

The super-successful *Lionheart* (with regatta help from the Brunel Volvo crew) is a completely new build based upon one of the family of Ranger designs drawn in 1936 by Starling Burgess and Olin Stephens but never built. Among the immediate gains over existing restored J-Class designs was the ability to put as much as 36 tonnes into that headstay...



New for old

Andre Hoek's design studio has proved masterful at adapting and employing the most modern design tools for the benefit of classic and historical race designs

Performance through research

Having invested in our first Velocity Prediction Program (VPP) in 1986, the team at Hoek Design have always placed great emphasis on performance. Initially using it to design and optimise traditional Dutch sailing yachts for racing, with leeboards and gaff rigs, we created that first VPP on a 126KB Apple Mac computer – with the computing power of a modern calculator. To build this VPP we first had to make a mathematical model accounting for the resistance of surface-piercing leeboards, and the interaction between

these and the hull as well as the aerodynamics of a gaff-rigged sail plan. Tank testing different hulls gave us valuable data to calibrate our 'new' software, and even from the early days these yachts were achieving great results. More than 300 yachts in this style have now been built to our designs and they still dominate the Dutch domestic race scene, winning the majority of races in the various classes along with many open championships.

Fast forward and it was in 2005 that we first started to study J-Class design, when an existing client of ours had tried to buy, and just missed, the J-Class *Endeavour*, and then requested that we research the optimal and best possible design that could be built... around 70 years after the last brand new J-Class was launched.

Today's J-Class Association (JCA) was founded in 2000 to protect the interests of the class and encourage new-build yachts to enter the field. New class rules were established, the most important of these being that only existing line plans made before 1937 were allowed to be used.

A total of 22 designs were made in the original J-Class era with 10 yachts being built before World War II. Sadly, only three of these yachts survived: *Endeavour*, *Shamrock* and *Velsheda*.

Studying Harold Vanderbilt's book, *On the Wind's Highway*, it was immediately apparent that the longer Js were more successful than their shorter rivals. The early Js that raced in the 1930 America's Cup had a waterline length of roughly 80ft, the second generation in 1934 were 83ft and the third generation in 1937 were 87ft, the last ones being dubbed 'Super Js'. Taking advantage of their extended waterline length and more spacious interiors, our focus was on these longer designs for reasons of both speed potential and comfort.

As we had done in the past, we then developed a new VPP specifically for these long-keel yachts with their long overhangs. Tank test and wind tunnel data using a 20ft tank model was then used to calibrate the new software. Twelve designs were put into this software, including several

existing Js, and the five that performed best were then run through a Computational Fluid Dynamics (CFD) program to see if the results we found in the VPP reflected those in CFD.

