Engineering Report
005-08-002-00

OMSTAR SALES AND MARKETING

Omstar d-1280x

Ecological. Economical. Effective.

Engine Dynamometer Test Using Omstar d-1280x Fuel Reformulator

Conducted June 10-26, 2009
At Pacific Power Products, Kent, Washington

Prepared By:

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August 10, 2009

Professional Seal

Rev.	Date	Description	By	Chk	App
0	08/10/09	Issued For Review	DP	RB	CG

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1.00 TEST METHODS SUMMARY

Test Number:	005-08-002-00
Date of Test:	June 10, 2009 through June 26, 2009
Purpose of Test:	Evaluate Omstar d-1280x additive in a 2-stroke diesel engine
Engine:	Detroit Diesel 6V71, Model 7063-7000, Serial 6VA-104482
Location:	Pacific Power Products, Kent, Washington, http://www.pacificdda.com/
Test Conducted for Owner:	Omstar Sales and Marketing
Owner Representative and Test Witness:	Everett "Buzz" Waid
Test Conducted by:	Pacific Power Products
Test Performed and Witnessed by:	Barry Driskell
Test Supervised by:	Travis Smith
Test Observed by:	E3 Energy Products, LLC
Observer Representative and Witness:	Daniel Parker, P.E.
Report by:	Daniel Parker, P.E.

Equipment Used

Dynamometer:	Taylor DX3010, Serial No. 52692
Dynamometer Controller:	PowerNet LT
Opacity:	CalTest 1000, Serial No. 104890
Exhaust Gas Analyzer:	Ecom A+ Emissions Analyzer, Serial No. 1007

Calibration

Dynamometer:	Calibrated July 18, 2008
Opacity:	Calibrated Dec 15, 2008
Exhaust Gas Analyzer:	Calibrated June 8, 2009 and July 18, 2009 to NIST traceable standards

Test Procedure Summary

The test procedure consisted of the following five phases:

Baseline (Control):	3 test runs, no additive
Cleaning:	9 test runs, 1:250 in fuel, 1:1305 in oil
Cleaning:	9 test runs, 1:416 in fuel, 1:1305 in oil
Data Run:	11 test runs, 1:1245 in fuel, 1:1305 in oil

Each test run consisted of the throttle at 44% for three minutes, then 68% for six minutes, and then repeating for 20 cycles for a total test period of 180 minutes. Tests were performed in accordance with ASME Performance Test Code PTC-17 Reciprocating Internal Combustion Engines.

2.00 CONCLUSIONS

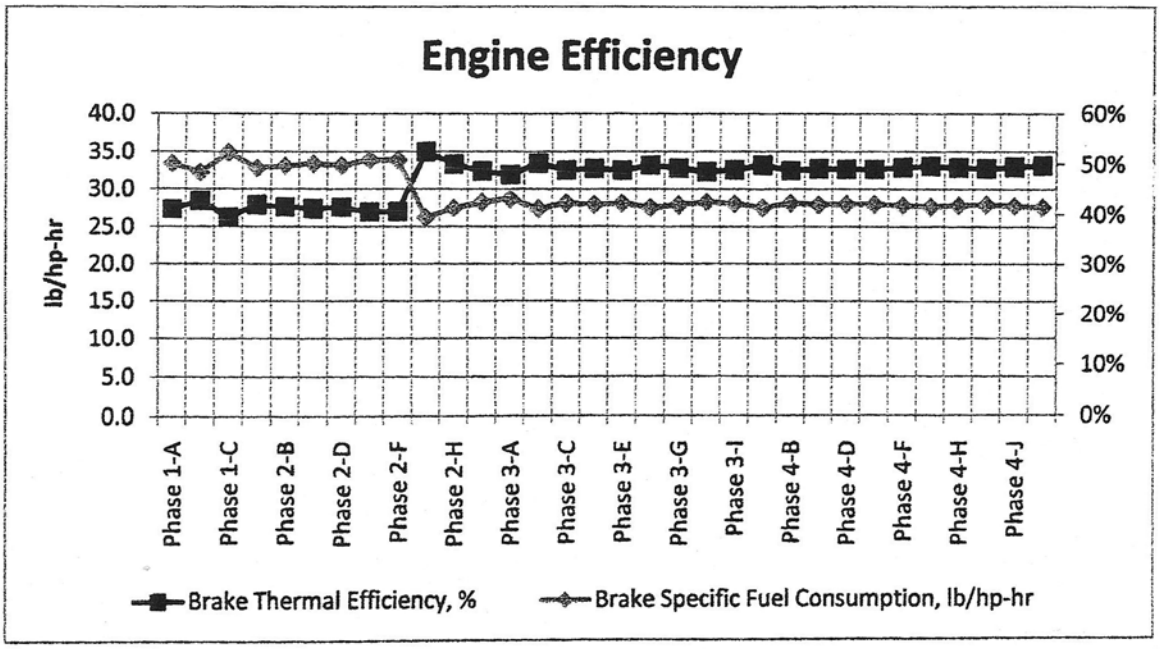
The purpose of this series of trials was to evaluate the effectiveness of the Omstar d-1280x fuel reformulator in increasing engine efficiency and reducing exhaust emissions. The trials were conducted under controlled conditions using calibrated instrumentation and a calibrated dynamometer test bed. The effect of the additive on engine cleanliness was also evaluated, albeit in a subjective manner only.

