AeroMarine Research
VBDP Performance Boat Report

Charger 16DL – Vee-Pad w/150hp Outboard
Performance Analysis

The Charger 16DL is a 16ft vee-pad design hull, originally designed by George Linder with the 18DL, both based on his well-known Challenger 21 hull. Our test hull is a somewhat light weight, 18deg (medium deep vee) hull design with a flat center pad, and specified with 150hp power and 6" setback jack plate. This is a well balanced setup to achieve maximum performance from this hull.

We have done a short analysis of top speed, dynamic stability and porpoising sensitivity through the full expected velocity range. We also completed a weight/performance sensitivity analysis. We used assumed setup details available from an on-water boat test. The performance results are very representative of the hull's capabilities. We used the new AeroMarine Research "Vee Boat Design Program", Version 7.15 to do the analysis, since it has many new features that make "fine tuning" the analysis quite easy for top speed, porpoising and stability simulation. Here are the results and a few of my conclusions from the analysis done. You'll see that the VBDP© results are very similar to those that the boat test runs recorded. You'll also see that the 150hp Charger 16DL is one great performing boat!

Dimensions supplied:
Hull weight (hull and deck, rubrail and steering rigging) = 800 lbs
Fuel weight (12 gallons) = 77 lbs
Misc. weight (battery, oil, bilge, etc) = 150 lbs
Engine weight = 409lbs
Driver weight = 200 lbs
TOTAL WEIGHT tested = 1636 lbs

Hull length = 16.1 ft
½ Vee width (planing vee) = 40 inches
Width between outer strakes = 64 inches
Center Pad Length = 12 ft
Center Pad Deadrise = 0.1 deg (flat)
Outboard engine = 150hp Evinrude XP
Gear Ratio = 1.86:1

Hull width (widest) = 100 inches
Hull deadrise at transom = 18 degrees
Width between inner strakes = 31 inches
Center Pad Width = 10 inches
Center Pad AngleInc = 0.4 deg
Lower Unit Height = -1 inch (below pad)
Propeller rigged = 26P SS Raker

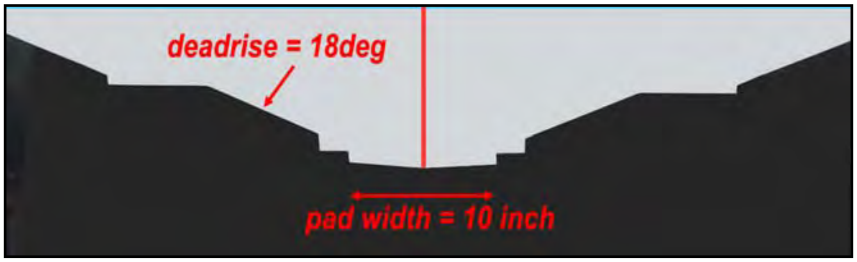
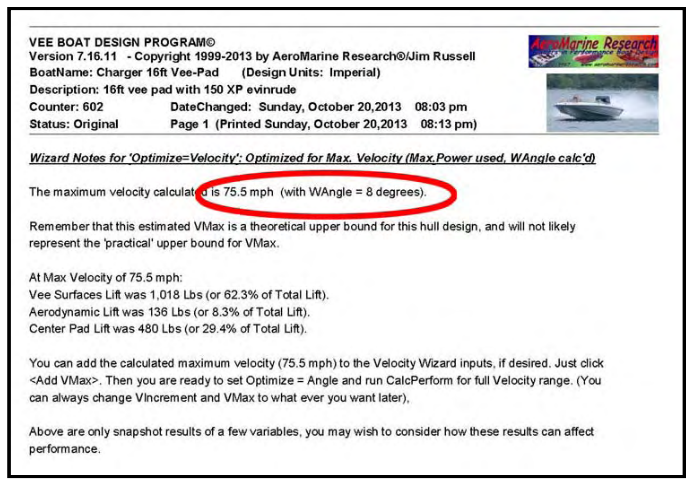


Figure 1 - General Dimensions

Here are the results from the performance analysis and a few of our conclusions.