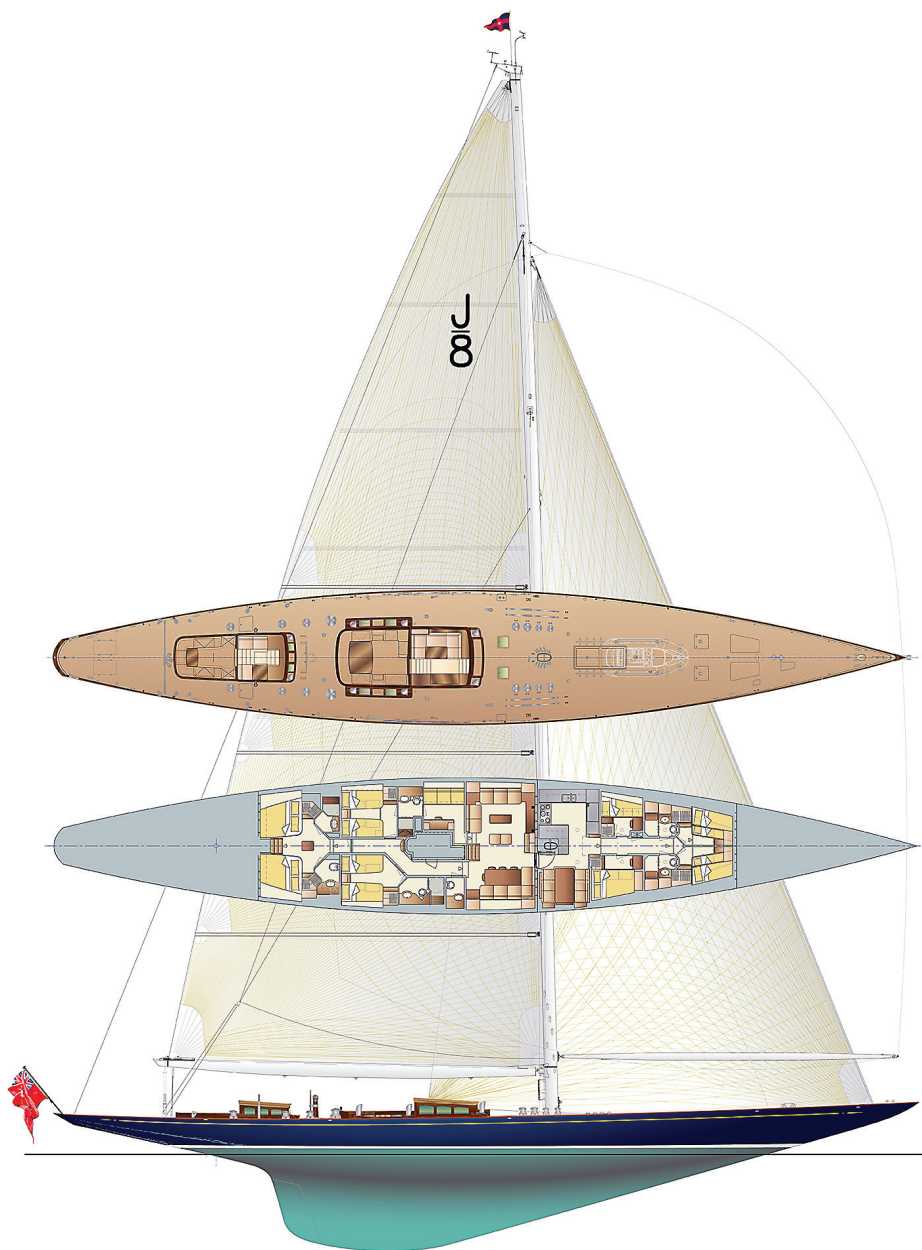
Even within our family of larger Js, the differences between the various designs in length, beam, volume distribution, wetted surface and keel shapes were considerable. These designs were then also run through the JCA's own handicapping system to determine which design was optimal on corrected time. The results showed that certain designs performed better in light air, others in heavy air and, notably, several behaved very differently in waves.

JH1 Lionheart was eventually chosen, a design based on the lines of one of the Ranger syndicate designs made in 1936, but never built. The IP rights for this design were bought and the team got to work on how the design could be optimised within the rules. This began with her aluminium structure which was run through a Finite Element Program to optimise longitudinal stiffness at high runner loads. Hull stiffness is not a measured element within the handicap system so a bonus could be possible here compared to existing Js. The existing fleet had generally until now carried a maximum headstay load of 25 tonnes, but to improve stiffness and upwind performance, a new main longitudinal structure was designed for an increased headstay load of up to 36 tonnes.

During the design and build we always work closely with the sailmakers as well as the manufacturers of the deck equipment, mast and rigging to optimise weights, deck layout and sail handling. With the considerably higher loads we are now targeting, as well as the constant development (ie increase) in line speeds, we require the most out of the winches and hydraulic system. This becomes most evident in a gybe-set manoeuvre, when most of the deck winches need to work simultaneously at different speeds and loads, asking different flows and pressures from the hydraulics.

Today's J-Class boats all also now boast full carbon spars and carbon rigging. This, combined with the latest more rigid sail materials and sheets and halyards, means that with little stretch available deformations are so slight that the dynamic loads have increased substantially throughout the sail-management systems. Much research has also been done by our team, together with Southern Spars and North Sails, on the optimal stiffness of the mast and rigging, and the interactions with both sail shapes and rig weight and CoG.

