in the hull in order to lower the boat’s center of gravity. Moreover, each case has man hole so as to ensure access to the tanks for future maintenance and inspection. If navigating in extreme cold, we recommend installing a heating system for the fuel that prevents the diesel from thickening.



Alfa-Laval filter

## 35. Engine room

Many pleasure yachts boast huge spaces for onboard guests, but ridiculously cramped conditions with regard to the most important part of the boat; the engine room. A cramped engine room, where nothing is at hand and all maintenance becomes a job for contortionists, represents a possible risk of damage to the ship. The lack of air in a cramped room can affect the operation of the engines, as the heat produced by the systems often cause various malfunctions. They range from the simple loss of the power conditioning system (often placed close to the engine without adequate ventilation) and the merger of the electrical wiring systems, to fires caused by the burning of oil and other materials in this location. As always the Ocean King harks back to the naval regulations and provides an engine room of unthinkable size for a yacht. The '88 has an engine room of approximately 70 meters square with a height of at least 85 centimeters. Your captain or yourself (if you have the passion for mechanics) will spend a lot of time in the engine room controlling and observing the beating heart of your ship. Access to the engine room, as in all true ships is through a watertight door with a ladder

of considerable size (90 cm wide). A gateway located on the main deck, with doors opening to the floor like trapdoors hidden by carpets in the living room, and ladders that go down into the engine room from the cockpit or from under the living room are not part of our philosophy. To us, the engine room should be built with the utmost care as we believe this place is the most important part of any ship. The internal temperature will never reach excessive levels thanks to a powerful ventilation system that draws air directly from funnels, which allow for extremely comfortable temperature even in the middle of August. The space between the engines will be enough to allow anyone to turn around and do any type of maintenance or lie on top of it to reach a critical point without getting burned, even when the engine is "hot". Each component will be installed "industrially" and will be easy to replace or repair. Each pump will have a nameplate and everything will be found in the documents given to the ship owner. The piping is a different color in accordance to the fluid flowing through them (i.e. red = fire, brown = diesel fuel). Electric panels will also be the high strength industrial type, and even a small work table with vise, drill and screwdriver kit as well as various other tools has its place.





The tubes in the machine room are built from steel or naval-tested RINA 360-510 Grade B or C, as in real ships. The rupturing of a pipe or damage due to corrosion is a very rare phenomenon at least 30-40 years pass before it can occur. Stainless steel pipes as often seen in yachts are not normal naval construction and are only used for freshwater. The pipes flowing into the salty sea water will be exclusively made of galvanized steel and not stainless steel. The reason does not stem from an economic issue, but for reasons of durability and safety. A naval-approved RINA pipe must have certain characteristics of thickness and diameter which are indicated by the term "Schedule A". A naval schedule will be 40 or 80 mm. A 3-inch tube (7.6 cm) in Schedule 40 will have a thickness of at least 5-6 mm of steel while Schedule 80 will be nearly 8 mm. The choice on the schedule depends on the pressure at which the internal fluid has to flow. The stainless steel used in yachts is usually thinner (1-2 mm). Steel pipes with 8mm thickness are not even on the market! Their widespread use in yachts is mainly due to their appearance. An engine room with gleaming pipes is definitely a commercial motive meant to up the possibility of a sale at a boat show. The thickness of a tube is crucial for its durability and its functionality. Although

stainless steel seems more robust, in reality it is much more delicate and the galvanic currents and vibrations tend to wreak chaos. A good galvanized steel pipe is much more resistant to galvanic currents since the galvanizing yields electrons preserving the pipe from corrosion. In fact, to protect a boat from galvanic corrosion is different loaves of zinc are put under the hull, precisely the same material that is used in the electrolytic process of galvanizing the tubes. In addition, when a pipe is in contact with the hull (steel) or a bulkhead, being constructed of the same material, it will not undergo any corrosive phenomenon, something that is an impossible occurrence with stainless steel. So if you want to have a real engine room with eternal and indestructible pipes, there is no other choice than the professional system which is perhaps less aesthetically beautiful but definitely more reliable and secure.



True engine rooms on true Explorer with galvanized steel

## 36. Fender and rub rail

As with true tugs, the Ocean King also has rub rails suitable for commercial use mounted on the sides. This option is not mandatory, and if an owner does not want to adopt it, a simple metal fender can be installed. However, we strongly recommend the rub rails because this option solves many problems and avoids berthing using the classic fenders on the sides. Whenever you need to pull over at a wharf, pier or commercial ship, avoiding the use of the fender is unnecessary. In addition, the resulting look will be very aggressive and is well suited to the strong and muscular line of the boat. The design and measurements of the fender can be revised according to the preference of the boat owner. You can choose between two simple lines, one running at floor level in the main deck just below the discharge of the broad masses, and the other that runs on the bulwark. Or, you can choose horizontal and parallel lines that create a parallelogram design. The final result can be seen in the photos. The hardness of the rubber used is rather standard and is a softer version than that of the tugboat. However, during berthing with other yachts, we strongly advise you to not use the classic fenders; don't forget that you own a 250-ton ship.