1. **<u>Top Speed estimate</u>** – top speed is usually indicated by one or many of several performance parameters. I used the VBDP©'s new 1-2-3 automatic Analysis Wizard to quickly get us to a realistic prediction of maximum velocity. Using the VBDP©'s "Velocity Optimizer" feature, the 1st analysis step is to test at a "very high" angle of attack (WAngle) to quickly approximate the bounding maximum speed. For the 150hp Charger 16DL, this comes out as 75 mph. *[NOTE: this is not necessarily the capable speed of the hull/setup, but rather the 'bounding limit', to guide further analysis.]*



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BoatName: Charger 16ft Vee-Pad (Design Units: Imperial)
Description: 16ft vee pad with 150 XP evinrude
Counter: 602 DateChanged: Sunday, October 20,2013 08:03 pm
Status: Original Page 1 (Printed Sunday, October 20,2013 08:13 pm)

<u>Wizard Notes for 'Optimize=Velocity': Optimized for Max. Velocity (Max.Power used, WAngle calc'd)</u>

The maximum velocity calculated is 75.5 mph (with WAngle = 8 degrees).

Remember that this estimated VMax is a theoretical upper bound for this hull design, and will not likely represent the 'practical' upper bound for VMax.

At Max Velocity of 75.5 mph:
Vee Surfaces Lift was 1,018 Lbs (or 62.3% of Total Lift).
Aerodynamic Lift was 136 Lbs (or 8.3% of Total Lift).
Center Pad Lift was 480 Lbs (or 29.4% of Total Lift).

You can add the calculated maximum velocity (75.5 mph) to the Velocity Wizard inputs, if desired. Just click <Add VMax>. Then you are ready to set Optimize = Angle and run CalcPerform for full Velocity range. (You can always change VIncrement and VMax to what ever you want later),

Above are only snapshot results of a few variables, you may wish to consider how these results can affect performance.

Figure 2 – The 1st step - "Bounding Maximum Velocity" (Summary Report Wizard – Velocity)

2. **<u>Trim Angle (WAngle)</u>** - In the 2nd analysis step, a detailed analysis of the trim angle (WAngle) to achieve velocity by the design provides more evaluation of hull performance at highest speeds. This step of performance analysis is the powerful of VBDP© and provides a huge amount of performance information – including a unique Summary Report Wizard that outlines in narrative format some of the key performance results and even recommendations. (*See the complete Summary Report Wizard – Angle on page 9, below*).

One of the amazing features of the VBDP© Summary Report Wizard (see *page 9, below)* is the Wizard's ability to sort through all the detailed performance data and interpret important conclusions. For example, a part of our 150hp Charger 16DL Report concludes, from analysis of WAngle trending…*"There is a notable increase in WAngle, between 70.4 mph and 75.5 mph. The incremental increase was +217% more than the previous incremental increase in WAngle...*<u>*Velocities greater than 70.4 mph may be approaching a region of unsafe or unstable operation for this hull/setup*</u>*".*

The detailed performance results show over 35 performance factors trended throughout the operating velocity range. *(See the complete Performance Output Details – Performance Results on page 8, below)* As for determining maximum Velocity, we can see this by examining a couple of theses factors.

Reviewing required trim angle (Wangle) throughout the velocity range is often the best indicator of the onset of instability. At velocities higher than 70 mph, the 150hp Charger 16DL design requires increasingly high trim angles (greater than 4 degrees) representing increasing instability (*see Figure 3 – Trim Angle (WAngle) vs. Velocity on page 3, below*).

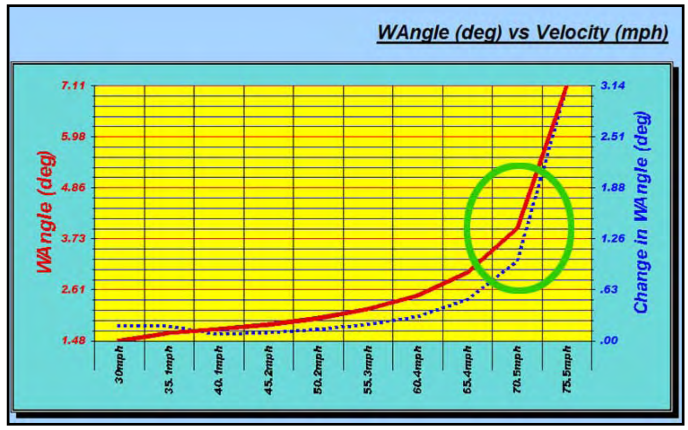

Figure 3 – Trim Angle (WAngle) vs. Velocity

Further, the rate-of-change of the trim angle is also increasing. In fact, at 75 mph the trim angle would be 80% more than it was at 70 mph and would be increasing at a rate 3X the rate at 70 mph! This would likely cause the hull to be progressively more difficult to drive and possibly unpredictable handling. In all designs/setups there is a velocity beyond which the ability for driver to adequately input and adjust for the required changes in balance is not realistic (safe).

