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<u>The Seaworthy Yacht</u>

Sir Robin Knox-Johnston

There are two aspects to a seaworthy yacht. One is the yacht itself and the other is the crew that man her.

There was a saying in use in the time of square-rigged ships that the ship is mightier than the men who man her. It is still true. If the crew do not look after their vessel they put the vessel and themselves at risk. It all comes down to seamanship, which cannot be learned through reading books, it comes through experience. A good crew can be turned into a bad crew by not being fed properly or not being allowed sufficient rest or bad leadership. Some go to sea to prove something, others because they like being at sea, others, like the crews of the Lifeboats, to save lives. One might make a comparison with those who go to the mountains to climb a particular peak and those who live in those mountains. Much of good seamanship is a matter of attitude. Overconfidence is as dangerous as a leaking boat and perhaps one of the most useful attitudes to have before setting out on a voyage is a healthy dose of apprehension.

But let us assume we have an experienced crew, who know their boat. They will have a good idea of how she handles in a variety of conditions and how to make her comfortable in rough weather so she rides easily and without damage. Two identical boats caught in the same bad weather need not behave alike. A lot will depend on how they are stowed, for example whether their fuel and water tanks are full or empty, what sail they have set, but above all, how they are handled. Ultimately though the strength and design of the boat is going to be as profound to survival as the crew's abilities.

Yacht design used to represent copies of traditional working craft, fishing boats, luggers, and smugglers even. These were vessels that had been developed over years to suit the conditions they expected to find themselves in. Their design and construction was the fruit of the combined experience of masters and shipwrights. Slowly yacht design diverged The quest for speed, coupled with different design demands and rating rules, meant that lines became finer, rigs lighter, and the vessels less robust than was required in commercial vessels. These days some motor yachts might resemble working craft, but sailing yachts have become a completely different species. It has become a science and industry of its own, using materials that originate from the aircraft industry not ship building. Indeed, in certain respects, commercial shipbuilding has adopted ideas and materials from the yacht building industry in recent years – an example is the use of GRP in minesweepers.

But are the boats we take to sea fit for their purpose? Have we allowed the quest for speed to outrun the need for boats that can be expected to survive in serious adverse conditions; are we building craft that rely on luck and the law of averages to avoid extreme conditions, forgetting that an average is just that, a mean of highs and lows, and by definition worse conditions can be expected 50% of the time?

For this discussion I am talking about offshore craft, not day boats and dinghies. I am talking about the yachts that cannot speedily seek shelter if conditions deteriorate quickly; yachts that would expect to make passages, be they cross channel or around the world and must therefore, at some point in their existence, expect to be caught out in really rough weather.

I am not discussing power yachts. This is in part because my own experience of power vessels is with large, relatively underpowered steel vessels, but also because the average small powerboat does not make long oceanic voyages although there are exceptions. Power boat races tend to be of short duration and close to land. It is perhaps pertinent though, to ask how would a modern 40 to 60 foot power yacht cope in a storm, especially if it lost is main engines. Whilst they may be perfectly seaworthy in rough conditions whilst their engines are working, what happens if the engines fail? Is an Arun going to be as safe and comfortable when engineless as one of the Rother Class?

The seaworthy yacht is one that has been designed, built and equipped to survive in extreme conditions. It means one that is sea kindly, an old fashioned term perhaps, but one that is of vital importance to those who are going to sea in her. It means that she has a safe range of stability, that her scantlings are sufficient to provide the strength to live through a series of knockdowns, that her hull is so shaped that she can run off, lie a-hull, or crawl to windward in safety, that her rig is well balanced with sails that can be managed in even the most adverse conditions, and, most importantly, the crew can sail or motor her safely through these conditions and know how to handle her when the sails are gone and the motor fails to start. It should also be able to withstand damage and still provide a safe conveyance for the crew.

Most of these criteria will be governed by the design and build, but designers and builders cannot be blamed if, for example, a well designed and built boat is in need of a proper re-fit, or has aged to the point where its strength is compromised. The problem is do amateur skippers know enough about yacht design to know whether they have a seaworthy boat, and if they do not without spending years studying the subject, there must be some proper checks to ensure that the designers, builders and sellers of yachts are creating a product that is fit for use by amateur crew. Whilst the final responsibility for the safe operation of a yacht must lie with the skipper and crew, we cannot expect amateur skippers and crews to fully understand all the requirements and parameters that are necessary to produce the seaworthy yacht. If yachts are going to risk facing these conditions then it is up to the yachting industry, rating authorities and race organisers to produce standards that ensure that they are suitable.

