

Aluminum Boats Prove Their Mettle

Reputation, Innovations Make Aluminum the Material of Choice of a Growing Number of Boat Builders

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Aluminum has been used in the marine industry for more than 100 years because of its light weight and ease of fabrication combined with good corrosion and fatigue resistance. However, for much of the past 30 years, fiberglass has been the material of choice of North American boatbuilders, particularly for higher-volume production lines. Competitively priced compared with boats made from most other materials, fiberglass boats can also be made from standardized molds that reduce their construction time and labor.

Additionally, the claim has been made that fiberglass boats are "maintenance-free." However, as more has come to be understood about delamination, blistering, leaks, and problems associated with structural fatigue, this claim has proved to be untrue.

Aluminum alloys, which are specified for marine use, suffer from none of these problems. Their high level of performance along with recent advances in aluminum cutting and welding is helping to reduce fiberglass' boats cost advantage, and the metal's utility for a wide range of boatbuilding applications is poised for reappraisal.



Changing Image of Aluminum Boats

"Aluminum boat technology is relatively new," says Steve Daigle, president of Daigle Welding & Marine Ltd., in Campbell River, British Columbia, noting that welded aluminum boats first came on the market en masse as recently as the late 1960s. Prior to that, riveting was the standard technique for joining aluminum sheets on boat hulls—a technique still used for many smaller boats that use thinner-gauge aluminum.

The image of a leaky, riveted runabout with ungainly lines persists for some people when picturing an aluminum boat. In fact, since the dawn of the welding age for aluminum boats, they have grown in stature to the point where they are the top choice in a number of categories of boats, including small recreational craft, small to medium-sized commercial fishing boats in the northwestern U.S., crew boats in the Gulf of Mexico, and fine yachts—both sail and motorized. Daigle himself notes that in just his 16 years in the boat business, the number of welded aluminum boat manufacturers in British Columbia has jumped from 6 to 24. But whether aluminum can make inroads into the large market for mid-sized recreational boats remains to be seen.

Corrosion-Resistant Alloys

Central to aluminum's suitability for use in boat construction is the high resistance to corrosion of its alloys for marine applications when used in the specified corrosion resistant tempers. The traditional marine alloys—5083, 5086, and 5456 as well as the more recently developed 5383 and 5059—resist corrosion in fresh water and saltwater. A new specification ASTM B 928 “High Magnesium Aluminum-Alloy Sheet and Plate for Marine Service” has been developed to help in the selection of the appropriate alloy-temper products.

Except for cosmetic reasons, 5xxx-series alloys don't even have to be painted above the waterline; the unpainted metal reacts with air (as would any other aluminum alloy) to form aluminum oxide—a hard, protective coating that protects the underlying aluminum. For most conditions the bottom of an aluminum hull needs only compatible antifouling paint to prevent the growth of performance-robbing barnacles and weeds and zinc anodes to prevent galvanic corrosion associated with non-aluminum metallic propulsion equipment and other attachments. Contrary to a common myth, with careful preparation and the application of proper primers and undercoats, aluminum holds paint very well.

Steel—aluminum's other principal competitor as boat material—by contrast, rusts quickly in saltwater and thus requires protection inside and out. The interior of a steel hull is typically painted with coal-tar epoxy, and the exterior epoxy-coated or flame-sprayed with zinc or aluminum. For both jobs, the steel must be sandblasted with sharp silica sand to provide a tooth for the flame spray or paint. This substantial, dirty, and expensive task can offset the higher material cost of the aluminum to a large degree.

Easily Welded

Aluminum alloys used for hull construction—commonly 5086 and 5083—are also easy to weld. Hull plating of 3/16 of an inch and above easily accommodates MIG (metal inert gas) welding for much of the basic construction, with TIG (tungsten inert gas) welding appropriate for the more detailed work, such as attachments. What's more, advancements in welding equipment have also made this less of a chore than it used to be by using less heat, thus distorting the metal less when it is being joined. This results in welds which can be made more easily and more precisely.



"We've replaced all our welding equipment and now use nothing but Pulse MIGs," says Jack Winninghoff, president and owner of Winninghoff Boats, Inc., in Rowley, Mass. Pulse MIGs, which use a computer to create a controllable square wave pulse, are capable of providing smoother welds with greater penetration into the metal for a more pleasing appearance. Winninghoff describes the Pulse

MIGs of the past four to five years as "a heckuva lot better—the welder has better control and can work faster," cutting an estimated 15 percent of the labor time.

Unlike fiberglass, which cannot be welded, aluminum is quick and relatively easy to weld under most conditions. Highly shapeable, the metal lends itself to sculptured detailing with soft shapes and edges—allowing for the more attractive lines of today's aluminum craft. More easily machined than steel, aluminum can even be cut with common carpentry tools—a router and saber, circular, and band saws—rather than a torch. In addition, hull fittings such as bait tank pumps and depth finders can be installed by simply drilling and tapping into the hull with a stainless steel fastener.

Here again, however, computers are starting to revolutionize this aspect of the aluminum boatbuilding business, with cost-saving results. Both custom and production boatbuilders can now create hull designs with three-dimensional CAD (computer-aided design) software that can be fed directly to a computer-controlled cutting table, making for uniform, more quickly cut, pieces. Ease of cutting and welding is a factor not only during the construction process, but also for repairs and remodeling. Since aluminum boats are not built from molds, changes in design, altering the location of bulkheads, resizing cabins, etc., are all accomplished more easily than on fiberglass boats. Equipment can also be relocated more easily on an aluminum boat—by cutting and welding or drilling and bolting—than on fiberglass.



