

AeroMarine Research TBDP Performance Boat Report

Renaissance 'Prowler' 246 Performance Analysis

There are many tunnel boat designs that are intended to reach high performance crowds. There are also several power-catamaran hulls that are not built specifically for high-speed, but nevertheless, perform to very high standards. The AeroMarine Research "Tunnel Boat Design Program", is just as proficient at prediction of performance characteristics at 50mph for a power-cat fishing outboard as it is accurate for top racing tunnels.



We did a "quick" analysis of the 24-ft 6-in Renaissance power-cat, looking at top speed, cruising performance and acceleration simulation.

I used a (few) setup details from the boat test in *Boating Magazine's* January 2001 issue. I admittedly, had to make some assumptions for many of the design and setup details that I was not aware of. The results should be, nevertheless, representative of the hull's capabilities. I used the new AeroMarine Research "Tunnel Boat Design Program", Version 7.8 to do the analysis, since it has many new features that make "tuning" the analysis easy for top speed, cruising characteristics, acceleration and stability simulation.

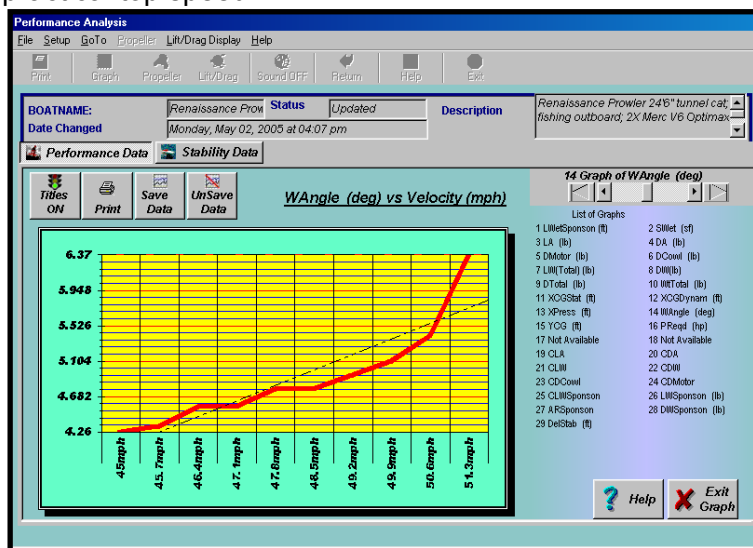
Here are the results and a few of my conclusions from the analysis done. You'll note that the TBDP© results are very similar to those that the *BoatingMag* boat test recorded.

Performance Analysis		
File Setup GoTo Propeller Lift/Drag Display Help		
Print Graph Propeller Lift/Drag Sound OFF Return Help Exit		
BOATNAME: Renaissance Prowl		Status: Updated
Date Changed: Monday, May 02, 2005 at 04:07 pm		Description: Renaissance Prowler 24'6" tunnel cat, fishing outboard; 2X Merc V6 Optimax
Performance Data Stability Data		
Optimized for Maximum Velocity Page 1		
Velocity (mph)	0.	
LWetSponson (ft)	4.57	
SWet (sf)	21.5	
LA (lb)	107.9	
DA (lb)	688.8	
DMotor (lb)	85.0	
DCowl (lb)	561.7	
LW(Total) (lb)	4,843	
DW(lb)	1,100	
DTotat (lb)	1,874	
WTotat (lb)	4,904	
XCGStat (ft)	9.15	
XCGDynam (ft)	4.14	
XPress (ft)	15.90	
WAngle (deg)	5.00	
YCG (ft)	4.16	
PRReqd (hp)	245.0	
Time (sec)	0.00	

