INSIDE

JENSEN MARINE

A tour through the plant

Introduction

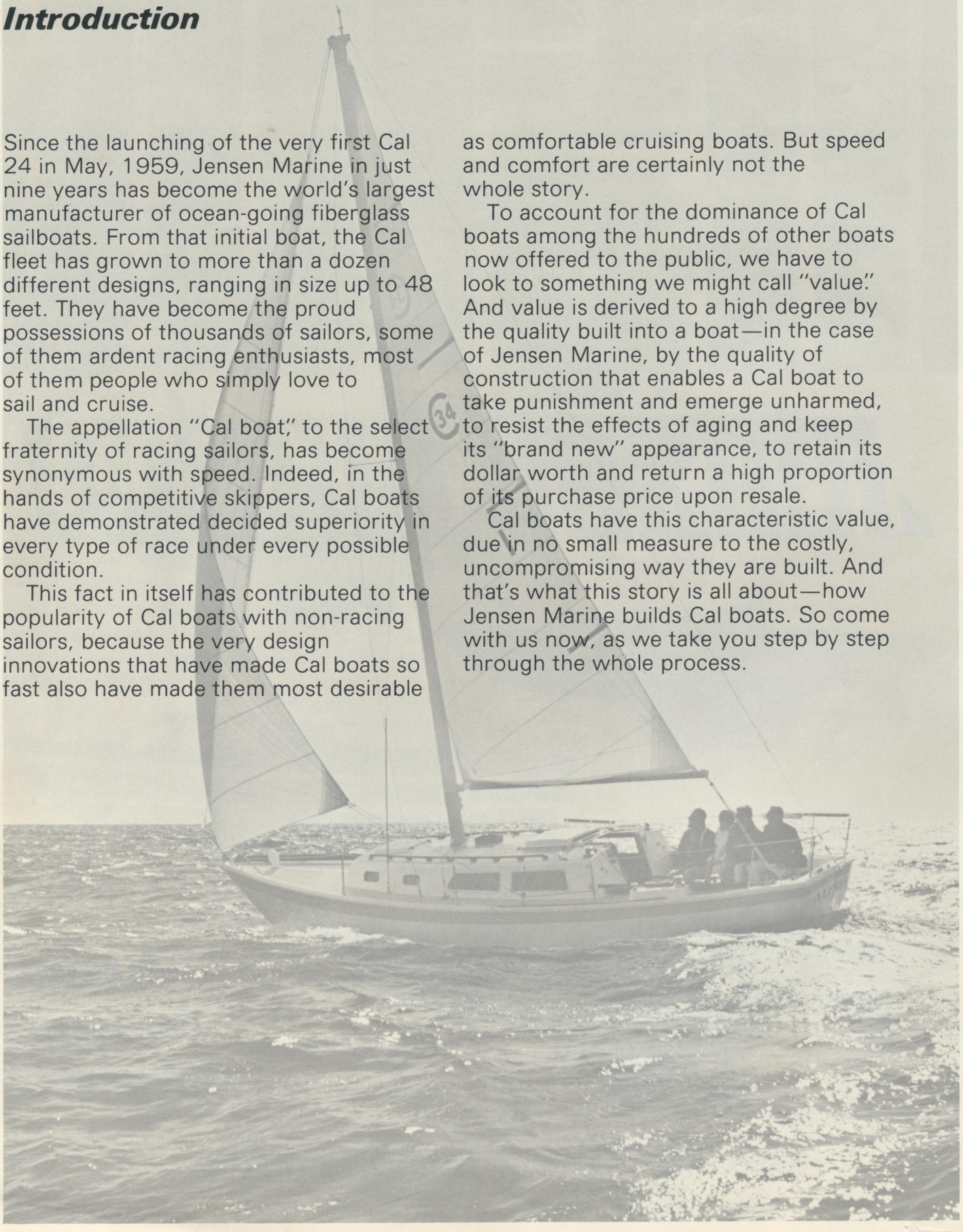
Since the launching of the very first Cal 24 in May, 1959, Jensen Marine in just nine years has become the world's largest manufacturer of ocean-going fiberglass sailboats. From that initial boat, the Cal fleet has grown to more than a dozen different designs, ranging in size up to 48 feet. They have become the proud possessions of thousands of sailors, some of them ardent racing enthusiasts, most of them people who simply love to sail and cruise.

