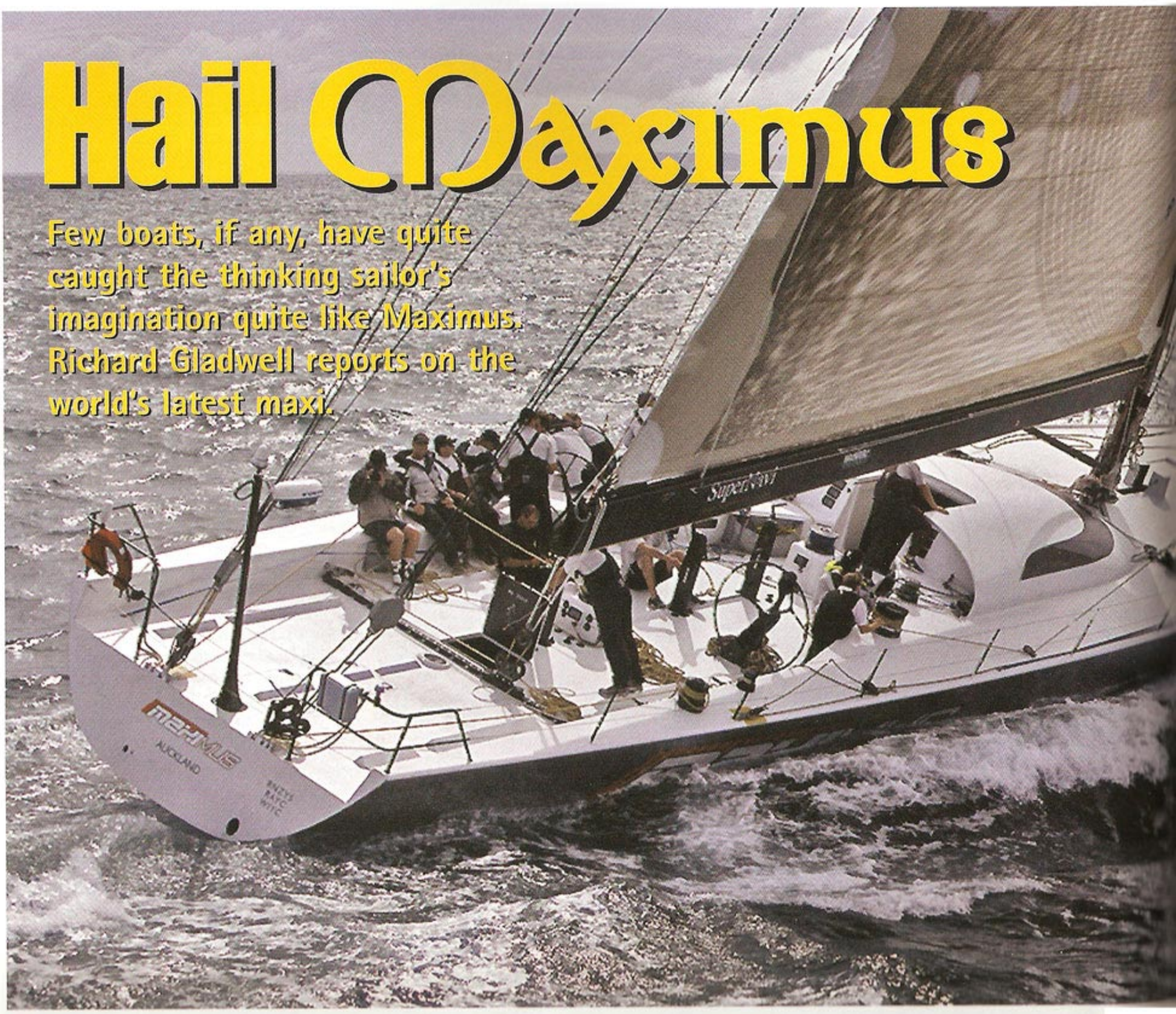
Hail Maximus

Few boats, if any, have quite caught the thinking sailor's imagination quite like Maximus. Richard Gladwell reports on the world's latest maxi.