For those of us who choose to go off the beaten track there is a duty to ensure that your craft has a sensible level of safety built into it so that multi-million pound rescues are avoided. Modern communications do mean that you can call for help wherever you are in the world, but with this must go a responsibility to minimise the likelihood of needing to make that call. Expensive rescues by the Australian Navy of individuals from upturned yachts in the Southern Ocean will always grab the medias attention, but they do nothing good at all for yachting. My suggestion that sailors who choose to take their boats to areas where rescue could be difficult and therefore risky and expensive, should take out a rescue bond met with howls of fury. But it is done in some out of the way areas where a Government can claim jurisdiction over the adjacent seas. If you wish to visit Spitzbergen for example, you need to have a rescue bond. The cost of diverting a large merchant ship or warship to pick up a yachtsman from a damaged yacht is considerable and these costs increase the further the yacht is from regular shipping lanes.

For the sailor it was all much simpler 34 years ago, when the lack of communications meant that you had no way of calling for help and so were dependant on your own efforts to survive. Frankly I find that preferable. If I want to risk my life that is up to me, and it is not right to use other seafarers and the Search and Rescue authorities as a form of ultimate life insurance policy when taking out of the ordinary risks.

Last month we saw the demolition of a large part of the Route de Rhum fleet. This is a trans-Atlantic race and so does not come under the category of being off the beaten track. 19 boats withdrew in the first few days including 2 boats abandoned from 5 capsizes, 4 dismastings, and many structural problems. Many of the yachts simply could not cope with the conditions they encountered. The conditions were nasty. It should be remembered that an oil tanker, the Prestige, broke in two in the same storm, but when a third of a racing fleet is forced to withdraw through damage we do have to ask whether the boats were suitable, or perhaps, whether the race should be run when the weather conditions can be expected to be so inclement.

There has always been a thirst for speed and that means a constant pursuit of lighter, better shaped, yachts with more horsepower. Dramatic photos of trimarans on one hull in ideal conditions are what the PR people want and the press love. But where are these same people when the boat is breaking up in a Force 10? The PR people are chewing their fingernails and writing defensive press releases, and the journalists filling columns with the latest sailing disaster. An couple of hundred kilos of additional strength in the right places would greatly improve the chances of survival, and therefore of winning, because you have to finish to win. But that weight would have been seen as a negative when the PR plans were being drawn up and the press came for a sail.

Three weeks before the Route de Rhum, the Around Alone fleet encountered similar conditions and although the 4 leading Open 60's sailed through the 70 knots of wind unscathed, the rest of the fleet sought shelter until the storm had passed. All except one, which broke its mast in a mere 20 knots of wind, avoided damage but they lost 6 days before they could clear their chosen shelter. But at least no yachts were lost; no serious damage ensued and once the weather improved the smaller craft were able to continue their race.

About 20 years ago I built a sturdy little catamaran called British Airways. She was built to round the Horn and so strength was important but it meant she was not ideal for short races. We came up against the journalists favourite Paragon on a number of occasions, undoubtedly a faster boat, but she never beat us because she never finished the races where we competed. When we won the World Championship for 60-foot multihulls that year I was frequently told that it was only because Paragon had been unlucky. I don't think luck had anything to do with it.

Everyone remembers, or at least has heard of the 1979 Fastnet disaster. The lessons learned were that many modern, well built, yachts proved to be vulnerable to the Force 10 conditions they experienced. There were catalogues of causes, new carbon fibre rudders that failed, yachts that had insufficient stability, (the average angle of vanishing stability was found to be about 115 degrees), yachts whose fittings proved inadequate for the conditions. Some were abandoned because they were sinking, some out of fear, some because assistance was on offer. Some sank, forcing their crews into liferafts. Others were abandoned and remained afloat. These abandoned yachts might have provided a safer place for the crew if they had had confidence to stay with the yacht. Of course some boats were badly handled, it was acknowledged that there was a lack of experience amongst some of the crews, they were simply out of their depth, and greater experience qualifications were subsequently introduced by the RORC.