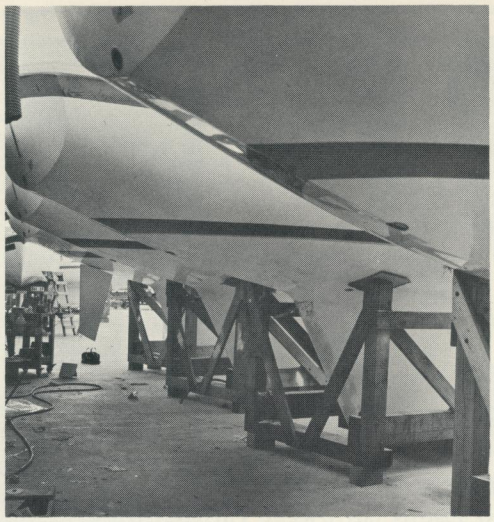
The appellation "Cal boat," to the select fraternity of racing sailors, has become synonymous with speed. Indeed, in the hands of competitive skippers, Cal boats have demonstrated decided superiority in every type of race under every possible condition.

This fact in itself has contributed to the popularity of Cal boats with non-racing sailors, because the very design innovations that have made Cal boats so fast also have made them most desirable as comfortable cruising boats. But speed and comfort are certainly not the whole story.

To account for the dominance of Cal boats among the hundreds of other boats now offered to the public, we have to look to something we might call "value." And value is derived to a high degree by the quality built into a boat—in the case of Jensen Marine, by the quality of construction that enables a Cal boat to take punishment and emerge unharmed, to resist the effects of aging and keep its "brand new" appearance, to retain its dollar worth and return a high proportion of its purchase price upon resale.

Cal boats have this characteristic value, due in no small measure to the costly, uncompromising way they are built. And that's what this story is all about—how Jensen Marine builds Cal boats. So come with us now, as we take you step by step through the whole process.



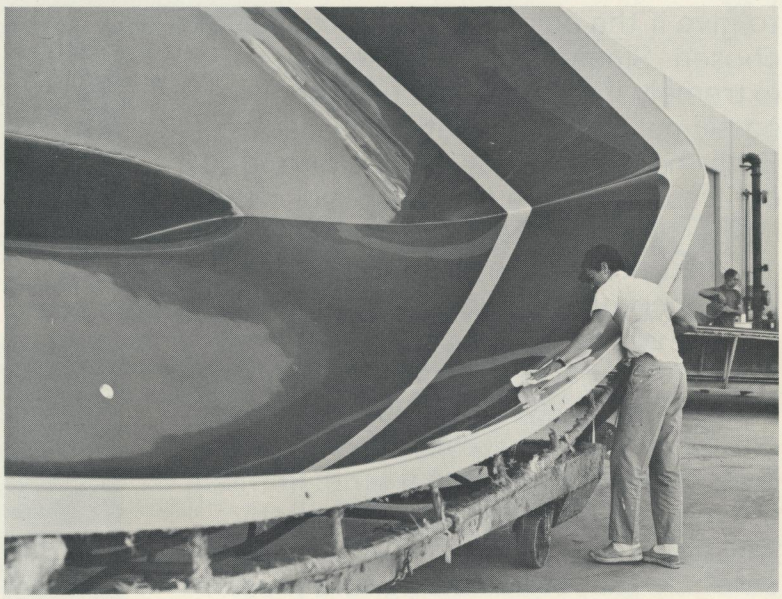


The object is to make all Cal boats in each class identical—not a millimeter different.