Dazzled by a plethora of claims about records, speed, general craziness and other tales, the general public has become a little blasé about the next that is claimed to be the latest and greatest on the sailing scene.

Maximus is not just another Big Boat. In the flesh, or rather on the water, the size and presence of the Greg Elliott designed supermaxi is awesome, attention grabbing and athletic.

Athletic is not a word one would normally use with in a sailing context, but how else would you describe a boat that has breathtaking acceleration, sails faster than the wind, and is completely orientated towards speed?

Up close it takes a trained and studious eye to fully appreciate this masterpiece. Appropriately, she is painted Porsche silver and the embodiment of engineering and fine design that puts New Zealand right up there with the world's best.

For the initiated the maxi-yacht racing world has been is something of a quandary for many years. The old 70ft maxi's were once thought to be the ultimate machines, then came the out and out speed machines like the aircraft carrier Vendee Globe types and the Volvo 60's, soon to become the Volvo 70's.

In the rating world, rules have come and gone, and now the market, or rather jungle, is making its own rules and new types seem to be emerging, led by owners rather than rule makers. Typically these boats fall into box rules – where length is the only real measure and within that box – anything goes – or may the fastest win.

The "box" that has emerged at the top of the scale is the Supermaxi class – which are informally limited to 100ft, but typically come in around 30 metres overall or 98ft in the old measure. Numbers of the type are somewhat vague, with 20 being touted as the world fleet. However, 8 is the more researched figure – most being located in the Southern Hemisphere, with five in Australasia.

Like many race boats, as the type becomes more refined the boats start to fall into the same "corner" of the rule and the incremental design advancements become smaller and smaller.

Maximus breaks this mould wide open with several design features, of which one alone would have been considered radical for this type of boat and design thinking. Her design inventory boasts a rotating wing mast, hydraulically lowered keel, canard complete with trim tab, and a Code Zero jib/gennaker. She is the first supermaxi to tread the technology path in all these areas.

Jointly owned and conceived by Charles St Clair Brown and Bill Buckley, she combines the entrepreneurial approach of St Clair Brown and the engineering expertise of Bill Buckley with designer Greg Elliott bringing the ideas into fruition. Then it was over to Cookson Boats to create the dream and Southern Spars and North sails to power her.

The mainstay of the Maximus project is to provide a demonstration of New Zealand marine design and technology excellence, in quite a different way from say the America's Cup efforts – which have been more a process of technology refinement within a strict set of

design rules. Maximus is a real blank piece of paper exercise.

Comparisons with Elliot's other radical creation, Mari Cha IV – the twin masted, canting keel, water ballasted 44m (145ft) holder of numerous world sailing speed records.

"There is no real comparison between the two boats as there are two different design briefs", says designer Elliott. "The design brief for Mari Cha IV was to design the fastest monohull in the world, whereas the design brief for Maximus was to design the fastest boat under 100ft. That is the end of it. If you look at the two boats there are very few similarities, if any. One has two masts and is a canting keel water ballasted boat and so on. The other has a single rotating mast, extendable keel and is 45ft shorter. They are very different".

Her vital measurements are: LOA is 30 metres or 98ft, waterline length is 1.5 metres less. Her beam at deck level 5.7 metres, coming down to 4 metres at the waterline. According to St Clair Brown, the deck beam measurement was more dictated by the spreader base width required to keep her rig in place, rather than by formal stability requirements. Her draft is 6m and with the keel raised it is 4m. Draft of rudder is 3.7m and same for canard which is raised hydraulically. Fully retracted, the canard is 800mm above the deck level. It is made of carbon with a trim tab to give a better asymmetrical shape to the foil. The canard has a trim tab on it which is 30% of the chord width, and is driven hydraulically from the steering position via a button.

Sailing on Maximus is an unnerving experience which has one constantly in reality check mode.

First is the sheer size and smallness of the boat. Even though she is 100ft long and certainly looks at from the bow, in the cockpit she feels like a 60fter due to the cockpit layout and forward positioning of the twin steering wheels.