Under the current J-Class rules the boats sail against each other using a handicap determined by the actual boat parameters and a measured stability. For this reason we remain involved in all of our projects after launch to optimise each design to its handicap to keep a little edge on the competition... Differences in weight, stability and sail areas are carefully calculated

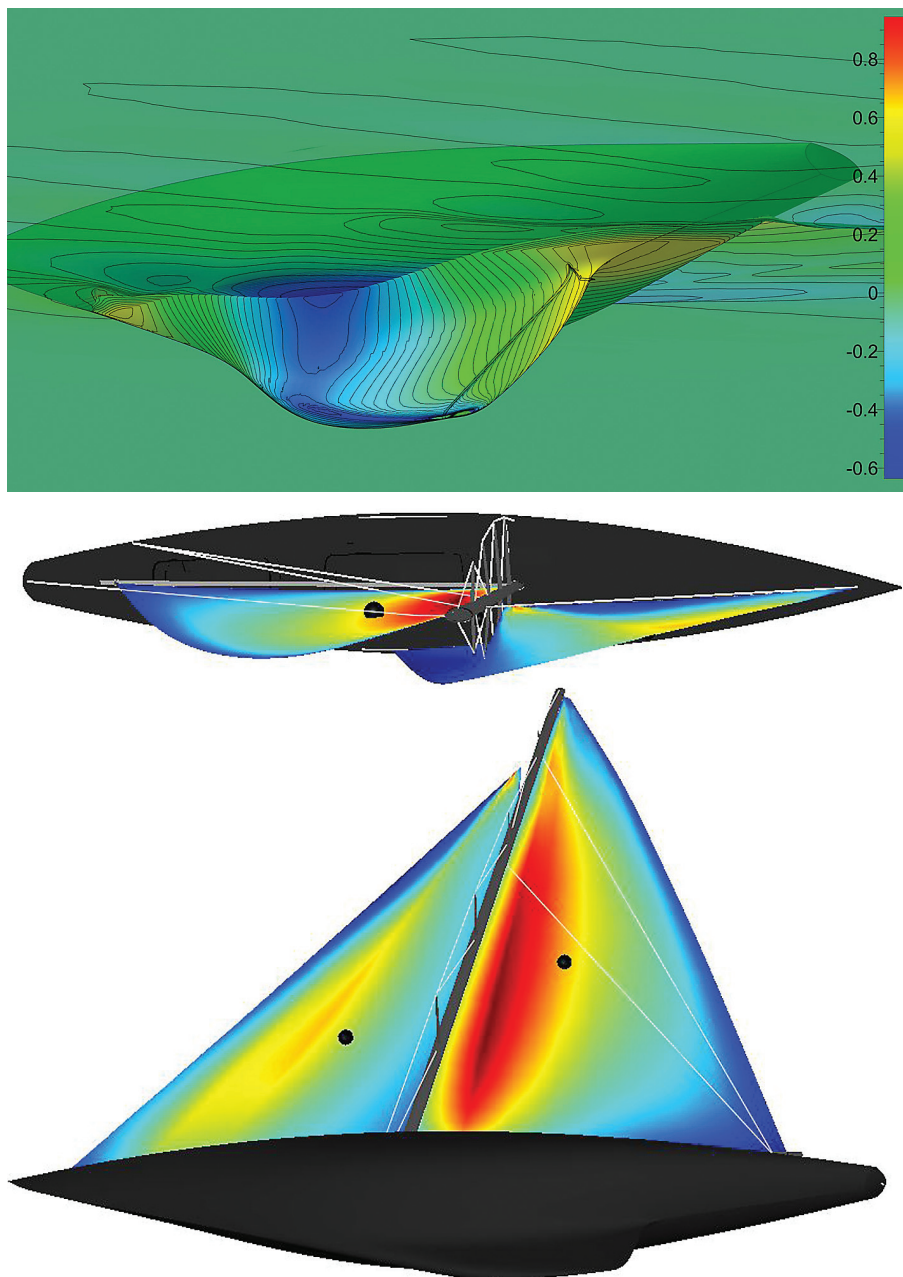


within our CFD software to compare actual difference with the calculated difference in handicap.

Of course, the new Js are not only designed for racing but also for cruising, and emphasis has necessarily been given to optimise deck layouts for both. With her unusual double cockpit layout, *Lionheart's* large centre cockpit is used for sail

storage during racing, while in cruising mode it accommodates a large dining table for eight to 10 guests.