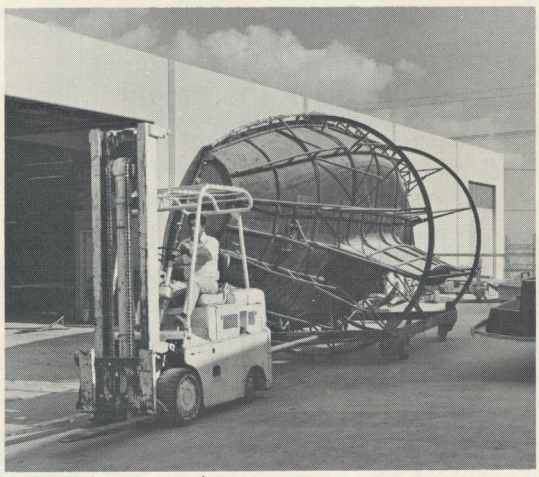
The Beginning

Here's where the building starts, with a full-size wooden version of the fiberglass Cal boat-to-be, lofted directly from William Lapworth's detailed plans. It's what we call by the homely name of "the plug." But there's nothing homely about her lines, for they are finished and honed to excruciating exactness—any blemish or tiny imperfection here will be reproduced on every fiberglass boat that follows.

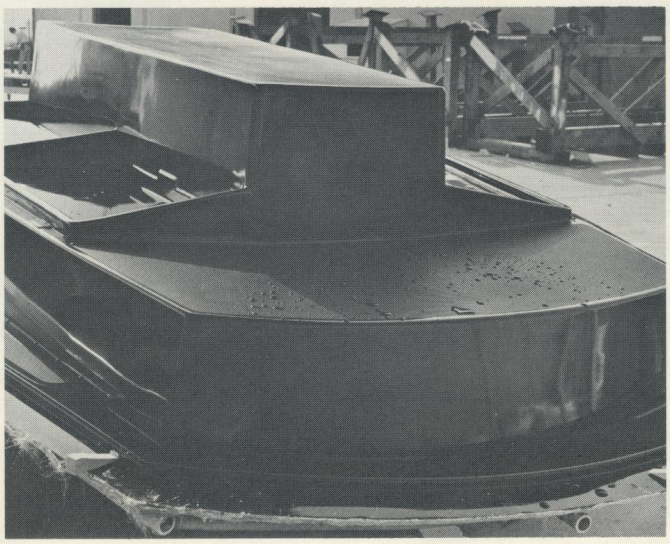
The plug serves as a core around which is constructed two master molds, made of special resins reinforced with fiberglass and backed with a rigid steel framework. The molds are made in two parts, one for the hull, the other for the deck, cabin, and cockpit. Later you will see how the two molded parts are joined precisely together to make a unified boat. After the molds are completed, the plug is destroyed, having no more purpose in our scheme of things.



The mold is a hull in reverse, polished to mirror perfection.



An elaborate steel framework holds every contour of the mold rigidly in place.



Cockpit and deck mold, ready for laying up.

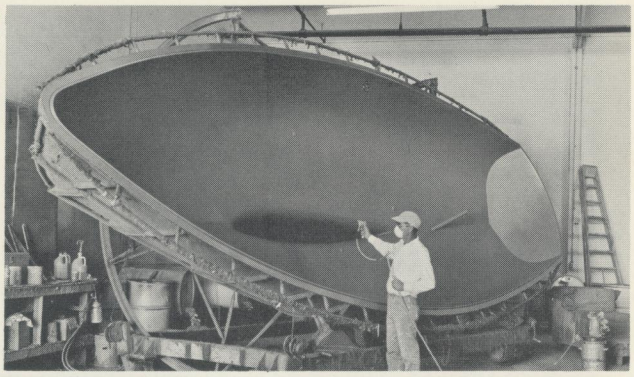
Laying Up

Now that we have our molds, we can begin in earnest the actual work of building a Cal boat. We construct our boats literally from the outside in. The outermost surface of the boat is the gel coat, a layer of resin which is pigmented to give it the color its future skipper has chosen. Since color fastness is extremely important, we use the most costly gel coat formulation available. Both the primary gel coat color and the contrasting colors (for boot top, sheer stripe, and non-skid surfaces) are sprayed evenly into the mold where they become the permanent outer surface of the boat.

After the gel coat comes the patient hand layup of layer after layer of resin, glass cloth, resin, woven roving. Each layer goes down one at a time, in much the manner that one applies a costly wall covering—since the materials are carefully precut according to a master plan to cover prescribed areas, and each is squeegeed to remove excess resin and air pockets.