We have recently had another so called disaster with the Sydney-Hobart Race and again lives were lost as boats succumbed to conditions that they could not withstand. I say so called disaster because this appears to be a selective term, with the media at least. Five lives were lost in that Sydney to Hobart Race, and although one is two many, just a few years ago 16 lives were lost on Ben Nevis in a 6 week period but no one has referred to the Ben Nevis or mountaineering disaster.

The excuse for the loss of lives and boats has been made that conditions were extraordinary and arrived with little warning, but a Force 10 is not extraordinary. A Force 12 might be unusual but not extraordinary. A yacht expecting to go into the Southern Ocean might well expect to meet conditions in excess of Force 12 and any sensible sailor going there would ensure that their boat could survive. And yet a few years ago we had a succession of capsizes which caught the world's headlines. Perhaps the most alarming from a sailors point of view being those pictures of boats floating upside down with their keels intact. From the designers and builders point of view, probably the pictures of the new maxi yacht "Drum" floating upside down having lost her keel in relatively light conditions was even more alarming.

Rating Rules have not tended to encourage seaworthy boats. They may have set out with the intention of producing them, but it ceased to be the major concern once the designers and owners had played with the rules to squeeze for the extra bit of performance, or find ways to reduce their rating. The IOR gave us yachts that proved dangerously directionally unstable down wind, would not lie a-hull comfortably and whose only option was to jog along gently to windward in really rough conditions which dangerously reduced the options.

Speed has produced rudders that are unsupported by a skeg or keel. They may be more efficient, but they are also very vulnerable to damage from anything that happens to be lurking below the surface of the sea, be it a mammal, fishing net, log, whatever. Last week I saw a yacht collide with a sunfish at 7 knots just outside Cape Town harbour. One of the rudders was broken as a result. I am not going into the just submerged container issue because a container is either buoyant or it isn't and if it isn't, it sinks. Not completely trusting what logic told me on this subject, I phoned the flag officer submarines and asked him how a container could float just below the surface and he told me he wished he knew because it would have made manoeuvring a submerged submarine much simpler!

Force 10 is often used as a standard for assessing the suitability of a seaworthy ocean going yacht, indeed it has now become a category, but why Force 10 and what sort of Force 10. A force 10 with large cross seas can be a great deal more dangerous than a Force 12 with consistent seas Seas tend to heap close to land making a Force 10 near land much more dangerous than one encountered out at sea, and tidal streams can aggravate the situation further, but the category does not take this into account, it relies purely on wind strength. Would not Force 12 be more sensible?

Merchant shipping accepted the need to recognise different sailing conditions years ago. Winter North Atlantic load lines ensured a greater freeboard than Tropical Fresh water conditions for example. There is no suitable equivalent for yachts, but if the winter storms are going to become more ferocious, or put another way, if yachtsmen are going to extend their season and go sailing at times when such storms are more likely, maybe we should be looking for some definition of what is a suitable yacht for those conditions. No sane sailor goes to sea in gale conditions let alone stormy ones unless it is to rescue lives, but those who make transoceanic races must, at least, be prepared to cope with them.

Some equipment is set out in rules. The recommended size and weight of anchors is a good example. But how many yachts have a fixed point strong enough to secure that anchor or a towline? There are no rules covering this but it is just as vital. Many do not even have a suitable eye in the Gammon to keep an anchor or two line lead through the bow and without this the boat is certain to yaw. Often the first strong point is the mast with the attendant damage this can cause, dismasting in some cases. Look around a marina and you will come across many inadequate mooring lines. I have seen clothesline on a 30 footer for example, which gives little confidence that the rest of the equipment on the boat is adequate. There was a fashion for a simple slot through the mast to serve as an exit for the spinnaker. Now everyone knows that a spinnaker can pull in almost any direction and the usual solution is a small crane to which is attached a swivel block. The plain slot was fine for the Solent, where the halyard could be re-reeved each evening in the calm of a marina, but it was totally unsuitable for a boat going on a longer voyage where the inevitable chafe would mean sending someone aloft at sea. The professional mast maker had not appreciated this.