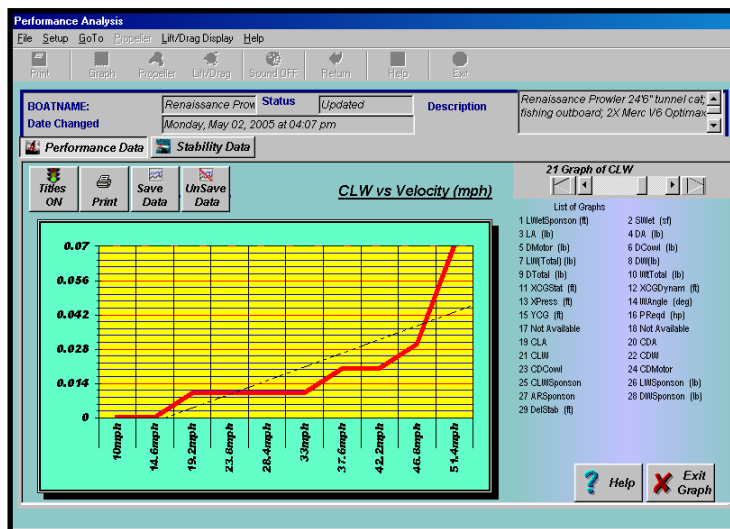
1. Estimate Max Velocity - Top Speed is usually indicated by one or many of several performance parameters. I start by using the TBDP©'s "Velocity Optimizer" feature to predict maximum attainable velocity. By using the Auto WAngle feature for maximum velocity prediction, the software 'intelligently' searches for the optimum angle-of-attack (Wangle), that will illustrate the bounding maximum speed. **For the Renaissance 246, this comes out as 50.8 mph.** This is probably an upper bound, as desired, however



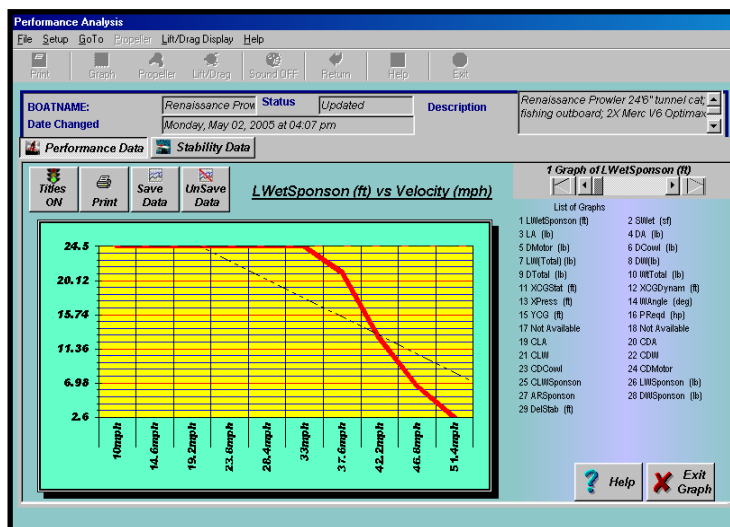
is very consistent with the *BoatingMag* test results, where a top speed of 45mph at 4900RPM (of max 5600 rpm) was recorded. Further analysis can subsequently tell us more of the practical top speed.



2. Trim Angle - Of course tunnel boat designers and drivers know that if you could keep giving it "up" trim forever without becoming longitudinally unstable, the speed would be ever-increasing. The angle of attack that is required to attain higher velocities is shown in the graph WAngle (deg) vs Velocity. The graph shows that the required angle of attack of the Renaissance 246 increases more and more as speed approaches 48 mph. At 51 mph the required angle of attack is 50+% more than it was at only 45 mph and the rate of change of the angle is now double what it was at 35 mph. **We can conclude from this trend, that 50 mph is about the velocity where the hull is reaching the upper limit of its power-demand for this setup.** There's still more indicators...



3. Sponson Lift - There's another easy clue in the sponson lift coefficient. The coefficient of (total) Lift increases as the angle of attack increases. When the lift coefficient gets higher and higher, the boat finds it easier and easier to go faster. If we look at the graph of the hydrodynamic lift coefficient (CLW vs. Velocity), we see that the CLW increases at about 33mph, and really jumps up again at 46 mph.

