Viscon Multi Media Evaluation
(Tier III)
Summary

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Tier III Multi-Media Assessment

I Introduction

Viscon California LLC has requested that the Air Resources Board (ARB) verify its fuel additive, Viscon, as a diesel emissions control strategy in accordance with Title 13 California Code of Regulations section 2700 and following sections. As a requirement for verification the company is required to expose Viscon to a multi-media analysis to determine if use of the product in California would have a significant adverse impact on public health or the environment when compared to CARB diesel.

On May 19, 2009 ARB informed the company that the Multi-Media Working Group responsible for reviewing the possible use of Viscon in California had given its conditional approval and cleared the company to proceed immediately to Tier III of the multi-media evaluation process.

Viscon

Viscon was designed to reduce PM and other harmful exhaust emissions from diesel fueled engines. The active component in Viscon is an ultra high molecular weight polyisobutylene polymer (PIB). The PIB is combined with CARB diesel at 1 part polymer to 99 parts diesel to form Viscon. Diesel fuel treated with Viscon has less than 5 PPM PIB. The PIB component of Viscon is a food grade substance which is non-toxic, colorless, tasteless, odorless and insoluble in water. A lower molecular weight PIB is a component in keep clean additives for gasoline in California. The same PIB used in Viscon has been used as a method for controlling and cleaning up accidental releases of diesel fuel to the environment and is licensed for use in California.

Viscon is currently being used in the State of Texas as a part of its low emissions diesel (TxLED) program. Viscon was approved for this program after completing an EPA Heavy Duty Diesel Transient test protocol. Both the test program and the results of the tests with Viscon were reviewed and approved by the EPA. To date Viscon has been used to treat more than 753 million gallons of diesel and biodiesel in the TxLED program. (Attachment 1)

Multi-Media Working Group

The company has submitted Tier I (Attachment 2) and Tier II (Attachment 3) reports to a Multi-Media Working Group formed by ARB and has met with the Working Group on numerous occasions to answer questions by the members. Communications between the company and Working Group members are in Tier II Report, Attachment 16.

The ARB informed the company that based upon evaluation of the Tier I and Tier II reports the Multi-Media Working Group approved Viscon for use in California conditioned upon the completion within one year of laboratory tests for biodegradability and fate and transport in soil and submission of a technical report illustrating Viscon's potential impact on different soil cleanup methods (Attachment 4). The protocol for biodegradability and fate and transport testing is Attachment 5 to this report. Additional information will be provided on how Viscon will affect soil clean-up procedures after the soils experiments are conducted in accordance with the test protocol.

The Tier I and Tier II reports were prepared with the assistance of Dr. Donald Lucas of the Ernest Orlando Lawrence Berkley National Laboratory. The Tier I and Tier II reports contain emissions data from a series of tests conducted using the ISO 8178 8 Mode Off-Road Emission Test Cycle which show significant criteria pollutant reduction.

Environmental Policy Council

Pursuant to the California Health and Safety Code section 43830.8, a multimedia assessment and peer review must be conducted when ARB establishes a specification for a motor vehicle fuel. Before adoption of a new or modified motor vehicle fuel specification, the Environmental Policy Council must determine if the proposed fuel specification poses a significant adverse impact on public health or the environment. In making its determination, the Environmental Policy Council must consider the following:

- Emissions of air pollutants, including ozone-forming compounds, particulate matter, toxic-air contaminants, and greenhouse gases.
- Contamination of surface water, groundwater, and soil.
- Disposal of waste materials, including agricultural residue, forest biomass, and municipal solid waste.

If the Environmental Policy Council determines that the proposed fuel specification poses a significant adverse impact on public or the environment, or that alternatives exist that would be less adverse, the council shall recommend alternative specifications or other measures that the state board (ARB) or other state agencies may take to reduce any adverse impact on public health or the environment.

II Effect on Air Quality

The primary pathway by which use of Viscon can affect air quality is through tailpipe emissions from diesel engines. The company has performed exhaust emission testing in accordance with ARB regulations. The results of these tests are summarized below. The engine used in the tests is a Caterpillar Model 3306. The fuels used were low sulfur diesel and ultra low sulfur diesel. The test cycle used was ISO 8178 8 Mode Off-Road Emissions Test Cycle. The tests were carried out at Olson-Ecologic Engine Testing Laboratories in Fullerton, California.

Test Series

1. Initial exhaust emissions tests, under ARB direction, were begun in 2003 and completed in 2004. The tests were carried out using low sulfur diesel. Particulate samples were gathered in an AVL Smart Sampler for the 8 mode cycle as a whole. State of the art Horiba analyzers were used for the HC, CO and NOx sampling and measurements. Fuel consumption was not measured. The protocol included a 1000 hour durability test period. (Attachment 2, Attachment 8)

Table 1
Summary of Results From Post Durability Tests
With Low Sulfur Diesel
g/bhp-hr

	THC	CO	NOx	PM
Baseline (w/o Viscon)	1.29	2.56	7.09	0.308
Post Durability (with Viscon)	0.94	1.59	5.29	0.159
% Improvement	26.8	37.9	25.4	48.4

2. At the direction of the ARB a second set of tests using the same Caterpillar Model 3306 engine were carried out using Ultra Low Sulfur diesel in 2006, 2007 and 2008. Particulate samples were gathered using the AVL Smart Sampler for each of the 8 modes individually. Fuel consumption was measured gravimetrically and compared to the carbon balance of CO2 measurements. State of the art Horiba analyzers were used for the HC, CO, CO2, NOx and NO sampling and measurements. Samples were drawn and captured for PAH and carbonyl analysis at the Desert Research Institute.