Thus, 70 mph can be considered the maximum upper limit of velocity for this setup.

3. <u>Dynamic Stability</u> – Often one of the determining factors for limiting velocity of performance is stability. Since no performance hull can be inherently stable (due to forces acting 'out-of-balance' with static CG location), I use a measure of stability that references the dynamic CG of the hull. This is the centre of balanced moments of all aerodynamic and hydrodynamic forces while the hull is under the specified running conditions, referenced fore (+) of the transom. The dynamic CG will change throughout the range of operating velocities. (To maximize stability at operating velocity, the location of the "dynamic center of gravity" (XCGDynamic) should be as close to the Static CG (deadweight balance).

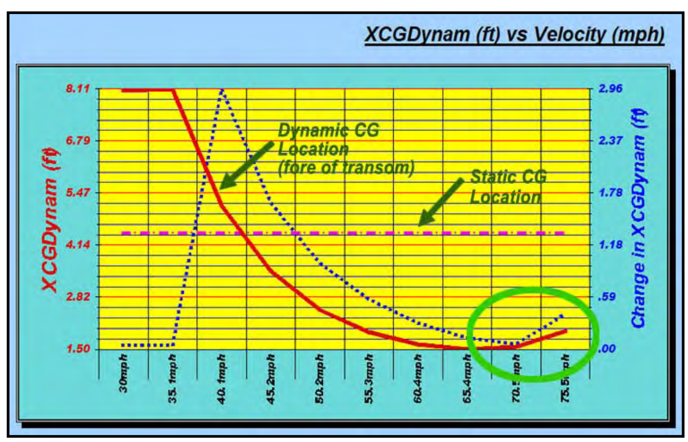

Figure 4 – Dynamic Stability vs. Velocity

This ideal situation is pretty well impossible for any performance boat, and so the *rate of change* of the XCGDynamic is also a good measure of how challenging the hull will be to maintain stability. It is important to review this performance characteristic throughout the full operating velocity range of the hull.

The observation for the 150hp Charger 16DL (*see Figure 4 on page 3, above*), is that the location of XCGDynamic changes from 8.1 ft fore of transom at 35 mph to 1.5 ft fore of transom at 70 mph. After the “hump” transition (at approximately 35 mph), the 150hp Charger 16DL exhibits no dramatic changes in XCGDynamic through the higher speed operating range. This generally smooth transition and absence of any “sudden” changes in XCGDynamic makes the “feel” of this hull one of general stability, and contributes to a more confident ride, with accessible control by the driver. So, the limiting (max) velocity can be estimated at 70 mph.

4. Porpoising Analysis - The VBDP© XPorpoise analysis is an engineering tool developed by AR® that helps predict your hull's inherent instabilities leading to porpoising. The technique is based on a unique Savitsky method of hydrodynamic prediction of the critical porpoise trim angle (CPA) for various hull/setup configurations, velocities and Lift characteristics.

Porpoising onset occurs when the lift is generated at a sufficiently high trim angle or sufficiently low deadrise hull so as to cause a dynamically unstable loading on the lifting surfaces. By analysis of a hull's design and performance characteristics and comparison to the CPA for each velocity in performance range, VBDP© can predict when the hull is susceptible to porpoising and when it is performing in a stable regime.

VBDP© analyzes the porpoising stability of the 150hp Charger 16DL hull design/setup throughout the entire operating velocity range and illustrates operation in "*stable planing regime*" or "*Porpoise instability regime*". When your hull is in the "stable planing range", the hull is less likely to experience porpoising. When your hull is in the "Porpoise instability regime", it is susceptible to porpoising.