Out of the boat the rig and sail area look huge; in the boat and looking skywards they seem even bigger, and certainly there's plenty of the high tension graunching noise associated with releasing sheets when under high load.

The rotating mast looks unusual, but after a short while seems quite normal. The rotation is quite noiseless – in spite of 170kN (38000kgs) of jack force under its heel. The fact that it has only two spreaders and a set of diamonds makes it seem more appropriate to a boat half the length. However, it functions faultlessly and you can almost feel the reduction in drag.

Sails hoisted, Maximus starts off at a fast jog around the inner Waitemata. Non-working crew quickly take up a position in the ample after end of the boat and keep a nervous eye out for flailing backstay blocks, sheets and keep a firm grip on something solid.

A quick glance at the speed read-out shows she is cantering at 9-10 knots under mainsail alone in 6-7 knots of breeze. The brain does a quick double take on this information. First a quick check out the back to see if the wind is only that speed – and the jobble on the water's surface looks about right. Then a look over the side to see if the water is really going past that fast, and it is. Then it's a glance over at the chase boat which is pacing alongside – and yes, it looks like it is doing about 10 knots.

On our day out, the canting keel was due to be tested, but some minor issues with an "O" ring put that one on hold, and we are just sailing in keel retracted, and uncanted, mode. The day turns out to be a bit of a light work-out, and the #3 jib is called for.

With this sail on and the wind flicking in the range of six to 10 knots, Maximus does a few quick laps of the harbour.

The reality checks are coming thick and fast, now as the eyes see the boat's speed, flick across to the true windspeed and realise that we are sailing upwind at faster than true windspeed. In fact she rarely drops below true windspeed, and is generally sailing at between 1.0 and 1.4 times the true windspeed.

A glance across to the apparent wind speed readout is very revealing and resolves the anxieties which are subsequently confirmed by Greg Elliott.

"In 10 knots of breeze we can comfortably do 14 knots – we are almost always bettering true windspeed – and that is reaching and running or anything that is cracked", he explains. "But our optimum upwind speed seems to be 12 knots and she is very close-winded. She is as

Bill Buckley and Charles St Clair Brown have put the Maximus project together to be a showpiece of New Zealand marine technology.

close winded as an AC boat but 2 knots quicker. I would think that we are close to whatever their true and apparent wind angles would be."

"The design brief was to have a boat that would sail very well upwind. It is not a downwind machine. A boat of this size could be considerably faster downwind if you wanted to do a downwind special. But as an all-round boat, we think it is very good. We are quite comfortably achieving 12 knots upwind and are getting close to having a 10-knot VMG – that is pretty quick upwind. It is very early days, and while we are seeing good numbers at this stage in flat water, I think we can achieve them in some sort of a seaway as well. It is very early days, but the upwind side of things needed to be emphasised."

St Clair Brown adds, "We are very happy with our VPPs – we wouldn't have built her otherwise. We did a huge amount of VPP analysis with Clay Oliver – and looking at the options, these included water ballasting and canting keel, all the various hull forms including slightly wider waterline beams. We did the analysis as best we could, using just a computer. We don't have time to go off and tank test hulls because that would have put the program back about a year. There are only narrow windows in all these things and you have to use known information about hull forms and VPPs which will tell you what different hull forms will do.

"This boat is an all-round offshore racer. If were going harbour racing we would reconfigure her and take some equipment out. The big issue is that our displacement has come in on where we targeted, and the next issue was the canard.

"We have always had our doubts about forward rudders and getting them to work properly. We have decided to put a tab on the canard – we are happy to have it close to the mast – as long as it is retractable. A lot of effort has gone into making it strong enough as you get some extraordinary side force loading as you come out of waves. So Brian Jones and his team at High Modulus have done an enormous amount of engineering calculation to take account of these, plus the work that has gone into the retracting mechanism and handling of the trim tab. The canard is raked but can't have a variable rake."

In spite of her advanced engineering, Maximus remains a very simple boat to operate and sail. However, there is very little that is conventional, and the complex is presented as being very simple from a sailing perspective.