2.01 Engine Efficiency

The engine efficiency was evaluated through calculation of the Brake Specific Fuel Consumption, the Brake Specific Energy Consumption, and the Brake Thermal Efficiency. The values for each of these for the Baseline and Data Run phases, along with the percent change, are given in the table below:

	Baseline				Data Run				
	U.S. Units		SI Units		U.S. Units		SI Units		
Test Parameter	Value	Units	Value	Units	Value	Units	Value	Units	% Change
Brake Specific Fuel Consumption	0.50	lb/HP-hr	306	g/kWh	0.42	lb/HP-hr	254	g/kWh	-16.89%
Brake Specific Energy Consumption	9,304	BTU/HP-hr	13,163	kJ/kWh	7,732	BTU/HP-hr	10,940	kJ/kWh	-16.89%
Brake Thermal Efficiency	27.38	%	27.38	%	32.91	%	32.91	%	20.20%

The test results show a decrease in fuel consumption for the same equivalent power of almost 17% and an increase in engine efficiency of approximately 20%.



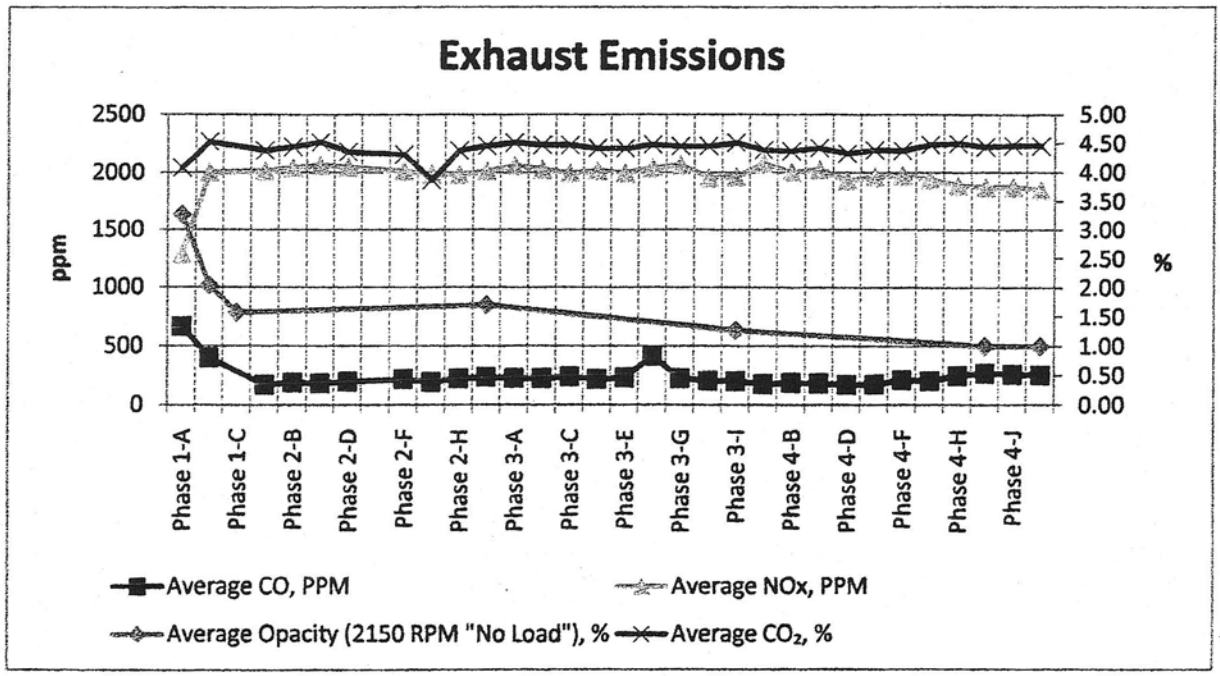
2.02 Emissions

2.02.01 Direct Exhaust Measurements

Engine exhaust emissions were measured using a portable emissions analyzer. The values for the exhaust emissions for the Baseline and Data Run phases, along with the percent change, are given in the table below:

Test Parameter	Baseline Value	Baseline Units	Data Run Value	Data Run Units	% Change
Opacity	2.29	%	1.00	%	-56.31%
Carbon Monoxide (CO)	534	PPM	213	PPM	-60.15%
Nitrogen Oxides (NOx)	1,642	PPM	1,945	PPM	18.43%
Carbon Dioxide (CO_2)	4.31	%	4.42	%	2.58%

The test results show that opacity is improved by better than 50%, which is an indicator that particulate emissions have been reduced. Carbon monoxide has also been reduced by 60%. An increase in NOx and carbon dioxide is an expected result of higher engine efficiency, and is an indicator that the fuel is burning more completely.