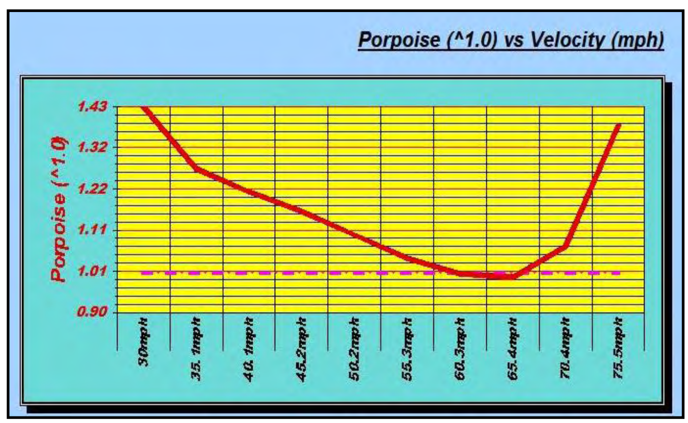

Figure 5 - Porpoise Analysis

It can be seen (*see Figure 5 on page 4, above*) that the “150hp Charger 16DL” is generally not susceptible to porpoising, since the hull design is operating in the "Stable Planing Regime" through the full velocity range tested. While the hull gets close to the “Porpoise instability Regime” at about 65 mph, it appears marginal and is unlikely to cause a problem. Porpoising, when presented, can be reduced by causing the hull to operate at lower trim angles.

5. Lift/Drag Distribution - VBDP© has a unique feature that shows the distribution of lift forces and drag forces by the key contributors of each design feature. For example, it can be seen (Figure 6 on page 5, below) that at 70 mph, the 150hp Charger 16DL hull gets 1170lbs (71%) of it’s lift from vee planing surface; 411lbs (25%) lift from the vee-pad surface and 59lbs (4%) of it’s support from aerodynamic surfaces. A similar presentation of drag forces at 70 mph shows the distribution of drag from vee surfaces, vee-pad surface, motor/lower unit drag, cockpit drag and associated aerodynamic drag.

All of the details of these lift/drag forces (as they change through the entire velocity range) are shown on the Performance Results detailed analysis, and the relationship is very helpful when assessing the desired performance of each of the design features of the hull.

For example, our 150hp Charger 16DL hull gets the advantage of some aerodynamic lift even at 70 mph. Further the remaining support is well distributed between the vee surfaces and the center-pad surfaces (71%/25%) providing effective lift benefit from the zero-deadrise pad surface while maintaining excellent balance and control from the vee section lift forces. This is a good balance of vee/pad support lift. While there is no "rule of thumb" for what is the "right answer", more pad lift can improve performance due to the very efficient lift/drag of the flat (zero deadrise) pad design; while too much pad lift can cause some lateral instability.

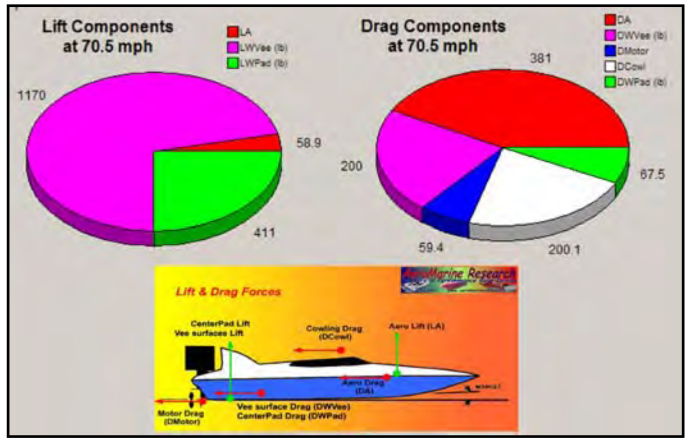

Figure 6 – Lift & Drag distribution of forces

6. <u>Propeller Sizing</u> - Approximate propeller sizing can be estimated by hydraulic calculation. The VBDP© software also does this for us after the Performance Analysis is completed. Based on the test setup motor specifications predicted propeller pitch is presented. It may only be an approximated sizing, based on some assumptions (like max RPM occurs at max HP), but it can help for initial setups. The estimated propeller size for the specified setup is 26 to 27inch pitch. This compares well to the 26P prop that was specified in the test setup for our 150hp Charger 16DL hull.