Starting at the bow she sports a 3.5m long prodder. Engineered from carbon fibre, the silver coloured prod is very simply secured to the boat and can be easily detached. It is quite unlike the aesthetically displeasing carbon tree trunks that seem to sprout from boats of this type to support the asymmetric sails.

Next item of interest is the jib tack point which is on the apex of an A-frame and tensioned hydraulically below deck. The device allows the use of a halyard lock to secure the halyard and the downhaul to tension the jib luff. The rest of the foredeck is clear, save for a large pneumatically sealed foredeck hatch which opens to a large working area – about the size of a small bedroom down below. The hatch slides fore and aft rather than opening. Again the application of some very clever engineering makes for a simple solution. Every foredeck hand wants a hatch that is as big as possible so that big, stiff sails can come and go as quickly as possible. And this one

The interior is functional and practical yet offers enough comfort for offshore racing.

doesn't leak either.

Moving aft, the rotating mast is the next attention grabber. Again the engineering is superb with Buckley being responsible for the titanium mast base and Southern Spars for everything above the base. In operation the whole idea looks deceptively simple and you wonder why this sort of rig isn't more commonplace.

Mast rotation is controlled by a short spanner, as is standard with a mast of this type, which is in turn controlled by a simple double purchase. Elliot describes the mast on Maximus as being more a rotating mast then a wing mast. The main reason for the rotating mast is less drag. It is an over rotating mast similar to that used in Moths many years ago. "It is self-rotating if you let the line go and in some cases we have to restrain it from rotating too much and have to pull it back. The load on the arm is so low it is able to be moved by hand when it is fully loaded. It might have 1kN (224lb) of load on the arm – which is not a lot when you consider there is 590kN (60 tons) of compression force. It is a very well balanced mast.

Elliott says the spar is a development of the one on Maverick – a 45 ft Elliott design and that in turn was a development of one that had been done before. The mast consists of two sets of spreaders and a set of diamonds – the purpose of which is to keep the lower section of the mast straight and without having to use a lot more carbon or making the section bigger and heavier.

The mast was made in a female mould by Southern Spars who did the total rig package including boom. The rigging is in PBO by Future Fibres – which rolls up like a rope for transport. The standing rigging weighs just 140kg. Had rod been used, Elliott estimates that it would be four times heavier. [Dubbed the 'world's strongest fibre', PBO fibre (trade name – Zylon; manufacturer – Toyobo Co. Ltd of Japan) is made by forcing under pressure the polymer Para-phenylene BenzobisOxazole), through a spinning machine. Its tensile strength is about 10 times that of steel. An object weighing 450kg (990lb) can be hung from a PBO thread of only 1mm diameter, provided you're clever enough to tie knots that don't reduce the thread's strength! Zylon has a specific gravity of only 1.55, an ultimate tensile strength of 5.8GPa and a tensile modulus of 270GPa – Tech. Ed.]

The deck area back to the cockpit is relatively clear due to the halyard tails being led aft through tunnels along the edge of the cabin

top, and back to a couple of winches at the forward end of the cockpit, but .below the coach-house level – reducing drag and making the winches easier to use.

The cockpit itself seems like half a tennis court. It is dominated by twin steering wheels positioned well forward, and three grinder pedestals and their associated winch drums with hydraulic controls on the aft end of the winch base units.

St Clair Brown explains: "This is the biggest non-custom winch that Harken manufactures. custom winches – which are significantly more expensive.

"Maximus is configured with three pedestals – all winches are set up for electric hydraulic as well, so when we want to regatta race and we are not trying to get a record, then like any boat over 24 metres we are allowed to use electric hydraulic winches. At the moment we are working on the basis of pedestals which are all linked together."