2.02.02 Net Emissions from Reduced Fuel Consumption

In Section 2.01 above, the engine was shown to have reduced fuel consumption per unit power produced when the Omstar d-1280x additive is used. This reduction in fuel usage resulted in a net decrease in emissions, which is shown in the table below:

Test Parameter	Without d-1280x		With d-1280x		% Change
	Value	Units	Value	Units	
Carbon Monoxide (CO)	0.0187	lb/HP-hr	0.0062	lb/HP-hr	-66.88%
Nitrogen Oxides (NOx)	0.0574	lb/HP-hr	0.0565	lb/HP-hr	-1.57%
Carbon Dioxide (CO_2)	1.5073	lb/HP-hr	1.2849	lb/HP-hr	-14.75%

The calculated emissions as an overall result of reduced fuel consumption and direct effects of the d-1280x additive are a nearly 67% reduction in carbon monoxide, a 1.5% reduction in NOx, and a nearly 15% reduction in carbon dioxide.

2.03 Calculation Methodology

Engine power output calculations are made using standard calculations as provided in ASME PTC-17. Raw data was validated and tests with incomplete data, or data that fell outside of permissible deviations were rejected. Net power output is calculated by formula (1) and a time-weighted average computed for each test. Brake Specific Fuel Consumption (BSFC) is calculated from the average net power and the total mass of fuel used during each test using formula (2). Brake Specific Energy Consumption (BSEC) is calculated from the fuel lower heating value using formula (3), and the Brake Thermal Efficiency (BTE) is calculated using formula (4).

$$\text{(FPS) } HP = \left(\frac{2\pi \times Torque(ft-lb) \times rpm}{33{,}000}\right) \quad \text{(SI) } kW = \left(\frac{2\pi \times Torque(N-m) \times rpm}{60{,}000}\right) \tag{1}$$

$$\text{(FPS) } BSFC = \left(\frac{\text{Fuel Rate (lb/hr)}}{HP}\right) \quad \text{(SI) } BSFC = \left(\frac{\text{Fuel Rate (g/hr)}}{kW}\right) \tag{2}$$

$$\text{(FPS) } BSEC = \left(\frac{\text{BSFC (lb/HP - hr)}}{\text{Fuel LHV (BTU/lb)}}\right) \quad \text{(SI) } BSEC = \left(\frac{\text{BSFC (g/kW - hr)}}{\text{Fuel LHV (kJ/g)}}\right) \tag{3}$$

$$\text{(FPS) } BTE = \left(\frac{2{,}544.43}{BSEC}\right) \quad \text{(SI) } BTE = \left(\frac{3600}{BSEC}\right) \tag{4}$$

Engine exhaust emissions are validated measured values that are displayed as an average for each test. Emission reductions through reduced fuel consumption are calculated using diesel stoichiometric carbon emissions data.

2.04 Engine Cleanliness

The engine cylinder head was removed both prior to and following the Omstar d-1280x trials. The condition of the engine was observed and photographed.

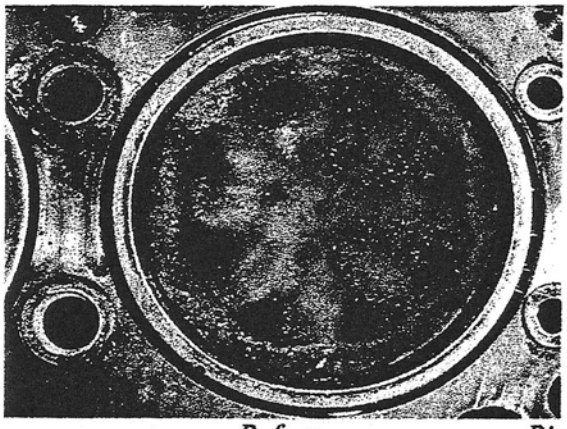
2.04.01 Engine Prior to Trials

Prior to the trials the engine had noticeable carbon deposits on the piston heads, cylinder head and valves. The exhaust ports had significant carbon buildup, to the point where as much as 25% of the port area appeared to be blocked.