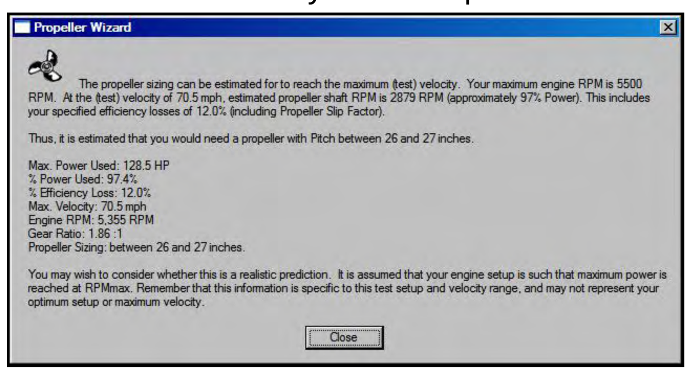

Figure 7 – Propeller Sizing

7. <u>Boat Weight vs. Performance</u> – A common question asked as we complete a typical performance analysis for a hull design or setup is – *"What can I do to go a little faster?"* There are many factors that contribute to the overall performance and to the top speed of a hull design/setup – and every boat is different. One of the constants in high performance hull designs is, however, that performance hulls are very sensitive to weight and power.

So, less weight can make a significant difference to the performance of a hull, without making any other big changes to design, engine or setup.

If we were to reduce the total weight (currently 1636lbs) of our 150hp Charger 16DL hull by only 150lbs, the boat would require less total lift, thus generating less drag too. This allows the hull/setup to achieve the same velocities with less power expended – OR – it allows the hull to utilize its full power to achieve a higher top speed. In this case, we can see that the 150hp Charger 16DL hull would be capable of +2 to +3 mph faster with this reduction in weight.

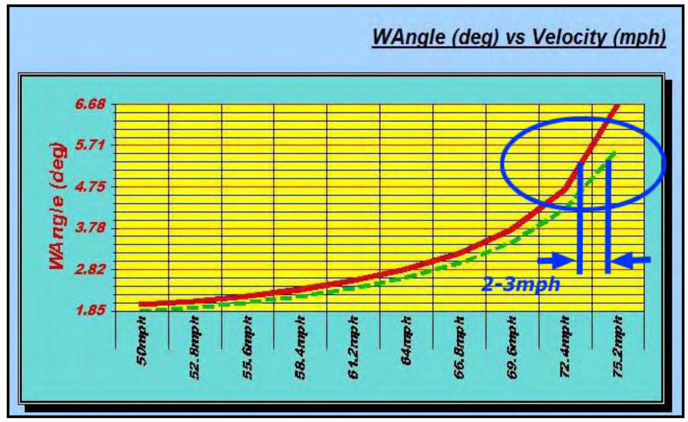

Figure 8 – Weight vs. Maximum Velocity

8. <u>Performance Analysis Reports</u> - Here's the design input and performance output that I got in my review of the 150hp Charger 16DL ☞

Figure 9 – Performance Output Details - Specification

VEE BOAT DESIGN PROGRAM©
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BoatName: Charger 16ft Vee-Pad (Design Units: Imperial)
Description: 16ft vee pad with 150 XP evinrude
Counter: 602 DateChanged: Sunday, October 20,2013 07:01 pm
Status: Original Page 1 (Printed Monday, October 21,2013 12:04 pm)