Rather crucial on the Js with their large fractional rigs and inline spreaders are the runners, and when racing these can be operated conveniently and without distraction while standing in the smaller aft cockpit. In cruising mode this aft cockpit



Left: the completed hull of J11 emerges at the Bloemsma shipyard. Based upon a 1937 Tore Holm design, J11 will be among the sleekest of today's growing (sic!) J-Class fleet with an almost flush deck making her particularly easy on the eye. So a real day racer in the spirit of the original J-Class... J11 will actually carry a sensible interior in order not to disrupt the excellent competitive equilibrium in today's closely-match fleet... J8 (opposite, top) and her successor J9 will feature the longest ever waterlines in the class (88ft) at the expense of some sail area. In the spirit of a former America's Cup class (above), today's J-Class designs undergo the full range of CFD and FEA analysis

also offers improved privacy for the owners with direct access from the master cabin. Staying with the theme of ergonomics, on *Lionheart* the helm is situated in between the aft deckhouse and the main cockpit with the primaries and mainsheet winches close by, making it possible to have the centre of command operating without headsets and offering excellent visibility for the trimmers and helmsman.

Lionheart has to date proved to be exceptional on the racecourse, winning the King's 100 Guinea Cup in 2012 in what was only her second regatta. In 2014 her winning streak continued, taking the J-Class trophies at Mahon, Palma and Sardinia, with the owner at the helm and Volvo race skipper Bouwe Bekking calling tactics.

The successes of *Lionheart* have led in turn to two more Hoek Design J-Class yachts (J8 and J11) that are currently being built and a fourth one in design (J9).

Developed on the basis of the hull lines of the longest waterline J-Class ever designed, a Super-J by Frank Paine, but also one that was never built, J8 is currently under construction at Holland Jachtbouw and is due for launch in spring 2015. Her stunning lines have been fine-tuned and optimised for racing under the JCA rules, with extensive CFD studies carried out to gain a better insight into leeway angles, rudder size, helm balance and sail plan design. Her Art Deco interior – very appropriate to the time of her original design in 1935 – is being designed

in-house, and will feature a striking combination of makassar, leather, stainless steel, white overheads and walnut floors.

J11, meanwhile, is based on the hull lines originally designed by Tore Holm in 1937 which were discovered in 1999 by John Lammerts van Bueren while researching 8 Metre plans. Known as *Svea*, she is arguably aesthetically the most beautiful of all the Js and her hull is now under construction at Bloemsma in the Netherlands, part of Claassen Shipyards. Bloemsma has been responsible for building the hulls of *Lionheart*, *Rainbow*, J8 and J9 and, not surprisingly, is now established as the specialists in these complicated craft.

J11 has been designed with an almost flush deck and two cockpits, an optimal layout for racing and close to what these yachts would have looked like in the past, with a lot of effort going into developing her performance, structure and looks. There is no doubt she will be a seriously headturning yacht on the water.

The latest J-Class presently in design and development by Hoek Design for Holland Jachtbouw is known as J9. The design, based on a lines plan by Frank Paine and similar to J8, has a single deckhouse with a large cockpit and a separate small helmsman's cockpit aft. Frank Paine made his name with *Yankee*, the only one of the smaller Js that could compete against, and win, with the Super Js. During the research phase of this project J9 showed to be extremely competitive and promising in both pure speed and on handicap. She is slightly different from J8 with a larger keel.

J8 and J9 were both designed for Mr Lambert in 1936 as possible defenders for the 1937 America's Cup. Mr Lambert also owned the three-masted schooner *Atlantic* along with the J-Class *Yankee* and was in the mood to build a new J-Class to defend the Cup, but Harold Vanderbilt won the right to defend, largely on the back of his two previously successful Cup campaigns which he had won with *Enterprise* and *Rainbow*. Uniquely for J8 and J9, Frank Paine opted for a longer waterline length of 88ft instead of 87ft and was to accept a penalty on sail area. Today, however, the handicap system is very different and this could be an advantage for both J8 and J9.

Ultimately, CFD in J-Class yachts has been one of the main reasons these magnificent sailing boats are improving all the time, both in development of sails and hull appendages. We know much more today about leeway and rudder angles before the boat even hits the water, along with using Rig Edge software to optimise the rigging and sail configurations. However, apart from today's different software and design experience, hands-on experience remains crucial for us to understand the loads and deck layouts, along with valuable input from the professional race crew. Our team members can regularly be found onboard today's J-Class fleet during the training and racing of these magnificent vessels.

Andre Hoek

