



HYDROGEN POWER SYSTEMS BUILDING A BETTER PLANET

Hydrogen Enhanced Combustion Systems that Reduce Fuel Expense and Pollution for Trucks, Autos, Boats and Generators

**Saturday November 11, 2012, San Pedro Harbor
Test on 50' diesel yacht delivers a 7.1% improvement in fuel economy.**

With optimized adjustments we expect fuel improvements between 15% and 25%



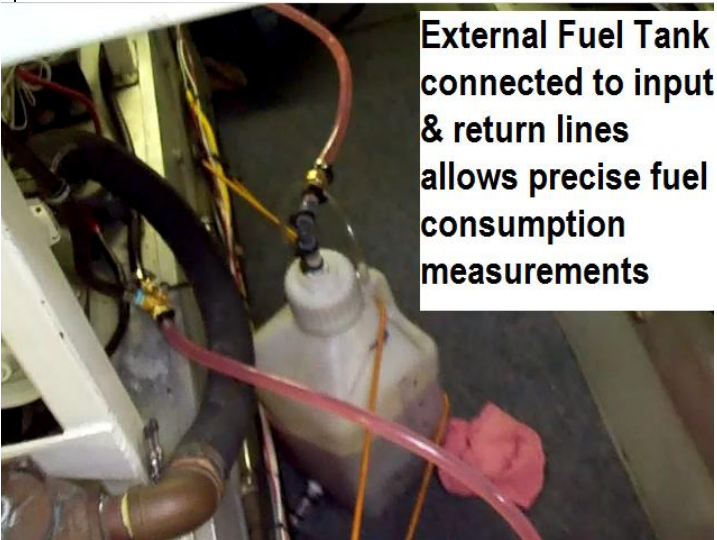
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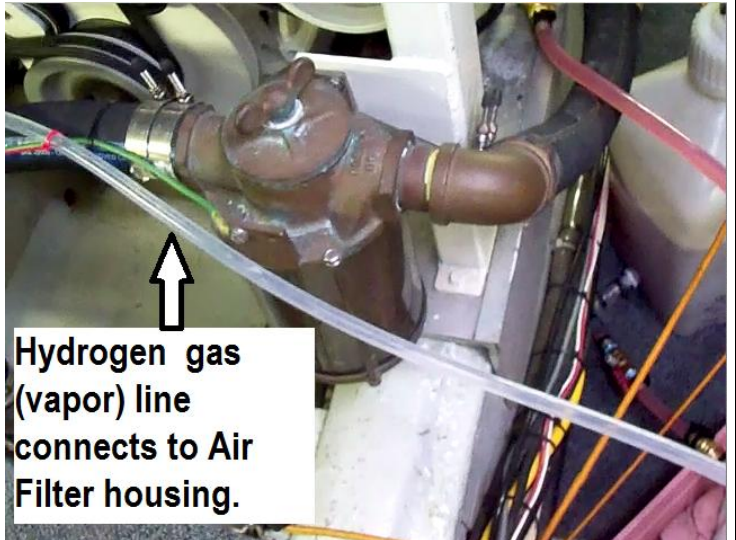


Ed Roe, Director of Manufacturing





External Fuel Tank connected to input & return lines allows precise fuel consumption measurements



Hydrogen gas (vapor) line connects to Air Filter housing.



Hydrogen gas (vapor) line connects to Air Filter Housing with a flexible hose and barb fittings.



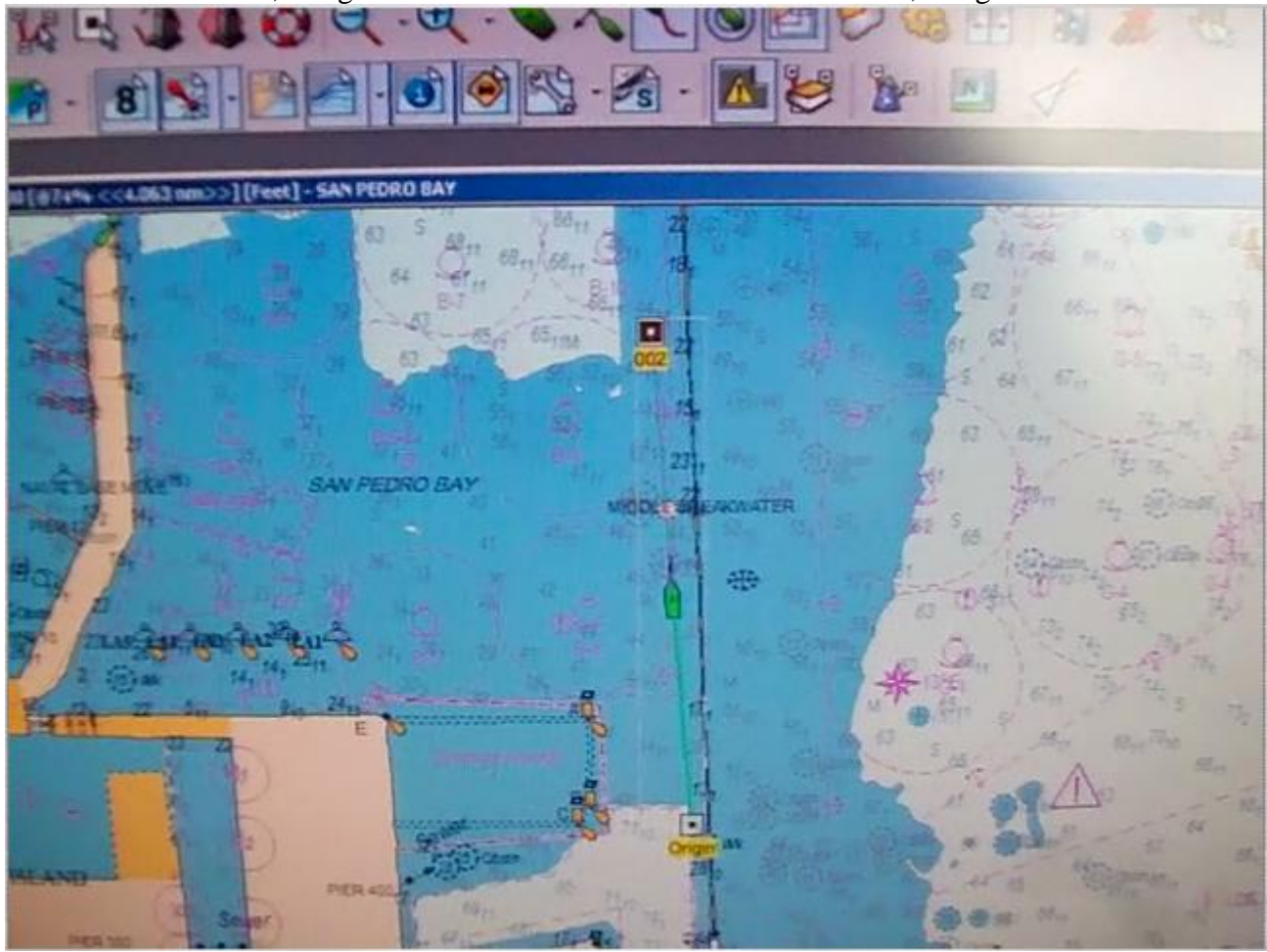
Engine	D6-310 I-B
Operation	4-stroke
Cylinder configuration	
Bore (in.)	4.06
Stroke (in.)	4.33
Compression ratio	17.51:1
Displacement (cu. in.)	336
Displacement (liters)	5.5
Displacement per cylinder (L)	.91