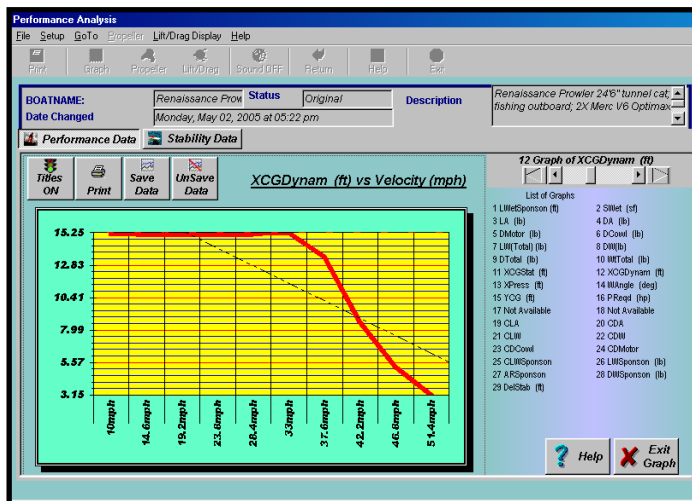


4. Wetted Surface - From the graph of sponson "wetted surface" we can see that at these same points, the length of wetted surface is reducing dramatically, down to less than 3 feet of sponson in the water at 46 mph. The sponson lifting efficiency improves, which means that the boat will start to exhibit more instability than at lower speeds, and the



sponsons will tend to "bounce" in and out of wave surfaces, with this higher efficiency occurring intermittently - ON...OFF...ON...OFF. When the coefficient starts to increase quickly, it's a good indicator that the hull is reaching its bounded stable velocity – and also time to be really careful. . The boat is now seeing alot more lift, will tend to behave more irratically, and the driver will have to react more quickly to compensate. This point of faster and faster increasing of (total) lift starts occuring with this design at about 38 mph, and becomes more pronounced at about 50 mph.

5. Dynamic Stability - Often one of the determining factors is stability. Since no tunnel hull or power-cat can be inherently aerodynamically stable, I use a measure of stability that references the dynamic CG of the hull. This is the center 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, XCGDYNAM should be as close to the Static CG (deadweight balance) and ahead of the aerodynamic center, XPRESS). Well, this hull (like most tunnels) shows it's inherent "instability" at about 33mph - this velocity region is called the "hump zone" - when the aerodynamic forces start becoming more important to the hull performance. We can also see that XCGDynamic constantly moving


aftward once through the "hump zone". This is a good thing - as long as this change is at a reasonably slow and constant rate, the hull will behave predictably and the driver will be able to compensate for the changing CG's. This hull maintains a very consistent rate of change in XCGDynamic, indicating that it will have a very stable "feel" to it throughout it's velocity range. I define the stability measure as the change in the location of the dynamic CG with respect to the aerodynamic center.

So, conclusion: Cruising speed is around 35-37mph; *maximum velocity for this hull should be about 50 mph, with very good dynamic stability up to this speed. What a great boat!*

7. General Performance - Relatively low deadrise sponsons contribute to good performance, but may introduce some "bumpy" rides in heavy seas. The good use of longitudinal strakes on the sponson pads will allow for good tracking. Relatively high CG and narrow tunnel may make lateral stability a bit tender, but the 8ft-6" beam is ample. Full length sponson Lifting Strakes give extra planing surface for better speed (with less horsepower) performance. Reverse chines are built in to the bottom to minimize spray. This hull performs very well in part, to its light weight (for its size), so analysis confirms that the hulls performance is somewhat sensitive to additional weight – but it starts out with a lower weight than other "working" boats of its size, and this is where it gets much of its performance!



Here's the design input and performance output that I got in my review of the Renaissance 246. ☞