In addition to the standard dosage rate of 1 oz to 20 gallons of ULSD, a set of three tests were performed using an overdosing rate of 10 oz to 20 gallons of ULSD. No significant change from the test with the standard dosage in any gaseous emission or PM was observed. (Attachment 3, Attachment 8)

Table 2
Summary of Results From Post Durability
Tests with Ultra Low Sulfur Diesel
g/bhp-hr

	HC	CO	NOx	NO	CO2	PM	FUEL
Baseline (w/o Viscon)	1.379	1.695	5.79	5.144	561.255	0.265	178.507
Post Durability (with Viscon	1.43	1.62	5.89	5.43	552.58	0.197	175.80
Change	+3.6%	-4.4%	+1.7%	+5.5%	-1.5%	-25.7%	-1.5%

Effect of Viscon on Mass Exhaust Emissions

In the post durability tests HC emissions were increased from the baseline by 3.6% and NOx emissions were increased from the baseline by 1.7%. However, CO_2 was decreased by 1.5%. Comparing the mass of these changes, emissions of HC were increased by .05 grams per BHP hour (g/bhp-hr) and emissions of NOx were increased by .1 g/bhp-hr, while CO_2 was decreased by 8.68 g/bhp-hr. On a mass basis the reduction of CO_2 using Viscon would be 163 times more than the increase in HC and 86 times more than the increase in NOx. If Viscon were used in 9 million gallons of diesel fuel in the state of California, the reduction of CO_2 would be 3,024,000 lbs. per year. If Viscon were used in 100,000 bbls, per day, the reduction of CO_2 would be 515,000,000 lbs. per year.

Effect of Viscon on Particulate Matter Emissions

California Air Resources Board (CARB) identified PM as a toxic air contaminant in 1998 and determined that diesel PM accounts for 70% of the toxic risk from all identified air contaminants. Test data from tests with ULSD demonstrates that the use of Viscon can reduce overall PM emissions from off road engines by 25.7%. In addition to the tests with the off-road engine carried out under CARB direction a test program was carried out for the State of Texas with an over-the-road engine. The test protocol was reviewed by both the Texas Committee on Environmental Quality (TCEQ) and the US EPA. The results of these tests show similar reductions of PM to those in the current program. (Attachment 6)

Table 3
Results of Tests with Over-the-Road Engine for TCEQ
g/bhp-hr

	T HC	CO	NOx	NO	CO2	PM
Baseline (w/o Viscon)	.142	1.634	5.391	4.986	575.01	.254
Post Durability (with Viscon	.138	1.693	4.811	4.440	543.33	.182
Change	-2.8%	-3.6%	-10.7%	-10.9%	-5.5%	-28.3%

Effect of Viscon on Toxic Emissions

The Desert Research Institute analyzed exhaust gas samples from testing at Olson Ecologic Engine Testing Laboratories for carbonyls and PAH's. They analyzed samples from both predurability and post durability tests.

Desert Research data shows that samples from predurability tests had an increase in all but two of the carbonyls over the baseline. Post durability data showed a reduction from predurability in all carbonyls except for m-tolualdehyde and hexanadehyde which showed increases. When compared to the baseline there were reductions in the post durability data in all carbonyls except for formaldehyde, m-tolaldehyde and hexanaldehyde. (Attachment 3, Tab B, Table 3b)

Table 4
Carbonyls
g/bhp-hr

	Baseline	Predurability	Postdurability	Postdurability/ Change
formaldehyde	0.027257	0.033467	0.030025	10%
acetaldehyde	0.007385	0.009281	0.006948	-6%
acetone	0.001867	0.002640	0.000886	-53%
acrolein	0.001025	0.001817	0.000672	-34%
propionaldehyde	0.001332	0.001512	0.001090	-18%
crotonaldehyde	0.000997	0.001186	0.000332	-67%
methyl ethyl ketone	0.000462	0.000480	0.000105	-77%
methacrolein	0.000447	0.000562	0.000037	-92%
butyraldehyde	0.004759	0.004031	0.000558	-88%
benzaldehyde	0.000633	0.000724	0.000489	-23%
glyoxal	0.000322	0.000669	0.000000	-100%
valeraldehyde	0.00617	0.000497	0.000000	-100%
m-tolualdehyde	0.000170	0.000110	0.000223	1260%
hexanaldehyde	0.000316	0.000368	0.000395	25%

