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# NOTES ON METAL BOATS

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I have been asked to provide some info on amateur metal boat building... I highly recommend perusing the various articles I have posted online on the subject of metal boats and their design and building at [www.kastenmarine.com/articles.htm](http://www.kastenmarine.com/articles.htm). But first, here are a few brief thoughts:



### Why Build A Metal Boat...?

- For things that go bump in the night.
- For ease of construction.
- For longevity.
- For the benefit of being able to create a custom design and build it economically, without the huge penalty of having to build a mold first, as with fiberglass.
- For freedom from the stench of fiberglass, and from the dreaded fiberglass boat pox.
- For easy repair-ability.
- For extraordinary strength.
- And most importantly, for the security of safe cruising.

It takes over 60,000 pounds per square inch (psi) to tear apart a chunk of mild steel, and 30,000 psi to permanently deform the same piece; i.e. to make it yield.

With aluminum, around 45,000 psi will tear it apart, and around 35,000 psi will deform it permanently.

Yes, you read that correctly: size for size, aluminum has a higher yield strength, but steel has a much higher ultimate breaking strength. In these facts lie the extreme benefits of metal for hull construction: The "plastic range" of either metal is quite high, so the material can take a terrific beating without failure.

Aluminum is light, strong, corrosion-resistant, non-sparking and weldable. Because aluminum is not abrasion-resistant, it can be cut with carbide tools. Aluminum is subject to electrolysis, pitting and crevice corrosion, but these liabilities can be managed as long as the installation of dissimilar metals and electrical items are correctly done. After that, it is a matter of attending to these matters during the life of the boat.

In terms of seakindliness, some boat shapes may be better if built in steel. Aluminum's extreme lightness can introduce a faster pitching and rolling motion in some hulls. For example, very beamy boats will exhibit a gentler roll if built in steel. Fairly narrow or light-displacement boats, which tend to have a narrower waterplane and less inherent form stability, will benefit most from aluminum construction.

These are of course generalizations. Given a blank sheet to begin a design, the roll behavior will be considered along with the choice of materials.



A design for construction in steel - the 32' tug-yacht *Terrier*

In terms of size, one can successfully build a steel boat for coastwise cruising and serious blue-water sailing down to around 30 feet LOD. Below that, the steel vessel will either have to be built with excessive displacement or with quite thin plate that will be more difficult to build due to distortion while welding.

An aluminum bare hull, built to the same **strength** standard, will weigh roughly 45% less than the same "bare hull" in steel. On the other hand, if high strength is of the highest priority, the

aluminum boat can be built to the same structural **weight** as the steel vessel, and then be considerably stronger.

One can therefore create good aluminum cruising boats down to, say, 22 feet. One could still build a safe aluminum boat in a size smaller than that, but who'd want to go to sea in it?

If designed with finesse in terms of aesthetics a steel or an aluminum vessel can be just as elegant and graceful as a vessel built of any other material, bar none.

We have observed that for most people "**Form Follows Budget**". Thus as a construction material, steel has a lot to offer.

In modern times (since the mid-fifties) proper surface preparation (sandblasting) and modern coating systems (epoxy paint) have been well developed, and have allowed small steel boats to last a very long time.

Due to weight considerations, it is not desirable to design small steel yachts with a corrosion allowance of any appreciable thickness. Therefore the original application of protective coatings by the builder is quite important.

In terms of maintenance, the proper care of any vessel usually involves keeping up the paint system. If the paint system has been **correctly** applied by the builder, one can expect approximately the same maintenance regime with a steel boat as with an aluminum boat.

Either metal will be more or less the same as maintaining a fiberglass boat, but without the prospect of developing "boat pox." The key to easy maintenance and long life is proper application of the paint system at the time of building.

In order to address this necessity when creating a new metal boat design, we add an eight page Paint Specification as a supplement to our usual Vessel Specification. In our Paint Specification the vessel's original coating application and subsequent maintenance are explicitly laid out for the benefit of owner and builder.

In choosing between steel and aluminum, the deciding points are mainly in the realms of:

1. **Budget:** Many builders can provide an alloy vessel for about the same cost as one in steel, if the alloy boat is not painted except on the bottom.
2. **Maintenance:** What is not painted will not need to be re-painted.
3. **Resale:** An aluminum boat will have a much higher resale value than a steel boat, allowing any minor difference in original cost to be more than recovered.

4. **Weight:** As we've seen, aluminum wins this one, and in a larger vessel, will permit lighter displacement, a smaller engine, and greater range.
5. **Carrying Capacity:** Less weight being given to structure will allow more to be put into fuel or cargo.
6. **Stability:** Aluminum wins again due to being lighter and therefore permitting weights to be lower down. With correct design, adjusting the vessel to suit the material, there is no reason to prefer one material or the other, unless steel will be top-heavy for a given vessel size restriction.
7. **Strength:** The overall point to be kept in mind is that an aluminum structure can be made with much larger scantlings, the same or greater strength, and still be much lighter than a similar structure in steel. In simple terms, aluminum is structurally more "efficient" than steel.

Does all of this make steel 'inferior' to aluminum?

Not at all..!

For example, steel is much more abrasion resistant than aluminum, and is more ductile in terms of fatigue resistance and in terms of having a broader 'plastic range.' Yes steel is heavier, however that translates into improved comfort.

Either metal can be easily fabricated by an amateur builder. In this regard, steel is probably the more likely choice, primarily due to being much less fussy to weld. That said, there is no reason whatever that an amateur builder should shy away from aluminum... it is just a matter of practice to get the welding right...!

I hope these preliminary notions will stir some good curiosity about metal boats.

I encourage you to read through the articles I mentioned above at [www.kastenmarine.com/articles.htm](http://www.kastenmarine.com/articles.htm) which will in all likelihood answer the vast majority of your questions.

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April 2006