There are MCA and racing regulations governing the size of windows, demand certain heights for hatch coamings and insist on certain sizes of cockpit drains. There is nothing that examines the suitability of a yacht to survive in angry conditions in the element in which it is going to operate. Classification societies have construction recommendations, but there is no real check to see if yachts are fit for purpose and no definition of what that purpose is. A boat which is sold as a cruiser and not subject to MCA or racing rules may be described as ocean going, but in what weather conditions? It is unsupported sales blurb.

There are no rules governing the suitability of sails. Some set out what must be carried which will usually include a storm jib and trysail but no one has defined "suitable". What requires a sail to be sufficiently rugged to survive the constant working of the material in a storm? We know modern materials are stronger; have less stretch and hold their shape better, but what is their life expectancy? A torn mainsail has an immediate effect on a boats sailing options. When we prepared Enza for her record run around the world we chose Dacron/Terylene for the mainsail, not Kevlar. We wanted a sail that could take a hammering for two and a half months in constant use.

And what about the running rigging? Nowadays we use a variety of man made fibres, which are considerably stronger than the vegetable fibres that predominated 40 years ago. Those vegetable fibres would stretch and eventually break if put under intense loadings. There is a suggestion that had the sail training ship "Marquesa" had vegetable fibres when she was knocked down by a heavy squall, they would have given, releasing the sails and thus allowing the vessel to come upright although there are some questions as to what her vanishing angle of stability was. Whatever, nothing gave and the force of wind held down the vessel until she had flooded and lives were lost.

We tend to have an almost superstitious faith in modern technology and materials, but stainless steel rigging has less give and work hardens about three times faster than mild steel and how often do boat owners remove their rigging to check whether a strand has gone? Dyneama is used in halyards, but it quickly deteriorates where it passes over a sheave and down comes the sail and up has to go a crew to reeve a replacement.

The Marine Accident Investigation Board in its regular and excellent reports on marine accidents has pointed out that once one thing goes wrong, whether it be with the sailing plan or with a craft, safety options are becoming restricted and it is essential to make a new plan. If a boat is damaged, or her engines or sails no longer as effective or reliable, a new plan that takes these new restrictions into account is essential. A boat might be heaving to quite comfortably until a cabin window was smashed. Immediately her options are limited. She might have to put herself about to put the hole in her coach roof on the lee side and this might mean she is drifting towards instead of away from danger. This danger might not have occurred if the window was smaller or stronger. The Offshore Racing Council's rules and the MCA code require boards that could be bolted over the opening to deal with this, nothing says a new cruising yacht, which anyone can buy, must have them.

The question is, how do we recognise a suitable ocean going yacht? At one stage there was a competition to see how small a boat could sail safely across the Atlantic. Most of these tiny craft succeeded. It might have been luck, it might have been that the boat was so small it just bobbed on the top, very uncomfortable for the occupant, but both survived. Much larger craft have failed in similar conditions. Is the traditional heavy displacement long keeled design built in wood any safer than a very modern shallow draft, wide sterned lightweight flyer built in carbon?

Size would be a factor of course, scantlings another, stability a third. The structure built to take a pounding, as a one off is dangerous, one built to withstand continuous pummelling is not. The larger craft, properly built and handled, is going to be a safer and more comfortable place in higher wind and sea conditions than a smaller one. The smaller boat will be heaving to earlier than the larger one of similar design. She is more likely to be swept by a sea or rolled and this needs to be taken into account when she is constructed. A large lightweight boat can fly before the wind and rising seas; the heavy displacement yacht cannot and needs to suffer the greater punishment that will come because she does not have the speed to reduce the apparent wind and sea. Heading into such conditions however, assuming there is no safe haven available and limited sea room, might find the heavier boat the better suited but only if the boat can keep moving forward. If a boat wants to lie a-hull pointing close into the waves if may be reasonably comfortable most of the time. But if one larger wave comes along and pushes the boat backwards the strains on the rudder and steering gear are enormous and it may well break. Lifeboats used to carry a steering oar for use if the rudder broke and handling through surf. How many yachts carry a steering oar as a standby these days?