TUNNEL BOAT DESIGN PROGRAM© Version 7.9.5 - Copyright 1999-2009 by AeroMarine Research®/Jim Russell BoatName: Renaissance Prowler 246 (Design Units: Imperial) Description: Renaissance Prowler 24'6" tunnel cat; fishing outboard; 2X Merc V6 Optimax 135hp @4900R PM. Counter: 50 DateChanged: Thursday, May 05,2005 03:08 pm Status: Original Page 1 (Printed Thursday, February 05,2009 03:20 pm)					
Hull Design					
1 Tunnel Height	25.00	inches	2 Tunnel Width	35	inches
3 Wing Chord	23.5	feet	4 Wing Thickness	55	inches
5 Pad Width	25	inches	6 Pad Deadrise	8.2	degrees
7 Deck Width	102	inches	8 Lwr Unit Height	-3	inches
Steps					
9 Step Select	No Step	Selection	10 Length Step1	n/a	feet
11 Length Step2	n/a	feet	12 Step Height	n/a	inches
CentrePod					
13 CtrPod Select	No	Option	14 CtrPod Length	n/a	feet
15 Pod Width	n/a	inches	16 Pod Deadrise	n/a	degrees
17 Pod Height	n/a	inches			
Spray Rails					
18 Spray Height	25	inches	19 Spray Width	2	inches
20 Spray Factor	0.7	factor			
AeroFoil					
21 Angle Inc	5.41	degrees	22 AeroFoil Type	Low Camber	Selection
Lengths					
23 Boat Length	24.5	feet	24 Driver Length	18	feet
25 Motor Length	-1	feet	26 Fuel Length	3	feet
27 Misc Length	2	feet	28 Motor Height	22	inches
Weights					
29 Boat Weight	2700	Lbs	30 Driver Weight	600	Lbs
31 Fuel Weight	500	Lbs	32 Misc Weight	200	Lbs
33 Motor Weight	904	Lbs			
Cowlings/Cockpit					
34 Cowl Type	None	Select	35 Rear Cowling Height	n/a	inches
36 FrontCowl Height	40	inches	37 Rear Cowling Width	85	inches
38 Open Deck	2	feet			
Design Analysis					
39 Optimize	Angle	Selection	40 Accuracy	2	(.05%-10%)
41 Starting Velocity	10	mph	42 Velocity Increment	4.6	mph
43 Start Angle	2	degrees	44 Accel'n Model	Constant	Select
Conditions					
45 Max Power	270	HP	46 Power Effy Factor	0.9	factor
47 Altitude	100.1	feet	48 Water Type	Salt	Selection
49 RPM Max	5600	RPM			
Drive Unit(s)					
50 Number of Drive	Two Drives	Selection	51 Skeg Width	9	inches
52 Skeg Length	10	inches	53 Skeg Thickness	0.2	inches
54 Torpedo Diameter	4.75	inches	55 Torpedo Length	12	inches
56 Drive Type	Merc V6	Selection	57 Gear Ratio	2	Ratio:1



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Description: Renaissance Prowler 24'6" tunnel cat; fishing outboard; 2X Merc V6 Optimax 135hp @4900R
PM.

Counter: 50

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Output Data: Optimized for Maximum Power Use