Tugs with single Fender



Tug with parallels and cross Fenders

## 37. Anchor winches and bollards

In a ship the choice of anchors, the anchor windlass winches, the capstan winches etc. is not dependent on the whim of the site or the owner, but is determined by specific rules that take into account the tonnage of the ship, its displacement, the area exposed to the wind, load, etc. These rules are part of the ship's so-called "armament module" and guarantee absolute security in every mooring situation. The choice of a still for example, is considered taking into account many variables and the calculation is made considering the worst possible conditions, such as poor sealing of the bottom and a wind of at least 40 knots. Like any self-respecting ship, the Ocean King adheres to these rules by adopting the "armament 1 5 2" form, which is the same as that used by professional tugs of the same size. Following this module, the Ocean King has a bow with anchors embedded in the hawse pipes. This is very handy and prevents the anchor from protruding on the bow, leaving this area completely free.

In addition, the chain will fall without going through the hawse pipe from the winch to the bow. The anchors used are professional

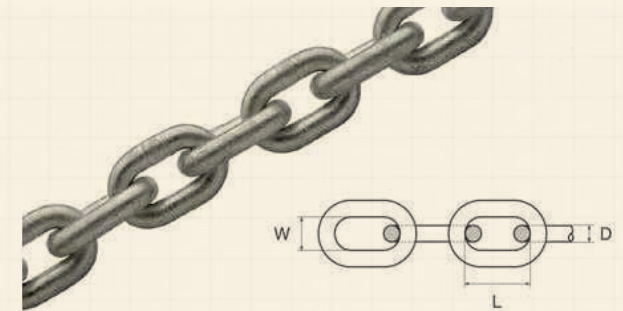
grade high adhesion and high fixing power. This means that their weight and shape is calculated with strict criteria for maintaining under all weather conditions imposed by the form of armament. (In the '88 the weight of a still is 225 KG, 3 times more than that of a normal pleasure boat) In addition, the chain is adopted of professional type with cross bar chain 19 or 20 mm (which means that the measurement of the link of the chain section is 2 cm of high strength steel, while the mesh size is 108mm x 68 mm) against the 12-14 mm of normal type that are used in a normal yacht of the same size. The chain with crossbar, compared to a normal chain presents a considerably higher breaking load, as if subjected to traction, the normal mesh without rib tends to stretch and flatten out more than the one with no crossbar. Suffice it to say that the tensile strength of a chain with cross bar is 19 to 21 tons against 4.5 in a chain from a yacht! These extensions take place in an imperceptible when dropping anchor and if they are not detected by the captain with the passage of time lead to the breakage of the chain.



Cleats normally used in Pleasure Yacht. In the O.K this kind of cleat is used only for hold the tender!



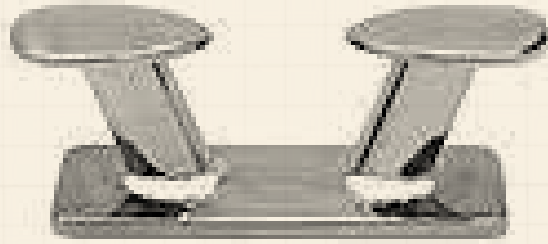
A real Commercial Chain



A "Real" professional BOLLARD "double pipe" with SWL (safe working load) of 8 tons. The base is welded to the deck. in the O.K we use this kind of bollards but in AISI 316 Stainless Steel.

A night spent at anchor in the harbor with bad weather will no longer be an owner's nightmare! The bow winch will have an output of 7.5 kw of continuous pull and requires a much more professional and powerful winch than the winches normally used in yachts of this size (which typically only fit 3 kw). The mooring winches have a capacity of 2.5 tons or 5.5 kw continuous shooting and will be equipped with an inverter for the power used. The dosage will have a steel bell 36 cm in diameter. The cleats will be recreational, there is no particular demand in this area (as in the platform and the points for the mooring of the tender) and professional type at the stern and bow and sides. Just have a look at their size (70 cm long) impressive! To these you can safely stick a small boat to tow it into port without any problems. Pleasure cleats differ significantly from professional cleats. Let's say a pleasure bollard installed on a tugboat lasts for a short time before breaking or bending. The problem is not just the size, or the little thickness of the steel used, but the type of attachment to the hull. In fact, the tightness of the cleat is delegated to a plate of a few millimeters of steel welded to the deck, or even worse, to two steel pins a few millimeters in diameter that are fixed to the deck by means of two nuts and through-bolts. The

