Boat Dimensions

What the Specs Tell Us about a Boat

$D/L = \frac{D}{(0.01 \times LWL)^3}$ LWL SA/D LOA $\sqrt{LWL} \times 1.34 = speed$

By Mike Huston

The Seattle Boat Show starts in just a few days and if you are in the market for a boat (or just interested) you are likely to end up with a handful of spec sheets for different boats. These sheets usually contain gorgeous pictures of the boat and a list of numbers. These numbers are the subject of this month's article. It is my hope to explain what these numbers tell us about a boat.

Let's start by defining the basic set of numbers – the boat's dimensions. I have also listed the units that these numbers should be in (in the US) for use in calculated ratios that follow.

Base Dimensions:

- LOA – Length Overall (feet)
- LWL – Length at the waterline (feet)
- Beam – Width of boat at widest point (feet)
- Displacement – Weight of boat dry (lbs.)
- Ballast – Weight of keel (lbs.)
- Draft – Depth of deepest part of boat (feet)
- Sail Area – Total area of mainsail and forepeak (area between mast/forestay). Note: this does not take into account any overlap area of a genoa. (sq ft)
- Mast Height – Height of mast above the waterline (feet)
- Engine – usually the manufacture, fuel type and horsepower are listed
- Water – Capacity of fresh water tanks (gal.)
- Fuel – Capacity of fuel tankage (gal.)

Calculated Ratios:

- SA/D – Sail area to displacement ratio
- D/L – Displacement to Length ratio
- B/D – Ballast to displacement ratio
- L/B – Length to beam ratio

Okay, these are most of the commonly reported numbers, let's look at what they tell us. Some of these numbers, while informative, have little direct impact on performance while others have a major impact in predicting performance. I'd like to start by discussing the performance ones first, and the most important of these is length at the waterline (LWL). Most keelboats have displacement hulls, meaning they do not plane (i.e. lift up and slide over the water) instead, they push through the water. And the speed at which you can, with relative ease, push a displacement boat is directly related to its LWL. This speed is called the theoretical hull speed, which can be calculated with this formula:

$\sqrt{LWL} \times 1.34$ = speed in knots

For example a boat with a 36 ft. waterline will have a theoretical hull speed of 6x1.34 or 8.04 knots.

Be aware that the LWL changes when a boat heels over. How much it changes depends on the shape of the hull so this impact is hard to know without a sea trial. But this explains why some boats can sail faster than they will go under power. A boat sailing faster than it travels under power can also be caused by an undersized engine and/or propeller.

This leads nicely into engine horsepower. Having an engine whose size matches the boat is important. On most modern models this is not much of an issue as the manufacturers usually do a good job of this. But on older boats it can be a concern, especially if you plan to cruise our local waters where wind can be inconsistent. Other factors, such as the propeller, come into play but suffice it to say that having an engine capable of pushing the boat at hull speed is preferable. For more information on this subject see the Sailing Tips article in the September 2011 issue – it is available online at www.48north.com

Sail area is the next big performance factor. In heavy winds almost any sail plan will push a boat at hull speed but in light winds having more sail area can be a big advantage. But other factors, such as displacement, come into play. This is where the first of our ratios helps shed some light. The SA/D ratio is intended to give a relative number so that two similarly sized boats can be compared. The higher the value, the more power per unit of boat size. Boats with high numbers will accelerate faster and generally will sail faster in light air assuming other factors, like sail set, are similar. To give you a feel for this number here are some guide lines: heavy cruisers run from 10 to 15, cruiser/racers from 15 to 20 and numbers over 20 are usually found on boats designed for racing. If you are looking at a boat where this ratio is not provided it can be calculated with this formula:

$$SA/D = \frac{\text{Sail Area}}{(\text{Displacement} / 64)^{2/3}}$$

Displacement is the next number to look at – it tells you how much the boat weights. Alone this number is interesting but does not say much about performance. This is where the next two ratios come into play. The D/L ratio shows how much the boat weights per unit of length. In general terms it provides a relative number that can be compared between boats to give you a feel as to its 'heaviness'. Most heavy cruisers will have numbers between 350 and 250, racer/cruisers will run from 250 to 175 and racing boats will be below 175. The formula is:

$$D/L = \frac{\text{Displacement}}{(0.01\text{xLWL})^3}$$

The next formula is the B/D ratio – it tells what portion of the total displacement is used as ballast. Generally the higher the number the more sail the boat can carry, allowing it to be faster. The formula is simple in that it is just the ballast divided by displacement. Numbers below .35 are generally found on cruisers and numbers above .45 are racers, in between lie the racer/cruisers. Think of it this way, on cruisers a lot of weight is added in tankage, living quarters, auxiliary equipment, etc. which increases the boat's total displacement and lowers the percentage of the total represented by ballast.

The next number to look at is the beam. Again, this number alone will tell you something about how roomy the boat is below decks but not a lot about performance. The L/B ratio is a better indicator of the beam's impact on performance; the higher the number the better the performance. This one is pretty intuitive – it takes more work to push a wider boat thru the water than it does to push a narrower boat of similar size.

Draft falls into this same area; while it has an impact on performance most boats come with two options, deep and shoal. And the waters you plan on sailing will have more to say about which you choose than will performance. In addition, the shape and type of keel will have more impact than will the draft.

The rest of the numbers are useful to know but have little to do with performance. Fuel and water capacities are the best two examples. Depending on what you intend to do with the boat you may want more (i.e. for cruising) or less (i.e. for racing).

Mast height is another nice-to-know number, mostly for going under bridges. Admittedly it has indirect impact on performance but unless you are hard core racing it is not significant. The total sail area, while being affected by mast height, is much more impactful. Therefore it is possible to have a shorter mast and still perform well. For example, a ketch and sloop with the same total sail area on the same hull would have about the same performance, but the mast height of the ketch will be shorter.

Length overall (LOA) falls into this same category in that a longer boats will generally go faster, but it is the waterline length that directly impacts speed. Here is an example that explains this point: compare an older Islander 36 with a LWL of 28′ 3″ to a newer Beneteau 34 with a LWL of 30′ 8″. Here the shorter boat will be faster under power due to its longer waterline. This is one of the reason many of the modern boats have gone to the more plum bows; sweeping the bow back like the Islander's may have a 'Classic' look but the price is a slower boat. Under sail I am unsure which would be faster as the Islander's waterline will increase as it heels over. My guess is the waterlines might be pretty close so other factors like sail area and set will be the deciding factors.

Realistically, LOA is probably a better indicator of relative price of the boat and moorage cost than it is anything else.

You can find an online calculator for many of these ratios at US Sailing's http://www.sailingcourse.com/

I hope this review of boat specs has been helpful and add to your enjoyment the boat shows!

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