My four experiences of the Southern Ocean have been in three very different craft, "Suhaili" a 32-foot heavy displacement ketch, "Condor" a 77 foot IOR maxi sloop, and twice in a 92-foot catamaran, "Enza New Zealand". The first survived 5 months of heavy punishment, seas that swept right over it, knock downs caused by cross-seas from which it could not escape. It had to be tough. One of her great advantages was her Norwegian stern that divided a following wave as it arrived rather than providing it with a large transom to smash against. Without the reserve buoyancy of a large transom, it did not tend to nose dive as a wave arrived at the stern, but it could be quite wet when an overtaking wave swept across the deck instead. The stern also reduced the forward momentum that a wave hitting a transom can provide. This is a design feature that extends back thousands of years.

The reason for streaming the warps was to provide an easy form of sea anchor to cut the speed and drift and keep the stern to the waves. There was more give in the warps than from a sea anchor and thus less strain put on the boat, both in its securing points and because it tended to give before the immediate impact of a wave before the warps exercised their full restraint and even then the warps slipped a little. In any case, if you have used a sea anchor in anger you quickly discover that its tripping line, designed to reverse it so it can be hauled in easily, almost inevitably gets tangled with the painter and you need the strength of Hercules to haul the boat back to it.

But even in a double ender directional stability can be lost if it is running before large waves unless there is some check on the forward movement. Warps streamed astern will prevent this. The experiences I have of this situation are mainly in storm conditions in the Southern Ocean where 600 feet of warp, streamed as a bight astern, immediately brought the stern round so it pointed into the wind and the boat lay very comfortably. On another occasion, in an Atlantic storm with 50-foot waves my warps became so entangled on the deck as I was trying to stream them, after we had been pooped, that I was unable to get them out. The inevitable result was the boat surging forward and broaching leading to four knock downs culminating in dismasting.

Directional stability plays a great part in the handling in extreme conditions. The lines of the boat, particularly the buttock lines, have a far greater effect on directional stability than is usually appreciated. The old fashioned long keel tends to keep a boat in a straight line, but this is not always the case. The modern fin and skeg, or fin and unsupported rudder configuration relies on the rudder to make up for this but it does not always work, especially when a large wave causes a surf. Even with a very speedy reaction from a skilled helmsman the boat may decide she is going to sheer off and a broach is then almost inevitable. The catamarans interestingly, were remarkably directionally stable and I put this down to long clean lines and two, well spread, rudders.

The maxi IOR boat could run before the seas, but tended to pull up into the wind on a really big surf that no amount of helm, easing the main sheet, or reefing the mainsail would check. These broaches usually ended with the boat on her side and it was with difficulty that we got her to head off down wind again. Damage was continuous, mainly to the sails and rigging, but there was an obvious risk to life as well. I found the only way to hold her safely downwind was to put her under twin headsails, one boomed out, and under that she behaved like a lamb. This did not satisfy the crew who thought that at 37 years of age, I had become overly cautious. It took a couple of incidents like this for them to appreciate that in fact under the boomed out headsails we made more ground in the desired direction in similar conditions than we did under spinnaker, with a lot less damage to rigging and sails. Another advantage was that the crew could actually rest properly when off watch.

This IOR boat had the benefit of size though and was able to keep running before seas that would have been a heaving to situation for the smaller boat, and the real danger came when pushing too hard and broaching under the wrong sail configuration. The catamaran's size and speed meant that gale to storm conditions just pushed her forward, the danger came when the speed was sufficient to overtake the wave in front so the yacht plunged down the forward surface and buried the bow in the back of the next wave ahead. This, typically, reduced the boat speed from in excess of 25 knots to zero in a split second and put huge strains on the rig. It also shot people forward, whether standing or in their bunks, and caused an injury on one occasion. When faced with headwinds it was necessary to heave to in particularly bad weather off Cape Horn and it might have been necessary to stream warps and run off if conditions had not improved.

