

Validation and the Use of PropExpert for Small High-speed Powerboats

A HydroComp Technical Report Report 116

HydroComp PropExpert is a program for the selection and analysis of propellers for motor yachts and workboats. While it was developed with the inboard propeller in mind, this report validates its use for small high-speed powerboats - both recreational and commercial - and provides guidance on some of the more common pitfalls and concerns.

PREDICTING VESSEL WEIGHT

Accurate operating vessel weight is important. Weight is used to make predictions on potential vessel speed and other vessel data. Unfortunately, all too often the true operational weight of the vessel is not known.

First, it is important to understand what is - and is not - meant by the vessel's operating weight. It is the total weight of the vessel underway, including hull, power plant, fuel and consumables, passengers and any cargo. The following are things that are **not weight**:

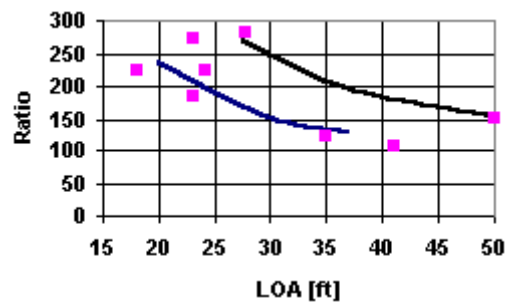
Hull weight or "light ship" weight - This is the weight of the hull alone. It is typically found by weighing the hull on a scale.

Gross or net tonnage - This is particularly confusing to those not working with merchant cargo vessels. This is actually a measurement of the volume of usable cargo space. (The name came from the British "tun", a barrel of 100 cubic feet.) Regulatory agencies typically use gross or net tonnage to determine taxes.

In PropExpert, we have provided a non-dimensional relationship of weight and length - the *Ratio* field. To the right is a plot of some sample values from real vessels taken from the table below. The lower curve is from recreational powerboat data from a publication by Mercury Marine. The upper curve is

typical of commercial working vessels. You can use these curves to find realistic figures for your vessels.

Vessel	Length OA	Weight [lbs]	Ratio	Speed [mph]	BHP
Mariah 180	18'-0"	2125	223	53	180
Carver 23	23'	5400	272	35	185
Regal 23	23'-1"	3700	184	55	330
Fibreform Continental	24'-2"	5175	224	29	---
Blackfin 27	27'-9"	9850	282	46	500
Deep-V patrol boat	35'	8500	121	38	---
Sport fisherman	41'	12000	107	46	---
West Coast Aquabus	50'-6"	32000	152	27.5	540



VESSEL DETAILS

For sterndrives, we recommend the following values:

Wake fraction	0.03
Thrust deduction	0.00
Relative-rotative efficiency	1.00
Shaft efficiency	0.97

EVALUATING TOP SPEED

Evaluating speed is always best using *Prior trial* data. To determine if the trial data makes sense, you can use the following two relationships. The first is a prediction of expected power based on weight and speed. The second is a "best vessel" minimum power curve. It is unlikely that a vessel would do much better than this best vessel curve.

BHP = Total installed engine power (hp)
 W = Total operating vessel weight (pounds)
 V = speed (mph)

Average vessel

$$BHP = (W * V / 4900) + (W^{0.833} * V^2 / 11100)$$

Best vessel

$$BHP = W * (0.026 + 0.004*V)^2$$

The following table shows predicted average and best horsepower versus the actual installed power.

Vessel	Weight [lbs]	Speed [mph]	Actual BHP	Avg	Best
Mariah 180	2125	53	180	173	120
Carver 23	5400	35	185	175	144
Regal 23	3700	55	330	298	224
Blackfin 27	9850	46	500	496	434
West Coast Aquabus	32000	27.5	540	566	592

PROPELLER PARAMETERS

Analysis of small sterndrive-style propellers suggest the use of the following definitions:

Flat-faced (stock) propellers

GawnAEW, No cup, T factor = 0.99, P factor = 1.02

Progressive pitch (high-performance) propellers

GawnAEW, Very light cup, T factor = 0.93, P factor = 0.95

For additional cupping, raise the amount of cup two or three levels (e.g., from Very light to Light medium).

HydroComp, Inc.
 13 Jenkins Court, Suite 200
 Durham, NH 03824 USA
 Tel (603)868-3344
 Fax (603)868-3366
 info@hydrocompinc.com
 www.hydrocompinc.com