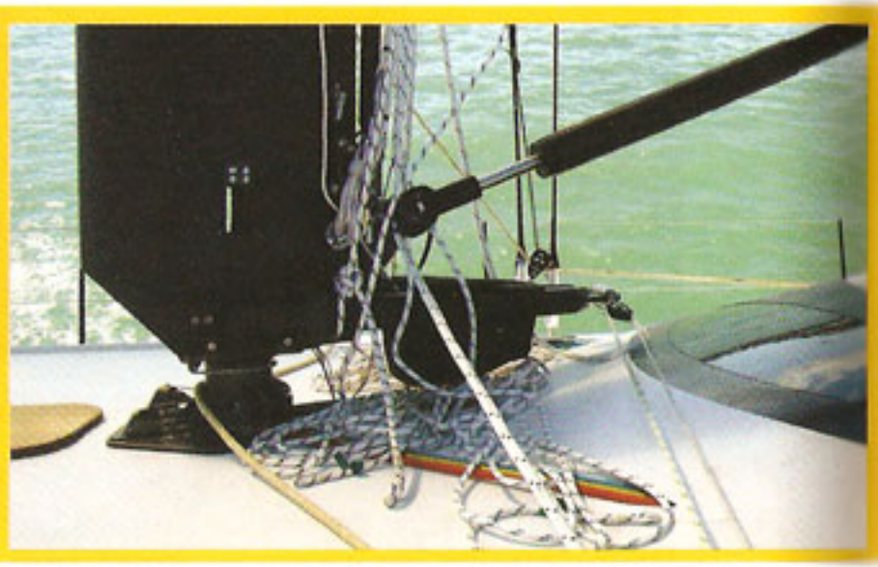
All keel retraction, canting, canard and canard tab adjustment is controlled from the cockpit by used by the navigator, tactician and others, and also serves as a good safe vantage point for on-board sponsors/guests/media.

Below-deck access in this area is via several hatches into small lazarette areas containing steering quadrants, diesel and liferafts.

"We have a good fuel transfer system between tanks, so if there is a problem with the fuel it doesn't go through the rest of the boat", says St Clair Brown. "The quadrant has independent systems so if one system breaks there is a fallback.

The retracting keel allows draft to be extended to 6 metres before the keel is canted up to 50 degrees.

Headsails are hoisted, halyards locked and then tensioned using an A-frame and below-deck hydraulics.



The mast step functions perfectly under 38,000kgs of load – controlled by a light 2-1 purchase.

This boat has the highest loads that a non-custom winch can take – so our sail area is maxed out to the winches. If any of our competitors want to increase their power ratio by increasing sail area, they will have to go to

hydraulic switches.

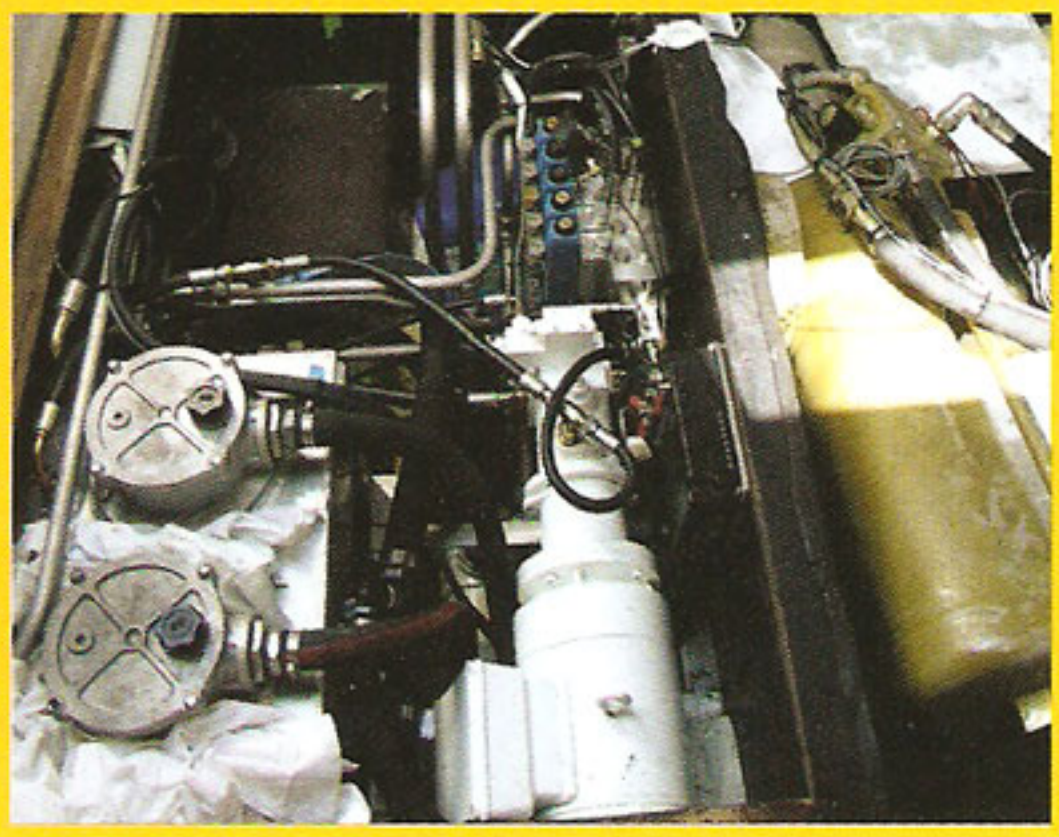
The wheels have been set well forward to give the helmsman better communication with the crew and the feeling is more of sailing a 65 footer than a 100 footer. The aft deck area is