In extreme conditions, unless running carefully downwind, the multihull is at risk of capsizing from sharp and heavy squalls, or particularly large waves, especially from the beam. This in fact is what happened to at least two of the trimarans in the Route de Rhum. One only had its staysail set but that provided enough windage to cause a capsize. There is a point, nearer to 45 degrees than 90, where a multihull becomes in danger of toppling over and it requires constant attention to ensure that the boat is kept so that this will not occur. A light machine like this will tend to run off very quickly, much faster than is safe. If you have been sailing close-hauled and bear away the speed and so the apparent wind builds up very quickly as the boat accelerates. A sudden squall has the same effect; the boat tends to accelerate and builds up the wind even further. This leads to a very quick increase in the heeling forces which threatens a capsize. It also sends the boat crashing into the waves much harder and increases the risk of damage.

One suggestion, from a leading multihull designer, commenting on the failures in the 15 boats that retired or were lost in the Route de Rhum, is that the materials used in modern construction, of which Carbon Fibre figures prominently, have too little give in them. Like cast iron, Carbon fibre is strong until strains exceed its designed strength and then it snaps. Snatching loads, which we get in all boats at sea, can easily causes strains that are well in excess of designed limits and the result is breakage. Older materials, glass fibre, wood, Kevlar, aluminium and steel all have a little bit of resilience in them. One of the reasons why *Enza* was able to withstand considerable battering off Cape Horn has been attributed to the fact that she had a Kevlar skin which gave her excellent shock absorbent properties.

In really bad sea conditions in a multihull I have found that putting the seas on the quarter has often seemed the most comfortable situation. Even so, in one hurricane near Cape Hatteras, the only thing that stopped us capsizing was the wave which had lifted the weather hull so it seemed to be vertically above us, although in fact it was probably nearer 45 degrees, breaking down onto the boat and stopping us heeling further. With *Enza* we did stream warps as we came back into the English Channel to reduce speed and the risk of nose-diving. Our problem was that even with the anchor and all the chain streamed out with the warps she would still reach 17 or more knots in a surf and I still wonder what we could have done if the winds had increased further.

It may seem surprising that I think the catamaran was the safest of the three boats. Apart from her size she was basically unsinkable because she was divided by watertight bulkheads and had no heavy metal keel that was going to drag her down even if every compartment did fill with water, which was unlikely. Even capsized she provided shelter for her crew and access to the new "deck". The maxi had no such subdivision and had she filled with water would have gone down like a stone. The smaller ketch, the same displacement as the catamaran 3 times its length, was even more vulnerable and susceptible to damage but withstood knockdowns and being swept by waves because she was extremely strong. Incidentally, it is unlikely that Suhaili could comply with the latest MCA down flooding requirements, she has no watertight bulkheads and I have only the vaguest idea of her angle of vanishing stability. All I know is that when she was knocked down well beyond 90 degrees she came up quite sharply.

The MCA requires watertight bulkheads in yachts that are carrying paying passengers or crew, but these are not a requirement in what we might call normal monohull ocean going racing yachts. They were required for the Volvo ocean race yachts and are required for the Open classes. The suggestion of watertight subdivision came from experienced around the world solo skippers at a meeting I chaired after the first BOC Challenge in 1983 in which two boats were lost, one through a hole in the hull, the other through loose keel bolts. There was no pressure from race organisers, Governments, classification societies or designers to include this requirement at that time, it came from experienced sailors. Initially the rule called for the boat to be divided into three separate compartments, not counting the space forward of the collision bulkhead, and to be able to float when the largest compartment was flooded. The number of watertight bulkheads has since been increased to 5 after the 3 well publicised rescues during the last decade and openings in these bulkheads must be watertight.

It is significant that in last month's Route de Rhum, which resembled a demolition derby with its capsizes, collisions, and dismastings, no lives were lost. All the entries in this race were either multihulls, or from the Open Classes, all of which have watertight subdivision. It is worth noting as well, that in all 6 of the current regular around the world races, Le Race, the Volvo, Around Alone, The Vendee Globe, Clipper and the Challenge Business, all have mandatory watertight subdivision, the first four by the organisers or class rules, the latter two because of MCA requirements.

There was also a simple stability requirement introduced for Around Alone in 1983, one that was easy to check and did not depend upon what a designer thought he might have produced. The boat was not allowed to heel more than 10 degrees with all tanks full on one side and empty on the other. This included fuel, water and ballast tanks. It was a start.