The build up in the molds follows a rigidly controlled plan, whereby areas of greater stress are given heavier materials in more layers. When the last laminate (layer) is down, the whole structure is allowed to cure. Then the small roughnesses are sanded down and the edges are trimmed to the desired terminal line.

The hull is not yet ready to be removed from the mold, however. It is destined for some woodwork, which is our next stage of construction.

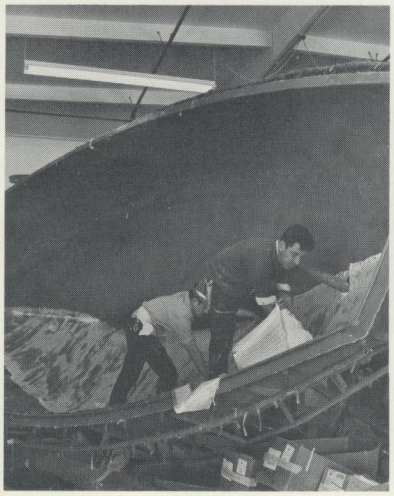


The layup begins with gel coat, the special resin that becomes the outer surface of the boat.

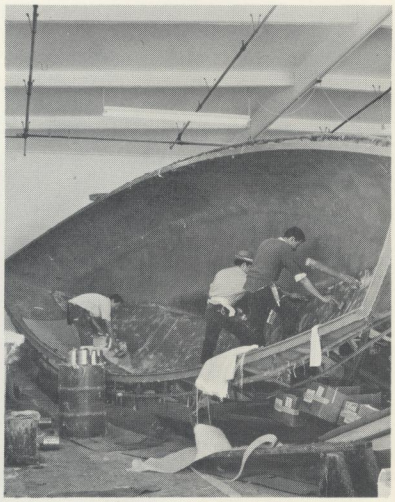
Resin follows fiberglass, poured on and brushed into the weave.

Excess resin and voids are squeegeed out of each lamination.

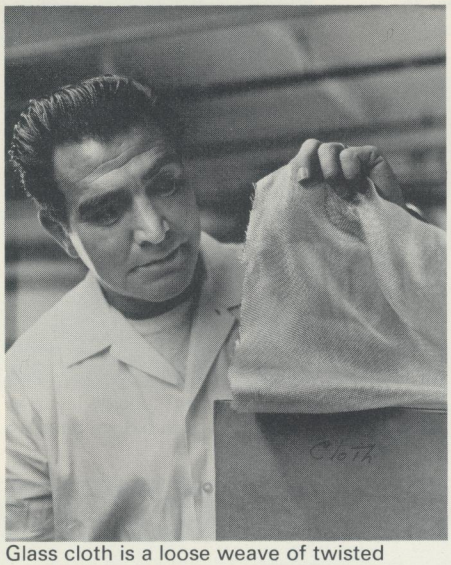
Another lamination is tailored into the mold.



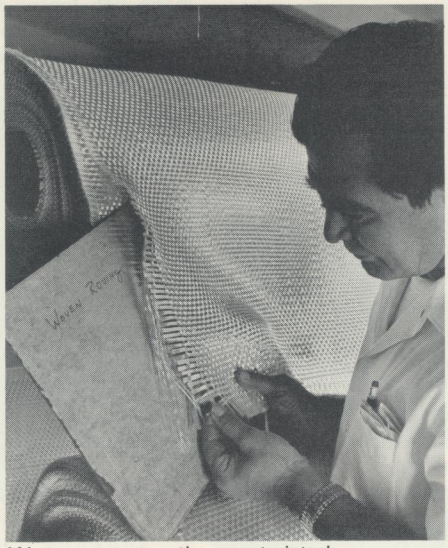
Each lamination builds on the previous one.