"There are three eight-man rafts all below the aft deck – saves having problems when an above-deck stowed liferaft inflates by mistake!"

Below decks the design simplicity achieved by smart design, quality boatbuilding and superb

engineering is apparent.
The layout is typical of what you would expect from a trans-oceanic racer – not the stripped-out hull of an overnight racer. Maximus has a good working interior, but is no luxury liner.
The companionway opens to a large saloon and living area. To forward and port is a galley with microwave and conventional gas stove and oven. Definitely not one of those one-burner deals with a gas can underneath! There's a small L-shaped working bench and sink – all in carbon fibre reinforced plastic (CRP) of course, with lockers behind. Opposite and to starboard there is a shower and separate toilet – again CRP where possible, including the toilet bowl.
All discharge water goes to a greywater tank.

Maximus is designed around winches at the top end of the Harken range, with hydraulic controls for the keel and canard set into the bases.



The canting rams and associated systems are under the saloon floor. The head of the canting keel is in a wetbox, which is drained when sailing.

Water tank capacity is 800 litres, and the vessel has an on-board watermaker. In the forward centre of the saloon there is an island with a custom-made fridge freezer made out of CRP and running off two little electric motors. The aft face contains a carbon drinks cabinet and small serving area surrounded a raised lip.
Forward is a large working area, broken by the centrecase for the canard at its after end, and with two watertight bulkheads fitted at the for'ard end. A third watertight bulkhead is aft.
Maximus is fitted down below with dual light systems – white and red for night vision. She has eight CRP pipe cots fitted on either side.
"There are a lot of safety features in this boat," explains St Clair Brown sardonically. "I have had some pretty interesting experiences offshore!"
The canting keel mechanism is contained under the saloon floor. Designer Greg Elliot explains why there is no intrusion into the cabin area from the canting keel. "Normally the head of the keel comes into the boat and sits in a wet box. What I have done is raised the saloon floor so the whole floor is level with the top of the keel rather than have the floor with the keel sticking through it. So it is a little more user friendly and hopefully the boat will have a life after racing."
The hydraulic rams which cant the keel are anchored to full transverse CRP bulkheads.

With the CRP floor down and acting as a lid on the wet-box and keel mechanism the whole area is just a big open space.
Mindful of the Skandia saga during the 2004 Sydney Hobart Race, our attention shifts to the rams and failsafe systems in particular. St Clair Brown explains: "The system is designed so that if there is an impact load the stress is spread around the wetbox. If there is a hydraulic failure the keel can be bought back to centre with a DC motor. If we are not up the right way, the keel will come back automatically. Thirdly, we can pump it back using a manual pumping system. Then there are also pins which are in the fore and aft end of the keel, and which are hydraulically activated. Flicking a switch will cause the pins to be driven straight in."
The process with the keel is that it is lowered to its full draft of 6m and then canted. The loads are such that lowering the 12-tonne bulb while canted is not going to be attempted. The owners and designers feel the trade-off, with a slight amount of drag caused by the intersection of the keel strut with the centrecase, is worth the gain of being able to extend the draft an extra 1-1.5 metres over conventional canting keel boats.
The keel system consists of a female piece which is the centrecase and the male piece, which is the fin (with bulb attached). The whole retracting

mechanism is built into the fin, and by doing this all the weight associated with the mechanism is below the centre of gravity and contributing to the righting moment rather than subtracting from it.