There has been a growing focus on stability in yachts since the Fastnet of 1979. In theory at least, a yacht with a heavy keel ought to have a good righting lever well beyond an angle of heel of 90 degrees, so that it can survive a knockdown, but in practice many only just exceed that angle. The MCA now insists on stability curves being produced and a proven angle of vanishing stability for commercial yachts, which is calculated from a set formula, which cannot be less than 90 degrees, in nearly all cases it is much more than that. With the Open 60, 50 and 40 classes, after the shocking photographs of yachts lying upside down, keel intact, in the Southern Ocean a few years ago, the rules have been significantly tightened from the original 1983 ones. It is now a requirement in the Class rules that the boat not only be able to right itself from 180 degrees, but demonstrate this ability through an inversion test for each boat, with its skipper inside the cabin, before it receives its class racing certificate. This has tended to check the trend towards even wider boats and encourage designers to include a convex deck. The canting keel too, must be able to be worked in the inverted position as this can help to start the boat swinging upright. The Volvo race rules for the last event called for a positive righting moment up to 142 degrees of heel, enough to survive a serious knockdown and this requirement is unlikely to be less if a new class is developed.

Once a yacht heels beyond the angle of vanishing stability, in other words the point at which the righting forces turn negative, everything is working to make it go upside down. A monohull that has capsized, provided she remains watertight is probably going to come upright but once a multihull capsizes it is a dockyard job to get it upright again. In a large swell a monohull may wobble itself back upright, but its mast and sails are acting as a damper and considerable force may be required to overcome this.

Some years ago the RORC did produce its SSSN as a means of stability screening, and more recently the STIX (Stability Index Numeral) has come in which will run in parallel with the SSSN for two years and then perhaps replace it. It is encouraging that the subject is now on the agenda and is being addressed, and a new international standard ISO12217-2 is with us, developed as a part of the EC Recreational Craft Directive. But this standard can only be as good as the criteria it is based upon, and inevitably, the ultimate standard they set. Will ISO 12217-2 produce better and safer yachts? Well insofar as it is a minimum standard to which all new boats must measure it will be an improvement, but whether it goes far enough is another question. Why does it require a lesser angle of vanishing stability than the MCA code? Surely if the MCA think that a certain level of stability is required for commercial yachts that would be a good point to start a general requirement for all yachts.

Under the new ISO rules a yacht in Category A conditions, which is up to a Storm Force 10, with significant wave heights up to 7 metres, must have a minimum angle of vanishing stability not be less than 95 degrees. A similar yacht, using the MCA code of practice, would require a vanishing angle of stability of 132 degrees. One has to ask why the ISO is content to accept a much lower figure than the MCA, indeed one that is below the 115 degrees that was found to be inadequate after the Fastnet storm of 1979. This appears to be a figure reached as a result of bureaucratic compromise, not recognition of what is really happening out at sea.

In the meantime some rating and racing authorities have moved on much further and are taking the requirements to a much higher level than the ISO demands.

Apart from the IMOCA rules, the most encouraging safety feature has come from the Offshore Racing Council's new stability requirement for Category 0 offshore racers: -

Either with or without reasonable intervention from the crew a yacht shall be capable of self-righting from an inverted position. Self-righting shall be achievable whether or not the rig is intact.

This gets us right to the nub of it all at last. The boat must come upright – period. One hopes that racing authorities that use the ORC Category 0 rules will follow the IMOCA example and ask for physical proof. We should be asking why the ISO lags so far behind this standard.

Commercial vessels usually have an angle of vanishing stability well under 90 degrees. In new square-rigged sail training vessels, there is a requirement for positive stability to a minimum of 90 degrees. These vessels, which may have to withstand a knockdown and at this point their righting moment largely comes from the ballast in the keel which would tend to encourage a high ballast ratio. But there is another factor with square-riggers, which prevents lumping too much weight in the bottom of the vessel. If they are too stiff, in other words have too much ballast and too great a righting lever, it swings them back quickly from a roll and they can make the yards unworkable for the crew who would be thrown off, and this, clearly, is not seaworthy. Ideally this rolling cycle should be between 8 and 9 degrees, and where this is less it may be necessary to turn off down wind. A simple rule is that the faster the rolling motion the less comfortable the craft will be for those who sail in her. In order to achieve an acceptable angle of vanishing stability one sail training vessel has had to increase her righting lever to the point where the rolling cycle is 3 seconds. In this case to increase safety in one respect the vessel has been made less safe in another. This is not the right solution and we must be wary of allowing safety to be controlled by a series of ticks in selected bureaucratic boxes which may suit officialdom but, in turn, create dangers for the sailors that are not, perhaps, fully understood by the officials.