professional cleats must instead ensure maximum grip and traction under all conditions to which they are subjected. A real bollard should even have the SWL (Safe Working Load) recorded, or the load for which it was designed to hold expressed in tons of shooting, and must be soldered to the hull, and must use a standardized form, and last but not least, must last for years! A cleat can be "double barrel" or "single barrel" (like the bow on the Ocean King) The double barrel must be made in two pieces consisting of two large, thick steel cylinders and from a steel plate formed from a large sheet. First, two cylinders are welded to the hull to reinforce it and create a highly resistant structure. This process coupled with the thickness of the steel guarantees a perfect hold under all load conditions. Of course the finish on the Ocean King's cleats for obvious reasons will not be painted but be polished steel.



A bow in a common yacht



A real yacht chain



### 38. On-board crane

In a true ship, the choice of the cranes to install on board is very important and should not be left to chance.. There are many types of on-board cranes from the classic “Bigo” fixed arm to more complex ones with a telescopic boom and articulated movements. Whatever the type of crane, it must nevertheless be built and designed for marine use and not for that use on land. This means it should not be constructed of stainless steel and all its components must be designed to withstand the low temperatures of the polar seas and sea water spray. A good painting and a good flame galvanized steel will ensure the absence of rust or corrosion for years. Do not forget that professional use does not provide for flushing with fresh water after use as the pleasure. and does not even provide a great deal of attention in the use but rather a quick and hasty prolonged use over time. The commitment to create long-lasting and reliable means is absolute and if the use of stainless steel were synonymous with greater reliability and robustness, each half would be built with this material. With the Ocean King project we decided to adopt a professional type crane, manufactured by leading companies for marine use with unthinkable power when compared to normal yachts. The size of the tender (almost

8 feet by 88 feet) forced us to use a particularly robust and reliable crane with incredible maneuverability. The choice could not be the one that we would adopt for a real tug and so we chose an “off the cuff” professional marine crane with the range of the arm 5 tons and 1.5 to 7 meters. If you consider that in a yacht of the same size, the range is about 4 times less, you soon realize what we mean by “professional.”. A professional crane is one built and designed to be mounted on vehicles to service the oil rigs in the North Sea where the extreme weather conditions require very robust and reliable means. Of course, the final look is very impressive and very different from that usually used by yacht owners. Like all professional products, this one does not have the polished stainless steel finish, but steel naval painting. If this can withstand extreme climates such as in the North Atlantic, it will certainly withstand use on craft limited to a few days a year. However, if an owner wants to install the classic yacht crane, we could settle even though it would mean abandoning the idea of the great tender and adopting one reduced in size and weight. We leave it to you to decide. Recall that a professional crane has a weight of 2 tons and allows the owner to have an efficient and versatile means to load anything aboard their ship (even a

car), and can only be installed on boats with special qualities of stability and strength, like the Ocean King. We don't believe this set up would be possible in another yacht of the same size.



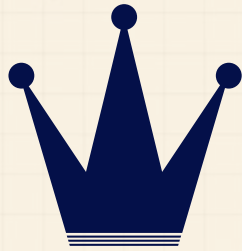
Davits used in the Yacht



Supply vessel with professional crane



Crane in the O.K



### 39. Exceptionally livable dimensions

What distinguishes the true Explorer from other vessels are its open living spaces. An Explorer as a tugboat has wide open spaces, mainly due to the width and volume both internal and external. One problem is that many yachts that are nicknamed Explorer or Expedition are just spaces. With the Ocean King project much effort was put into finding the best solutions, and the result is impressive. Inside Ocean King 88 there is an outdoor space a total of 250 square meters while the interiors occupy about 230 square meters plus 70 square meters of the engine room! This translates into an incredibly large amount of space for an 88 footer, comparable to the 110 feet of a conventional yacht! Comparing the Ocean King 88 with a similar competitor, we find that the width is at least 1 or 2 meters higher, which results in at least 24 or 48 square meters of space for the bridge. Calculating the three bridges available, there is at least 72-144 square meters of space! Which equates to extra space available to the owner and his guests. Outside is place everything from a tender of almost 8 meters (hard to find even in 110 feet), 2 jet skis with a Jacuzzi, a barbecue, deck chairs, sofas, and two 10 person tables. Inside are

9 bathrooms, 3 double cabins for the crew or guests, each with private facilities, 35 square meter cabin with a king size bed, a VIP cabin, two guest cabins with twin or double beds split with a separate bathroom, a huge living room, a dashboard like a real ship, a galley with a freezer and refrigerators large enough to contain provisions for long periods, a trash compactor and even a freezer dedicated to the storage of waste during long voyages, laundry and ironing, crew mess area, and a lift for the food that rises from the canteen area at the bridge command.