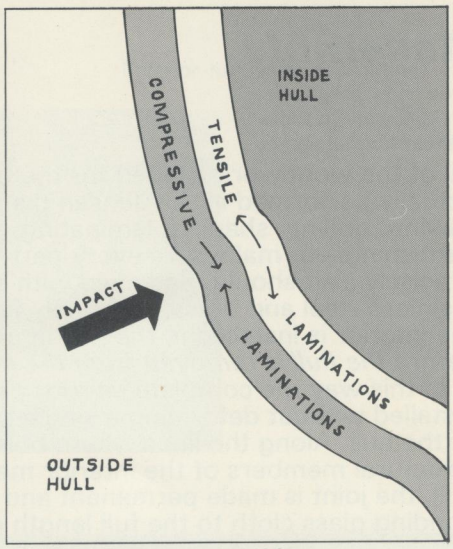
As resin is applied the new lamination becomes a permanent part of the hull.



Glass cloth is a loose weave of twisted strands of glass fiber—weight depends on the size of the strands.



Woven roving gathers untwisted strands and weaves them tightly—the heaviest and strongest of fiberglass reinforcements.



Jensen layup is sequenced for maximum resistance to outside impact.

Some facts about Jensen fiberglass

If the hand layup procedure depicted in these pages seems to you to be an arduous way to build a fiberglass boat, you're right, it is. It is the costliest method we know of, and the best. It is very similar to the method prescribed by the U.S. Navy for construction of all its boats under 50 feet in length.*

Why should Jensen persist in doing it the hard way when it is obvious that a sailboat won't be pounded and driven as hard as Navy power boats? Especially since newer techniques promise greater layup speed and far lower cost?

The answer lies in three words: strength, durability, and weight. In all three respects, Jensen hand layup with woven roving is unequalled by any other method. Since hull damage is usually caused by impact from the outside, such as groundings and collisions, the Jensen layup is engineered for maximum impact strength. The laminations are designed with compressive strength materials on the outside of the hull and tensile strength materials on the inside.** Many fiberglass boat manufacturers today use the "chopper gun" or "spray up" technique. With this method an operator sprays a mixture of chopped glass fibers and resin into the mold cavity much as a painter sprays an automobile. By eliminating the cutting, laying down, pouring, brushing, and squeeging of the hand method, it does indeed save time and money.

But what of the result? Chopped fibers, simply lying at angles to each other, cannot have the tensile strength of glass fabric, whether twisted strand glass cloth, or heavy, dense-weave woven roving.

Further, Jensen layup uses resin as a binder only, chopper layup requires it as binder and filler. With a high glass-to-resin ratio, a Jensen layup therefore is structurally denser, and pound for pound stronger than steel.

Of course, there are many other benefits, but we'll conclude with uniformity and control. With the layer-by-layer hand process, every square inch of hull and deck can be minutely controlled in content and thickness to a degree impossible to duplicate by any other method.

If you've ever tried to paint with a spray gun or an aerosol can, you know how difficult it is to achieve an even deposit over a surface.

Until a method of building better boats comes along, Jensen Marine will continue hand layup. The record—and future—of Cal boats justifies it.

Careful squeeging of each lamination yields a high-density layup.

*For example, see *N.S. 0238-083-8000, Specifications for Building 33-Foot Utility Boat, Mark 3, FY 1964,* which specifies hand layup and the use of woven roving and glass cloth.

**Discussion and test results of layup and lamination methods, "A Study in Fiberglass," may be obtained by writing Jensen Marine.

Assembly

All of the woodwork needed for the boat is actually performed in the Jensen plant—sawing, drilling, shaping, laminating, sanding, varnishing—to make sure every part fits precisely as it should. Fastened with screws of stainless steel and brass, and finely finished, the interior is installed in the hull in units *before the hull is removed from the mold.*

In this way the complete interior can be installed without deforming a single contour of the hull. Along the lines where bulkheads or structural members of the interior meet the hull, the joint is made permanent and solid by bonding glass cloth to the full length of both sides of the wood and along the hull. The interior is thus made rigid in place and the hull is given additional stiffness.

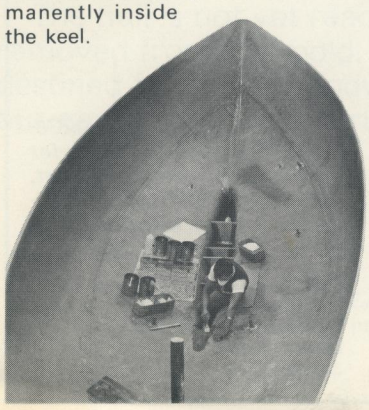
Lead ballast is pre-cast in lead to the shape needed to fit inside the molded fiberglass keel. Actually the ballast is installed even before any wooden members are dropped into position. This technique concentrates the center of ballast deep in the keel, at the lowest possible point, for maximum sailing stability.