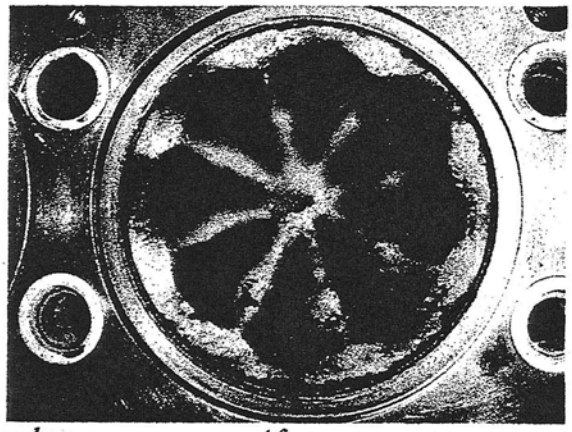
2.04.02 Engine After Trials

When the engine was opened up after the trials it was significantly cleaner. The piston heads had only a thin patina of carbon and deposits that could be fairly easily wiped away. The cylinder head and valves showed a significant reduction in deposits. The exhaust ports were clean and clear of deposits.

2.04.03 Before and After Comparisons

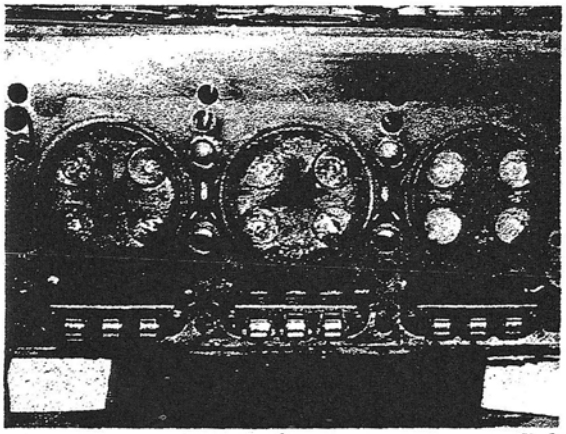


Before

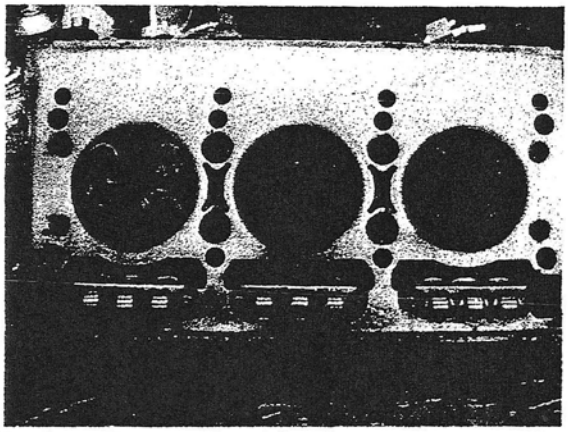


After

Piston Head

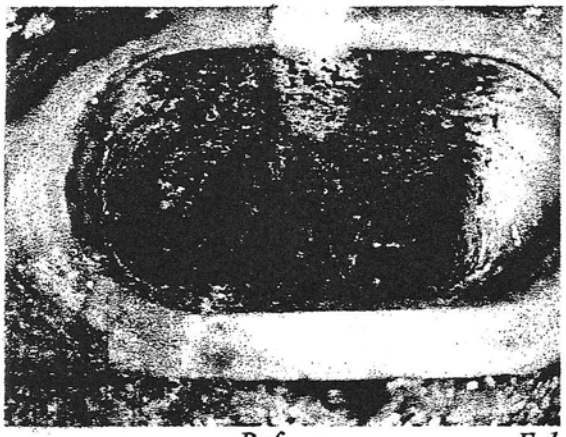


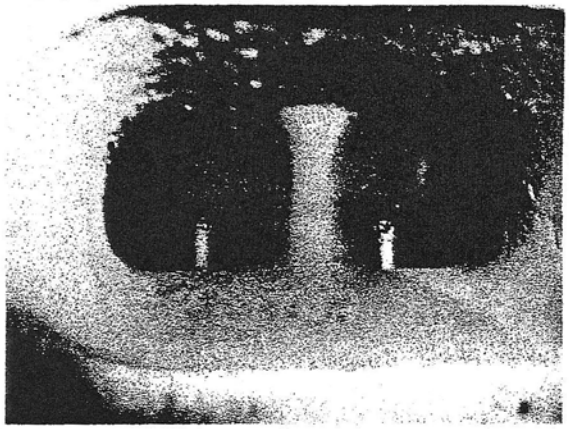
Before



After

Cylinder Head





Before *Exhaust Ports* *After*