When the STA Brig Stavros Niarchos was being built, I went to the yard to check on progress and noticed that the sidelights had been moved from the break of the Foc'sle and put on the foremast lower shrouds. When I questioned the reason I was told the MCA required the change. I asked the reason and was told that this meant they were more visible. In theory yes, they were higher. However what had been forgotten was that this was a square rigged sailing vessel and when the fore course was set it, which it frequently would be, the sail would hide a light on the shrouds. After discussions the lights were put back on the break of the foc'sle where they would be visible to a vessel approaching from leeward. The change was no doubt well meant, but it did not take into account how the vessel worked and what actually happens when the vessel was at sea under sail which is what it was designed to do.

The freeboard, hull shape, superstructure and masts play a significant part in how a vessel will handle in strong winds. The traditional Brixham trawler, with its deep draft aft and much less draft forward, wanted to pay off down wind. If it had its 20-foot bowsprit out this effect was even more pronounced. A high freeboard gives greater leeway and the placing of a wheelhouse forward or aft can help decide whether a boat will tend to want to head off or fly up into the wind. In the older, traditional rigs, such as square rigs and gaffers, it was possible to reduce top hamper. Topmasts could be struck to reduce windage and increase stability. There was usually sufficient manpower in the crew to make this a reasonably speedy evolution. On how many occasions do we read historic accounts of vessels cutting away their masts in bad weather? The modern yacht, with its continuous aluminium or carbon mast cannot reduce its rig at will, unless it gets rid of it completely. There is a competitive desire for tall masts, both to increase power and aspect ratio, but every pound at 100 feet above the deck is 25% more pitching moment than the same pound at 80 feet and will require a heavier keel, or, with a multihull, a wider platform, to compensate.

All but one of the modern lifeboats in RNLI service have a righting moment to 180 degrees, and the exception is extremely close. A major reason is the large sealed superstructure that provides buoyancy that can assist a vessel to right itself. It tends to swing the boat back upright, or at least to the point where the righting lever becomes positive. Flush deck yachts will not have this advantage, those with a large superstructure might, but only if it can be sealed and very few yachts are as well able to seal their superstructures as a lifeboat. Nor is a yacht designer going to produce drawings that show a lifeboats superstructure on a sailing yacht. Apart from looking rather ugly, it would provide permanent windage which could be a disadvantage in some circumstances and, if not properly built, it can be very vulnerable when the boat is knocked down or swept by a wave.

Conclusion.

We only have to look at what is considered to be the more dangerous side of the sport of yacht racing and cruising to see that steps have been taken to improve the safety of the yachts. In multihulls, and in around the world racing yachts watertight bulkheads are the norm. Stability has become a recognised issue. There will be a need to examine the structures of racing multihulls after the Route de Rhum, but the enormous insurance payouts will probably ensure high premiums, which will act as an incentive.

Sailing is a remarkably safe sport considering the numbers involved. It is said that more people die from drowning in riding accidents than in sailing ones. But the fundamental point remains that until such times as the ability of a boat to handle comfortably and easily in extreme conditions becomes as important as a few points in the rating, unseaworthy boats that put their crews at risk will continue to appear.

But any boat, however well designed and built, is in the final analysis only as safe as the crew who man her. A bad crew with a good boat are probably more at risk that a good crew in a bad boat.

The sea is just as dangerous as it has always been. We may understand the weather better, even be able to forecast it with some degree of accuracy, but the fundamental fact is still with us. However much we advance in technology, when caught out in rough weather it does not matter how much modern technology is carried aboard, it does not matter what material has been used to construct the yacht, what it all comes down to is whether the yacht, however constructed or designed, can survive. The essence of good seamanship is safety, but good seamanship may not be sufficient if the craft turns out to be unsuitable.

RKJ
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