D6-310
Volvo Penta's 6-cylinder D6-310 is developed from the latest design in modern diesel technology.

The engine has common rail fuel injection system, double overhead camshafts, 4 valves per cylinder, turbocharger and aftercooler.

Together with a large swept volume and **the EVC system (Electronic Vessel Control)**, this results in world-class diesel performance, combined with low emissions.

Test Route: 1.2 nautical mile course, inside San Pedro Bay, adjacent to the San Pedro Harbor breakwater, from Latitude 33 42.815 N, Longitude 118 14.284 W to Latitude 33 43.328 N, Longitude 118 12.866 W



Initial run at slow speed without Hydrogen		
Run 1 South: RPM : 1470* Speed : 6.5 Knots FlowScan: 2.19 to 2.21 GPH	Run 1 North: RPM : 1470* Speed : 5.4 Knots FlowScan: 2.19 to 2.21 GPH	Total miles traveled: 2.4 Fuel consumed: 1 gallon Fuel Economy: 2.4 MPG
* Captain was <u>easily able</u> to set/maintain RPM at 1470 and cruise on auto pilot.		

Initial run at cruising speed without Hydrogen		
Run 1 South: RPM : 1970* Speed : 8.4 Knots FlowScan: 5.40 to 5.41 GPH	Run 1 North: RPM : 1970* Speed : 7.4 Knots FlowScan: 2.19 to 2.21 GPH Run time Approx: 10:55	Total miles traveled: 2.4 Fuel consumed: 1 7/8 th gallons (1.875 gallons) Fuel Economy: 1.28 MPG
* Captain was <u>easily able</u> to set/maintain RPM at 1970 and cruise on auto pilot.		

Hydro Run 1, slow speed @ 10 / 20 Amps (48-50); duty cycle = 38% so real amp draw is 19Amps		
Run 1 South: RPM : 1460* Speed : 6.4 / 6.5 Knots FlowScan: 2.17 to 2.27 GPH**	Run 1 North: RPM : 1460* Speed : 5.3 Knots FlowScan: 2.30 GPH Run time Approx: 11:31	Total miles traveled: 2.4 Fuel consumed: 1 gallon Fuel Economy: 2.4 MPG
* Captain was <u>unable</u> to set/maintain RPM at 1470. It was either 1460 or 1480 or above on auto pilot. ** FlowScan initially showed 2.15 to 2.17 for about a minute then stayed between 2.25 and 2.27		

Hydro Run 2, Cruising speed @ 10 / 10 (36): duty cycle = 34% so real amp draw is 12Amps		
Run 1 South: RPM : 1980* Speed : 8.3 Knots FlowScan: 5.46 to 5.48 GPH	Run 1 North: RPM : 1980* Speed : 7.5 Knots FlowScan: 5.58-5.8 GPH Run time Approx: 9:39	Total miles traveled: 2.4 Fuel consumed: 1 & 7/8 th gallons (1.875 gallons) Fuel Economy: 1.28 MPG
* Captain was <u>unable</u> to set/maintain RPM at 1970. It was either 1960 or 1980 or above on auto pilot.		

Hydro Run 3, Cruising speed @ 40 / 40 (90 to 103); duty cycle = 45% so real amp draw is 46Amps		
Run 1 South: RPM : 1980* Speed : 8.2 Knots FlowScan: 5.53 to 5.55 GPH Run time Approx: 9:36	Run 1 North: RPM : 1980* Speed : 7.6 Knots FlowScan: 2.19 to 2.21 GPH Run time Approx: 10:57	Total miles traveled: 2.4 Fuel consumed: 1 & 6/8 th gallons (1.750 gallons) Fuel Economy: 1.371 MPG
* Captain was <u>unable</u> to set/maintain RPM at 1970. It was either 1960 or 1980 or above on auto pilot.		

The improvement between 1.28 MPG and 1.371 MPG is 7.1%
With optimized adjustments we expect fuel improvements between 15% and 25%