After the interior is in—all wood units, fittings, hoses and plumbing, and ballast—then and only then is the hull lifted from the mold, even though such construction reduces the number of hulls that can be molded in any given period of time.

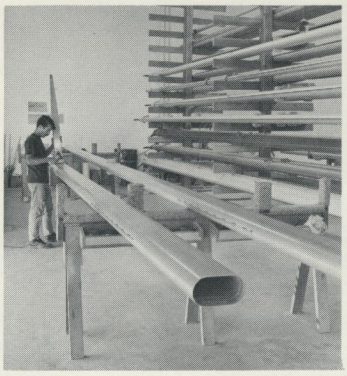
With the hull separated from the mold, the interior is ready for painting and installation of an auxiliary engine. The deck section, also separated, is interior painted and then turned upright for installation of ports and deck hardware.

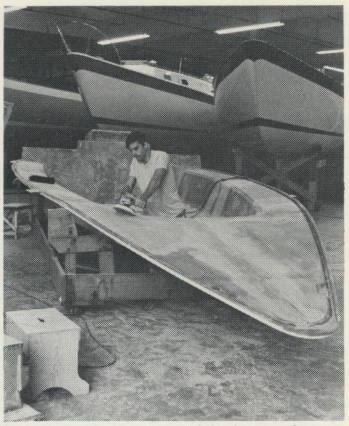
A word about fastening hardware. Unlike wooden boats, which require heavy backup plates or blocks to hold fastenings securely in the deck, Jensen fiberglass has obsoleted backup devices. Since the position of every cleat, winch, track and plate is designed into the boat, their positions are reinforced during the layup stage. As a consequence, when the bolts are tightened down there is absolutely no "play" or possibility of working loose—you might as well try to pull the washer and nut through a beefed up section of solid steel!

Ballast is bonded permanently inside the keel.



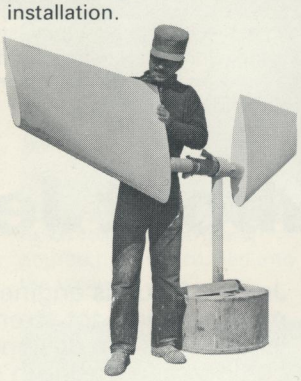
Starting with extrusions made with Jensen dies, all aluminum and stainless fabrication is done in the Spar Department.



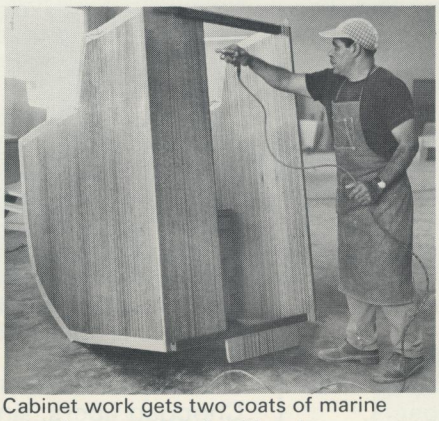


The reinforced topside layup is sanded smooth before painting.

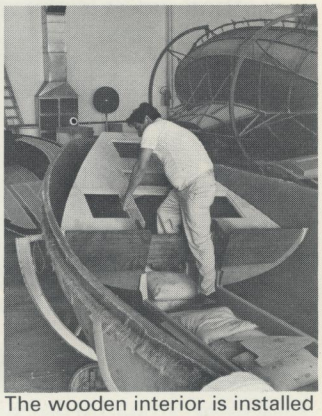
A pair of rudders get a fine sanding before installation.



Boat interiors start with precut parts in the Wood Department.



Cabinet work gets two coats of marine varnish, sprayed on for fill and smoothness.