<u>Hull Design</u>					
1 Vee Deck Ht	34.56	inches	2 (Non-VeeWdth N/A)	11	inches
3 (VeeAeroChrd N/A)	16	feet	4 (VeeAeroThk N/A)	6	inches
5 Vee 1/2 Width	40	inches	6 Vee Deadrise	18	degrees
7 Deck Width	100	inches	8 Lwr Unit Height	-1	inches
9 Vee Type (N/A)	Asymmetrical	Selection	10 Hull Wet Length	13	feet
<u>Steps</u>					
11 Step Select	No Steps	Selection	12 Length Step1	n/a	feet
13 Length Step2	n/a	feet	14 Step Height	n/a	inches
<u>CentrePod</u>					
15 VeePad Select	Yes	Option	16 Pad Length	12	feet
17 Pad Width	10	inches	18 Pad Deadrise	0.11	degrees
19 Pad Height	-1	inches	20 Pad AngleInc	0.4	degrees
<u>Spray Rails</u>					
21 Spray Height	4	inches	22 Spray Width	2	inches
23 Spray Factor	0.5	factor			
<u>AeroFoil</u>					
24 Vee AngleInc (N/A)	0	degrees	25 Vee AeroType (N/A)	Zero Camber	Selection
<u>Lengths</u>					
26 Boat Length	16	feet	27 Driver Length	8	feet
28 Motor Length	-1.3	feet	29 Fuel Length	2	feet
30 Misc Length	2	feet	31 Motor Height	22	inches
<u>Weights</u>					
32 Boat Weight	800	Lbs	33 Driver Weight	200	Lbs
34 Fuel Weight	77	Lbs	35 Misc Weight	150	Lbs
36 Motor Weight	409	Lbs	37 Boat CG	0.45	(.05 to 1.0)
<u>Cowlings/Cockpit</u>					
38 Cowl/Cockpit Type	None	Select	39 Rear Cowling Height	6	inches
40 FrontCowl Height	9	inches	41 Rear Cowling Width	60	inches
42 Open Deck	6	feet			
<u>Design Analysis</u>					
43 Optimize	Angle	Selection	44 Accuracy	1	(.05%-10%)
45 Starting Velocity	15	mph	46 Velocity Increment	6.72	mph
47 Start Angle	2	degrees	48 Accel'n Model	Constant	Select
<u>Conditions</u>					
49 Max Power	150	HP	50 Power Effy Factor	0.88	factor
51 Altitude	328.1	feet	52 Water Type	Fresh	Selection
53 RPM Max	5500	RPM			
<u>Drive Unit(s)</u>					
54 Number of Drive	One Drive	Selection	55 Skeg Width	9	inches
56 Skeg Length	10	inches	57 Skeg Thickness	0.2	inches
58 Torpedo Diameter	4.75	inches	59 Torpedo Length	12	inches
60 Drive Type	OMC V6	Selection	61 Gear Ratio	1.86	Ratio:1

Figure 10 - Performance Output Details – Performance Results

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BoatName: Charger 16ft Vee-Pad (Design Units: Imperial)
Description: 16ft vee pad with 150 XP evinrude
Counter: 602 DateChanged: Sunday, October 20,2013 07:01 pm
Status: Original Page 2 (Printed Monday, October 21,2013 12:04 pm)

Analysis set: 'Optimize=Angle': Optimized for Max. Power Use (Req'd WAngle is calc'd)