## 40. Isolation and insulation

We often emphasize the terms “trade” or “profession”, but for many owners these terms and our intent in using them may not be shared or understood fully. As described above, the use of these words for us is synonymous with great quality and unmatched seaworthiness for a yacht. For many owners, these terms might suggest a raw product made to accommodate men in rough seas or experienced sailors with the comfort of a cargo ship rather than a luxurious cruise ship. Noise and vibration, especially within the housing is for a professional sailor very common, but for a yacht owner and their guests, unacceptable. Although in new commercial construction noise and comfort of the crew are taken into account (also because it is covered by the classification register), for us a yacht must have a peaceful atmosphere devoid of vibration. Guests in the inside cabins do not have to hear any noise; whether it comes from the other cabins or from the engine room. When navigating with the propulsion system in motion, there must be absolute comfort. Do not forget that a ship of this type is designed for long voyages and therefore the comfort of the guests can not be underestimated. We have already said that the engine room is the primary

source of noise in the ship. We place great care in isolating this area. We take many measures to ensure that no noise escapes. First, motors and generators are assembled with flexible couplings which dampen a lot of vibration. The generators used are closed with soundproofing shell and are slow type, working with just a few rounds of rotation. The walls and ceilings are insulated with a special material with several layers to absorb sound waves and dampen vibrations. The outer cover of finishing presents a perforated sheet of stainless steel (much more expensive than the usual glossy panels mounted in other yachts) which serves both to dampen vibrations and sound waves. The bulkhead separating the engine room from the cabin is given greatest possible care. Inside, the insulating material is doubled, while inside the cabins there is a wall 8 inches thick formed by a Sandwich consists of wood and sound absorbing material of the latest generation.

Between the engine room and captain state-room there are about 35-40 inches of various materials that block any possible contamination acoustics. Suffice it to say that the total weight of all the material used as insulation is more than 14 tons! In the captain state-room the only noise you hear stationary is that of the cooling fan, and at cruising speed the only way to notice when the engines are in motion is to check the monitors. The decibels measured in the various locales are extremely low, from about 45 to 50 dB.



soundproof generators



Anti-vibrations support



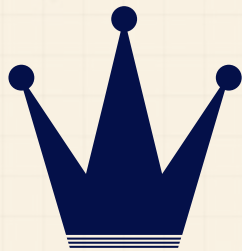
A sandwich panel for acoustic and thermal insulation

A similar material is adopted to insulate in the cabins from any noise. We believe that nothing on the market today can guarantee a better level of insulation. Thanks to this arrangement, in each cabin the environment is extremely quiet and free of vibrations.

## 41. Furniture and interior

This chapter was deliberately saved for last. We, as people of the sea, attach more importance to the functional, practical, and safe aspects than to the aesthetic of the interior. The interior of a professional boat is simple, easy to clean and maintain, but is certainly not suitable for recreational use. We are aware of this and know that often the trump card in the sale of a yacht is the interior. Our concept is simple. Our ship must be one that impresses from the outside for its strength, and that may seem a bit rough but in fact is the product of great attention to detail. But as soon as the owner or the guest crosses the threshold of the door that opens to the interior, we expect them to be breathless. The concept is to impress in all sectors, including furniture. A professional staff of interior designers and architects will collaborate with you on everything; the preferred stain of wood, choice of carpets, rugs, floors,

etc. In our design, the interior is CUSTOM in the sense that each owner can choose not only the type of furniture most pleasing to him, but also some options in the cabins. If an owner wishes to utilize a room differently, we can, as far as possible, change it and direct it to the use that the owner wants. We can happily customize the boat in a thousand ways cosmetically, but do not ask us to change structures, the hull, or the security systems because this request will not be accepted. Great attention is also paid to the board lights, that is, to all automation systems on-board: TV, stereo, cell phone, Wi Fi, telecommunication systems, intrusion detection, and so on. If you want to use the ship as a floating office, no problem, we can provide every possible solution. Each Ocean King will be different from the other and each will fully reflect the nature of their owner. Your Ocean King will be like a home, with every detail will be chosen by you. In a short time you can be enjoying your small but “true” ship.







**OCEAN KING**  
YACHT EXPLORER

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