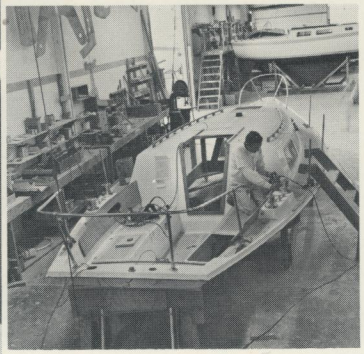


The wooden interior is installed while the layup is still in the mold, preventing any distortion of the hull contours.

Preassembling the interior permits finer, more efficient cabinet making.

Water under pressure is forced between the hull and mold, separating the two surfaces—then the entire hull is lifted free.

Where structural parts of the interior meet the hull, they are bonded full length on both sides with resin and fiberglass cloth.



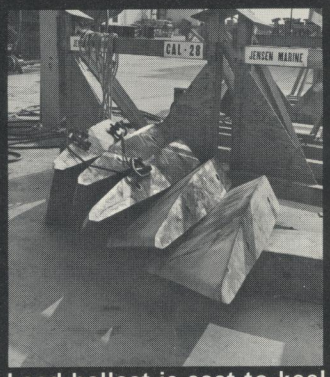
Exterior hardware and fittings are installed while both sides of the layup are completely accessible.

Now comes the moment we've been working toward, when we join the deck and hull. As the halves move toward each other, the reason for all the care in preserving the exact contours and dimensions of both in previous operations becomes dramatically apparent. Whether the boat is 20 feet or 50, the two halves will mate within a fraction of an inch all around. There is no need to "shoe horn" one to the other—never a gap which must be forcibly closed. Where the edges overlap they are bonded together to form a double-thick seam which acts as a strong structural member around the entire waist of the boat. Upon curing, the seam is concealed by a decorative rubber or teak rail on the outside, and rendered invisible on the inside by filling, taping, sanding, and painting.

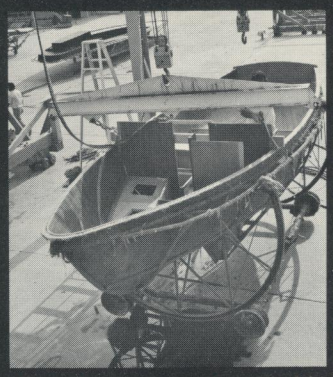
Finishing touches call for hookup of electrical wiring from the hull to cabin illumination and outside lights, paint and varnish detailing, buffing the entire boat, and an exhaustive final inspection. In the final inspection nothing is left to chance,—every conceivable detail of the boat is listed for inspection and checkoff. The inspection form becomes part of the boat's permanent record kept on file at Jensen Marine.

When pronounced ready for shipment, the boat is lifted to a trailer and tied down for an overland trip. Spars, stays, and shrouds, fabricated in the Jensen metal department, swaged and outfitted according to the boat design, are nestled on the trailer for simultaneous shipment.

The auxiliary engine is the final major installation before the hull and deck are joined.



Lead ballast is cast to keel contours to fit inside the molded fiberglass keel.



With the interior bonded in place, the hull is ready to be lifted from the mold.

Thorough detailing and touching up is the last production step.

Afternote:

Although the description and photos of Cal boat manufacturing were taken directly from the Jensen main plant in Costa Mesa, Calif., we might just as easily have used the Jensen plant in Morgan, N.J. For the boats they produce are identical—not even an expert eye can detect a difference. Both plants use identical molds, tooling, procedures, materials, and people who are equally trained and skilled. They should be, since the Morgan plant has literally been equipped and staffed from the Costa Mesa facility, another assurance that wherever you buy your Cal boat it is Jensen-built to Jensen standards.

An exhaustive final inspection certifies each boat before it can be shipped. The inspection document goes into the boat's permanent file at Jensen Marine.

On their way to eager skippers—new Cal boats to join the fastest family of ocean going sail boats in the world.

JENSEN MARINE 20 / 2-24 / 25 / 28 / 2-30 / 34 / 36 / 40 / 48 / 46

235 FISCHER STREET, COSTA MESA, CALIFORNIA 92627 (714) 540-3440

"BANGOR PUNTA'S WIDE WORLD OF BOATING" JENSEN/LUHRS/O'DAY/STARCRAFT/ULRICHSEN