More Durable Than Steel, Fiberglass

As for durability and reparability: aluminum comes out ahead of both steel and fiberglass. Compared with a steel hull, a "strength-equivalent" aluminum hull (i.e., built to the same stiffness) boasts about 29 percent greater dent resistance and 12.5 percent greater resistance to rupture, according to Michael Kasten, of Kasten Marine Design, Inc., of Port Townsend, Wash. (Such an aluminum hull would be approximately 50 percent thicker, but lighter, than its steel counterpart,

due to aluminum's lighter physical property.) Fiberglass, on the other hand, is extremely brittle and far more likely than either aluminum or steel to rupture upon impact.

Due to the metal's ductility, when an aluminum boat does sustain a dent, it can often be pounded out with a hammer or, if necessary, cut out with a saw and easily replaced. Tales abound of aluminum boats stranded on rocks for days, absorbing blow after blow against their hull, denting—but not rupturing—and being towed to a yard where their damaged sections are cut away and replaced, so the boat could be returned to service. In such instances, if a fiberglass boat did not sink on the spot, its damage would likely render it too costly to repair.

With regard to flammability, aluminum does not burn and requires a temperature of over 1000°F to melt. Further, aluminum boats can be easily fitted to provide "structural fire protection," i.e., containment of fire in a particular compartment by the craft's structure without help from firefighting systems. Fiberglass, on the other hand, frequently contains petroleum-based resins that can burn energetically once started. And, while watertight bulkheads can be built in such fiberglass boats, structural fire protection may not be achievable due to the material's flammability.

Lightness + Strength = Versatility

An aluminum boat of a strength equal to a comparably designed steel or fiberglass boat will weigh less by approximately 20 percent or more. In fact, weight savings of 35% to 45% in hulls, and 55% to 65% in superstructures, can be achieved with aluminum compared to steel. Put another way, pound for pound aluminum is stronger than either material.

Aluminum's weight advantage means that an aluminum craft of comparable design and equal strength will generally move more quickly if sail driven, use less fuel if motor-driven, be able to accommodate a heavier cargo, and be more easily trailerable than its steel and fiberglass counterparts. Higher vessel speeds and load capacities, enabled by use of aluminum, attract extra traffic volume and profit for the ferry operator. The use of aluminum can also improve seaworthiness, safety, and reliability, and lower maintenance costs.

So why isn't the aluminum boat king?



Consider a Boat's Lifetime Costs

Up-front costs for a fiberglass boat will almost always be cheaper than for comparable steel or aluminum craft (although plasma cutting machines, used by many aluminum boatbuilders, have started to eat into this margin). But when the costs of routine maintenance—corrosion control, painting, and repainting for steel boats—as well as major repairs—leaks, cracks, and problems stemming from structural fatigue in

fiberglass—are factored in, aluminum becomes more price-competitive with both materials. What's more, aluminum boats typically last longer than comparable steel or fiberglass boats and,

on average command a higher resale price—both highly relevant when considering a boat's "cost."

One final important difference distinguishing aluminum boats from fiberglass is the known consistent quality of the material. Aluminum manufacturing facilities' operations are certified to one or more ISO standards, notes Daigle, the Canadian builder. And the aluminum that they produce conforms to one or more ASTM and/or Aluminum Association standards.

"There's a huge quality-control process that goes through to the end manufacturer," Daigle comments. However, it is important that the aluminum alloys and other components are purchased to the appropriate material specification (such as the new ASTM B 928) and that proper design and fabrication methods are employed and the appropriate classification society guidelines are followed. Good communication between the naval architects, boat builders and material suppliers helps to ensure that the boat owner will be able to enjoy the full range of performance advantages over the life of his aluminum craft.

With fiberglass, any number of vastly-different-quality resins may be used whose performance and durability can vary widely. While aluminum welds can be x-rayed for verification of a boat hull's integrity, an entire section of fiberglass would have to be excised and essentially destroyed to subject it to analysis.

All told, aluminum boats offer significant advantages over the competition with regard to their weight, strength, durability, the maintenance they require, and their resale value. And, if your aluminum boat bucks the odds and winds up headed for the scrap heap, take heart; it's also highly recyclable.

For information on aluminum products for the marine market you can visit the web sites of the following aluminum producer companies:

Alcan Inc. -

<http://www.rolledproducts.alcan.com/index.html?menuID=2&segmentID=10&action=segment>

Alcoa Inc. - http://www.alcoa.com/global/en/about_alcoa/businesses/alcoa_mill_prod.asp

Corus Aluminium Rolled Products - <http://www.corusgroup-koblenz.com/english/products/shipbuilding/index.htm>

Kaiser Aluminum & Chemical Corp. - <http://www.kaiser.com/kaiser/kaisermain.nsf>

Pechiney Rolled Products - http://www.sheet-coil.pechiney.com/is-bin/INTERSHOP.enfinity/eTS/Store/-/-/-/Marine_Storefront-Start?Activite=Marine

Many aluminum products for marine applications are also available through the distribution network. The Metal Service Center Institute web site (<http://www.msci.org/sitemap.adp>) can help to direct you to a distributor in your area.