Velocity (mph)	15.	21.7	28.4	35.2	41.9	48.6	55.3	62.	68.8	75.5
LWetVee (ft)	13.00	13.00	13.00	12.93	6.72	3.64	1.97	0.99	0.42	0.09
SWet (sf)	1,277.7	438.0	193.8	99.6	51.8	28.1	15.2	7.6	3.2	0.7
LA (lb)	0.6	1.6	3.4	6.1	9.2	13.5	19.8	29.9	49.8	118.7
DA (lb)	18.1	37.4	63.0	94.6	146.5	203.9	265.1	326.4	374.9	347.8
DMotor (lb)	3.0	6.1	10.2	15.4	21.6	28.9	37.1	46.3	56.6	69.9
DCowl (lb)	9.1	19.0	32.6	49.8	70.6	95.1	123.2	155.0	190.4	229.4
LW (Total) (lb)	1,635	1,634	1,633	1,633	1,636	1,636	1,631	1,618	1,591	1,520
DW(Total) (lb)	3,247	2,257	1,681	1,310	1,021	793	601	432	294	245
DTotal (lb)	3,268	2,300	1,754	1,420	1,189	1,026	903	804	726	662
WtTotal (lb)	1,636	1,636	1,636	1,636	1,636	1,636	1,636	1,636	1,636	1,636
XCGStat (ft)	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45
XCGDynam (ft)	8.05	8.03	8.06	8.07	4.47	2.77	1.94	1.57	1.52	1.95
XPress (ft)	10.12	10.22	10.32	10.43	10.47	10.52	10.61	10.77	11.04	11.60
WAngle (deg)	0.92	1.15	1.40	1.67	1.77	1.92	2.17	2.62	3.55	7.01
Porpoise (^1.0)	2.35	1.85	1.51	1.27	1.19	1.12	1.04	0.99	1.03	1.39
PReqd (hp)	130.7	133.2	133.1	133.1	132.8	132.9	133.2	133.1	133.1	133.3
Time (sec)										
Accelln (fps/s)										
CLA	0.0130	0.0162	0.0197	0.0235	0.0249	0.0271	0.0306	0.0369	0.0500	0.0988
CDA	0.1499	0.1452	0.1403	0.1350	0.1331	0.1301	0.1254	0.1173	0.1013	0.0534
CLW	0.0027	0.0038	0.0050	0.0064	0.0086	0.0118	0.0169	0.0264	0.0504	0.1835
CDW	0.0054	0.0052	0.0051	0.0051	0.0054	0.0057	0.0062	0.0070	0.0093	0.0295
CDCowl	0.2581	0.2581	0.2581	0.2581	0.2581	0.2581	0.2581	0.2581	0.2581	0.2581
CDMotor	0.0089	0.0087	0.0085	0.0084	0.0083	0.0082	0.0082	0.0081	0.0080	0.0075
CLWVee	0.0026	0.0036	0.0049	0.0063	0.0085	0.0118	0.0169	0.0273	0.0556	0.2501
LWVee (lb)	1,377	1,412	1,434	1,451	1,423	1,391	1,346	1,285	1,199	1,045
ARVee	0.26	0.26	0.26	0.27	0.51	0.94	1.75	3.47	8.28	37.99
DWVee (lb)	3,006	2,089	1,555	1,210	929	708	521	358	226	165
DelStab (ft)	-2.1	-2.2	-2.3	-2.4	-6.0	-7.8	-8.7	-9.2	-9.5	-9.7
CLWPad	0.0043	0.0051	0.0060	0.0070	0.0092	0.0123	0.0165	0.0236	0.0393	0.1157
LWPad (lb)	258	222	198	182	213	245	284	332	393	475
ARPad	0.07	0.07	0.07	0.07	0.11	0.16	0.24	0.34	0.53	1.14
LWetPad (ft)	12.000	12.000	12.000	12.000	7.686	5.070	3.517	2.443	1.584	0.732
DWPad (lb)	241	168	126	99.3	92.6	85.1	79.3	73.4	68.1	79.7
YCG (ft)	2.89	2.91	2.93	2.95	2.96	2.97	3.00	3.03	3.11	3.40

Figure 11 **- Summary Performance Report Wizard – Angle Optimized (for Max Power)**

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Status: Original Page 1 (Printed Monday, October 21,2013 11:53 am)

Wizard Notes for 'Optimize=Angle': Optimized for Max. Power Use (Req'd WAngle is calc'd)

WAngle started at 0.92 degrees (at 15.0 mph) and finished at 7.01 degrees (at 75.5 mph)

The biggest change in WAngle was +3.5 deg or 97%, between 68.8 mph and 75.5 mph.
The biggest change in XCGDynam was -3.6 ft or -45%, between 35.2 mph and 41.9 mph.
The biggest change in XPress was +0.6 ft or 5%, between 68.8 mph and 75.5 mph.
The biggest change in DelStab was -3.6 ft or 150%, between 35.2 mph and 41.9 mph.

There is a notable increase (+3.46 deg) in WAngle, between 68.8 mph and 75.5 mph. The incremental increase was +272% more than the previous incremental increase in WAngle, between 62.0 mph and 68.8 mph. It may be prudent to consider if operating velocities greater than 68.8 mph may be approaching a region of unsafe or unstable operation for this hull/setup.

The biggest change in LWetVee was -6.2 ft or -48%, between 35.2 mph and 41.9 mph. Your planing vee surface design has No Steps. If you prefer steps in your design, consider a step located approximately between 12.9 feet and close to 6.7 feet.

The biggest change in LWetPad was -4.3 ft or -36%, between 35.2 mph and 41.9 mph. Normally, this value is probably the velocity at which the Vee-Pad starts generating more significant Lift, and when driving the boat you could experience this change in Lift as the Pad becomes useful. The wetted length of the Vee-Pad at this transition is = 12.0 ft.