Velocity (Mph)	10	14.6	19.2	23.8	28.4	33	37.6	42.2	46.8	51.4
LWetSponson (ft)	24.50	24.50	24.50	24.50	24.50	24.50	20.94	12.67	6.66	2.64
SWet (sf)	6,895.2	2,305.1	1,015.6	521.4	294.0	174.3	98.6	59.7	31.4	12.4
LA (lb)	4.9	10.5	18.3	28.2	40.1	53.9	69.2	86.9	105.1	132.0
DA (lb)	28.3	60.4	104.5	160.5	228.6	308.6	400.5	508.2	627.4	759.5
DMotor (lb)	3.8	8.0	13.6	20.7	29.3	39.2	50.6	63.4	77.6	93.2
DCowl (lb)	23.4	49.8	86.2	132.4	188.5	254.6	330.5	416.3	512.0	617.6
LW(Total) (lb)	4,899	4,894	4,886	4,876	4,864	4,850	4,883	4,858	4,836	4,801
DW(lb)	9,043	6,248	4,693	3,693	2,992	2,455	1,946	1,617	1,253	948
DTotat (lb)	9,075	6,317	4,811	3,874	3,250	2,803	2,397	2,189	1,958	1,800
WTTotal (lb)	4,904	4,904	4,904	4,904	4,904	4,904	4,904	4,904	4,904	4,904
XCGStat (ft)	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15
XCGDynam (ft)	15.19	15.09	15.07	15.09	15.15	15.25	13.28	8.56	5.24	3.24
XPress (ft)	12.17	12.64	13.09	13.56	14.05	14.59	15.22	15.29	15.63	16.33
WAngle (deg)	1.09	1.45	1.82	2.22	2.67	3.23	3.98	4.08	4.55	5.87
YCG (ft)	3.53	3.58	3.64	3.71	3.78	3.87	3.99	4.01	4.08	4.30
PReqd (hp)	242.0	245.9	246.3	245.9	246.1	246.7	240.4	246.3	244.3	246.8
Time (sec)										
Accelln (fps/s)										
CLA	0.3110	0.3143	0.3166	0.3178	0.3173	0.3163	0.3126	0.3117	0.3064	0.3190
CDA	0.0706	0.0707	0.0707	0.0708	0.0708	0.0707	0.0706	0.0706	0.0705	0.0708
CLW	0.0033	0.0047	0.0061	0.0077	0.0096	0.0119	0.0164	0.0214	0.0329	0.0683
CDW	0.0061	0.0059	0.0059	0.0058	0.0059	0.0060	0.0065	0.0071	0.0085	0.0135
CDCowl	0.3016	0.3016	0.3016	0.3016	0.3016	0.3016	0.3016	0.3016	0.3016	0.3016
CDMotor	0.0117	0.0115	0.0113	0.0112	0.0111	0.0110	0.0109	0.0109	0.0108	0.0108
CLWSponson	0.0033	0.0047	0.0061	0.0077	0.0096	0.0119	0.0164	0.0214	0.0329	0.0683
LWSponson (lb)	4,899.1	4,893.5	4,885.7	4,875.8	4,863.9	4,850.1	4,882.9	4,858.0	4,835.8	4,800.7
ARSponson	0.0961	0.0961	0.0961	0.0961	0.0961	0.0961	0.1124	0.1859	0.3538	0.8929
DWSponson (lb)	9,042.8	6,248.2	4,692.5	3,692.8	2,992.0	2,455.1	1,946.3	1,617.3	1,252.9	947.7
DelStab (ft)	3.0	2.5	2.0	1.5	1.1	0.7	-1.9	-6.7	-10.4	-13.1
CLWPod										
LWPod (lb)										
ARPod										
LWetPod (lb)										
DWPod (lb)										



SPEED			EFFICIENCY				OPERATION		
rpm	knots	mph	gph	naut. mpg	stat. mpg	n. mi. range	s. mi. range	run angle	sound level
1000	5.5	6.3	2.2	2.5	2.9	269	309	0	76
1500	7.6	8.8	2.6	2.9	3.4	318	366	1	78
2000	9.4	10.8	4.8	2.0	2.3	211	243	3	80
2500	15.1	17.4	7.1	2.1	2.5	230	265	5	84
3000	19.5	22.4	7.8	2.5	2.9	270	310	3	87
3500	27.6	31.8	9.1	3.0	3.5	328	377	2	90
4000	32.4	37.3	14.0	2.3	2.7	250	288	2	91
4500	36.6	42.1	19.4	1.9	2.2	204	234	2	94
4900	39.6	45.6	30.3	1.3	1.5	141	163	2	96

From: Boating magazine

January 2001 - Performance Test
'Prowler 246'

LOA.....24'6"
Beam8'6"
Draft2'3"
Displacement (lbs., approx.).....2,700
Bridge clearance.. 6'4"
Minimum cockpit depth2'2"
Max. cabin headroom
.....4'3"
Fuel capacity (gal.)120
Water capacity (gal.)16
Price (w/o power)\$28,900
Price (w/test power)\$53,000

STANDARD POWER:
None.

OPTIONAL POWER:
Twin outboards to 300 hp total.

TEST BOAT POWER:
Twin 135-hp Mercury Optimax V-6 outboards with 153 cid, 3.50" bore x 2.65" stroke, swinging 14 3/4" x 22" four-bladed ss props through 2:1 reductions.

STANDARD EQUIPMENT (major items): Hydraulic steering; 270-qt. insulated fishbox; 94-qt. removable cooler seat; 40-gal. aerated livewell; leaning post/tackle center; 4 gunwale-mounted rodholders; transom door; dive platform; locking rodboxes.



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