"All these things are about evaluating the trade-offs. Our aim was to have a boat with a maximum righting moment – a very high power to weight ratio", explains St Clair Brown.

The performance expectations were certainly confirmed during the recent Auckland to Tauranga race where Maximus missed the race record by only a couple of minutes, despite being becalmed for a substantial period of time.

Designer Greg Elliott seemed to be well satisfied with her performance on this first outing. "Overall, the performance was very good. We were doing about 12 knots all the way to Channel Island – it was a beat not a lay through, and then we had no wind there, and then we had a jib top reach when the wind came in from the outer end of Great Barrier, which lasted to the Hole in the Wall. In 18 knots of wind we were doing 20-21 knots on a jib top reach. Then it came flat off and we were doing 17 knots in 20 knots of wind.

"We are still not up to full potential because of the building program and trying to get the boat in the water to meet the commitments that have been set up. Everything has been very, very tight, so there has been no time to really work the boat up fully. It appears at this stage to be very encouraging and she certainly has a lot of potential.

"The boat has done over 20 knots two-sail reaching in the harbour. Going to Tauranga in 18 knots of breeze, we were doing 18-20 knots on a flat run, so it is a very quick boat. It is hard to get a measure of true performance from the Tauranga race as the next boat in size was a 72 footer. I guess we will find out when we start the Trans Atlantic."

Maximus is the only New Zealand entry in the Rolex Transatlantic Challenge, which starts in New York on 21st May.

When entries closed, 20 yachts ranging in length from 70ft to 230ft had entered the prestigious race. One of the objects of the race is to break the Trans Atlantic race record which was set in 1905 at just over 12 days, by the schooner Atlantic. Since then the Trans Atlantic time has been halved by a monohull, however this was not set in the context of a race, and was done using a chosen favourable "weather window".

On paper the event would appear to be a duel between Maximus and the 140ft Mari Cha IV, also co-designed by Elliot, which holds the current monohull record for the Trans Atlantic passage.

Aside from the Elliott design pedigree, Maximus and Mari Cha IV are the only two yachts in the fleet to feature canting keels, however the "go-fast" technology and more recent design pedigree of Maximus is expected to more than compensate for the considerable difference in the lengths of the boats.

Conducted by two of the most prestigious yacht clubs in the world – the New York Yacht Club and the Royal Yacht Squadron, the new time for the 3000 nautical mile TransAtlantic race is expected to be within a day or two of the monohull record, which represents an average speed of 18 knots.

Maximus is very much an all-Kiwi project. "We have designed and built this boat in New Zealand; it will race around the world under a New Zealand flag and will highlight New Zealand technology."

The race program for the 2005 season culminating in the Sydney Hobart will cost 3million Euro – "which is hellishly expensive for us", says St Clair Brown. "And that is the sort of money we are looking in a sponsorship. We may also look at sponsors for individual events. Maximus is a great platform for sponsors. It will probably be the fastest 100ft supermaxi for the next year or two on the world circuit and you are talking about racing and exposure on four continents. There will be a lot of attention and interest in the events. There is talk of chartering the QE2 to accompany the Trans Atlantic Challenge fleet across the Atlantic and I think it does create a lot of opportunity for a sponsor. There will be real-time footage coming back to NZ for that event."

"Ideally, I would like a large NZ company to come in behind the project. We are racing around the world with a NZ flag with a NZ crew and NZ technology and NZ boatbuilders and designers. Everything possible is from NZ.

"Part of our business concept is to promote New Zealand products internationally, and put on show our NZ boatbuilding, marine industry and sailing skills, other than just via the America's Cup."