The design values for WAngle (7.0 degrees) and AngleInc (0.0 degrees) will create a maximum aerodynamic angle of incidence of 7. degrees at 75.5 mph, which is greater than normally expected, and may cause unexpected airflow separation and dynamic instability. Consider reducing either WAngle or AngleInc or both.

The biggest change in LWetPad was -4.3 ft or -36%, between 35.2 mph and 41.9 mph. Normally, this value is probably the velocity at which the Vee-Pad starts generating more significant Lift, and when driving the boat you could experience this change in Lift as the Pad becomes useful. The wetted length of the Vee-Pad at this transition is = 12.0 ft.

At Max Velocity of 75.5 mph:
Vee Surfaces Lift was 1,045 Lbs (or 63.8% of Total Lift).
Aerodynamic Lift was 119 Lbs (or 7.2% of Total Lift).
Center Pad Lift was 475 Lbs (or 29.% of Total Lift).

The Dynamic CofG (XCGDYNAM) is the location of the balanced moment of all forces while the hull is under specified running conditions. XCGDYNAM changes throughout the operating velocity range. To maximize your hull stability, XCGDYNAM should be as close to XCGSTAT as possible. With your hull design/setup, analysis shows that XCGDynamic is located at the XCGStatic (4.45 feet fore of the transom) location at approximately 42.0 mph. You should examine your detailed Performance Results to determine the level of hull stability throughout the critical velocity range. As the locations of XCDDynamic and XCGStatic get increasingly apart, hull instability increases.

Design is performing in Porpoise Regime (xPorpoise = 0.99) at 62.0 mph, which may be undesirable. You may consider changing design features so that operating trim angle (WAngle) is reduced.

You can add the calculated WAngle values at each velocity (starting at .9 degrees at 15.0 mph up to 7.0 degrees at 75.5 mph) to the Acceleration Wizard inputs, if desired. Just click <Add to Accel>. Then you are ready to set Optimize = Power and run CalcPerform for Power, Acceleration and Elapsed Time predictions. (You can always change any of the AccelWiz inputs to what ever you want later).

Above are only snapshot results of a few variables, you may wish to consider how these results can affect performance.

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"Tunnel Boat Design Program© ", V7 software - http://www.aeromarineresearch.com/tbdp6.html

"Vee Boat Design Program© " software - http://www.aeromarineresearch.com/vbdp.html

"PropWorks2©" software for propeller selection and powerboat speed prediction - http://www.aeromarineresearch.com/prop2.html

About AeroMarine Research:

Jim Russell is a professional engineer with a mechanical and aeronautics background. Currently living in Canada, he has done extensive aerodynamic research at University of Michigan, OH and University of Toronto, Canada and marine research at the NRC water channel laboratory in Ottawa, Canada. His published works and papers are highly acclaimed, and are specifically related to the aerodynamics and hydrodynamics of high performance catamarans and tunnel boats, vee and vee-pad hulls. Russell has designed and built many tunnel and performance boats. As a professional race driver, he piloted tunnel boats to Canadian and North American championships. He has written power boating articles for many worldwide performance magazines and has covered UIM and APBA powerboat races. He has appeared on SpeedVision's '*Powerboat Television'* as a guest expert on 'Tunnel Hulls', was performance/design technical consultant on National Geographic's '*Thrill Zone*' TV show, and editorial consultant on Discovery Channel's '*What Happened Next*' TV show. Russell is the author of the "Secrets of Tunnel Boat Design©" book, "The Wing in Ground Effect - Their relation to Powerboats©", book, and the "Secrets of Propeller Design©" book. His company has designed and published the well-known powerboat design software, "Tunnel Boat Design Program©" and "Vee Boat Design Program©" specifically for the design and performance analysis of tunnel boats, powered catamarans, performance Vee and Vee-Pad hulls.

Notes about this Report: The considerations addressed in this report are for a high performance powerboat design and application and thus results are highly dependent on detailed specifics of the hull design, modifications, construction, hull setup and operation, and other factors that are not within the scope of this report. The TBDP©/VBDP© software uses proven engineering algorithms to predict performance of planing hull designs of different configurations and lends itself well to comparative performance analysis. The software provides typical predictive performance data to aid in making design comparisons which may be helpful toward making design decisions.

Since the existing design of the hull, any subsequent modifications, and ultimate performance is complex, this performance review, this report and included recommendations are for your information only and cannot guarantee the results.

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