The Desert Research Institute analyzed PAH's only from the predurability tests. The CARB administrator in charge of the Viscon project said that further testing was not required because of the amount of reductions in PAH's in the predurability test. The predurability data showed that Viscon reduced all PAH's except for dibenzo (ah+ac) anthracene and benzo(ghi)perylene which were increased by .0000000002 g/bhp-hr and .0000000001 g/bhp-hr respectively. (Attachment 3, Tab B, Table 3c)

Table 5
PAH's
g/bhp-hr

PAH's	Baseline	Viscon	Change
Naphthalene	0.0000105330	0.0000046060	-56%
2-methylnaphthalene	0.0000097644	0.0000025767	-74%
acenapthylene	0.0000001930	0.0000001621	-16%
acenaphthene	0.0000006595	0.0000000644	-90%
fluorine	0.0000005351	0.0000001308	-76%
phenanthrene	0.0000013444	0.0000005032	-63%
anthracene	0.0000001810	0.0000000748	-59%
flouranthene	0.0000000673	0.0000000503	-25%
pyrene	0.0000002270	0.0000001258	-45%
benz(a)anthracene	0.0000000076	0.0000000015	-80%
chrysene-triphenylene	0.0000000118	0.0000000054	-55%
benzo(b+j)flouranthene	0.0000000010	0.0000000003	-67%
benzo(k)flouranthene	0.0000000003	0.0000000002	-50%
BeP	0.0000000009	0.0000000005	-37%
BaP	0.0000000004	0.0000000000	-100%
Perylene	0.0000000003	0.0000000000	-100%
indeno(123-cd)pyrene	0.0000000001	0.0000000001	-50%
difenzo(ah+ac)anthrcene	0.0000000001	0.0000000002	+100%
Benzo(ghi)perylene	0.0000000000	0.0000000001	

VOC's were analyzed at Olson Ecologic Engine Testing Laboratories. VOC data was reported for both predurability and post durability tests. The postdurability data shows an increase compared to the baseline in all of the VOC's. The largest was an increase of .00426 g/bhp-hr for 1,3 butadiene. Comparing predurability with post durability there was a significant decrease in benzene, a small decrease in toluene and small increases in ethylbenzene, m&p-xylene and o-xylene. The most significant change from predurability to post durability was in 1.3 butadiene, which the predurability test shows as undetectable. This may be the result of a testing error. (Attachment 3, TAB B, Table 3a)

Table 6
VOC's
g/bhp-hr

	Baseline	Predurability	Postdurability	Postdurability/ Change
1.3 butadiene	0.000252	<RL	0.004498	+1682%
Benzene	0.009026	0.011392	0.009158	+1%
Toluene	0.004228	0.005176	0.004994	+18%
Ethylbenzene	0.001811	0.001742	0.002174	+20%
M&P-xylene	0.003898	0.002504	0.003996	+2%
O-xylene	0.002311	0.001699	0.002556	+11%

Conclusion

The use of Viscon in diesel fueled off-road engines would improve air quality in California. PM emissions would be reduced by 25.7%. Although there are small increases in g/bhp-hr of NOx and HC the mass of tailpipe emissions, including CO2 would be reduced. Test data shows that VOC's increased but carbonyls and PAH's decreased.

III. Effect on Water Quality

Viscon

Viscon is comprised of 1% ultra high molecular weight polyisobutylene (PIB) and 99% CARB diesel. PIB is a non-toxic, colorless, tasteless, odorless food trade substance which is insoluble in water. (Attachment 2, pages 1 and 2)

Release Scenarios

Release scenarios for Viscon are in Appendix A to this report.

Exposure Pathways

Exposure pathways for Viscon in aquatic ecosystems in relation to both human and ecological receptors are reduced when compared to those for neat CARB diesel, the major component of Viscon. The 1% PIB component of Viscon adds viscoelastic properties to the 99% CARB diesel component. Studies have demonstrated that addition of viscoelastic properties to a hydrocarbon liquid reduces the tendency of the liquid to disperse in water and to spread on the surface of water (Attachment 2, page 4). Studies have also demonstrated that the cohesiveness of a viscoelastic hydrocarbon increases the capability of spill containment and recovery equipment (Attachment 2, page 4). The changes in behavior of a spilled hydrocarbon when viscoelastic properties are added reduce potential contacts with human and ecological receptors when compared to the neat hydrocarbon.

CARB Diesel Containing Viscon

The treatment rate for Viscon in CARB diesel is about 500 PPM, therefore the treated fuel contains about 5 PPM PIB and 495 PPM additized CARB diesel. PIB is a C_4H_8 hydrocarbon that does not change the chemistry of the treated fuel (Attachment 2, pages 1 and 2).

The effect on water quality from a release of CARB diesel treated with Viscon would be the same as the effect on water quality from a release of untreated CARB diesel. (Attachment 2, pages 2 and 3).

Release Scenerios

Release scenarios for CARB diesel treated with Viscon are in Appendix B to this report.

Exposure Pathways

Exposure pathways for CARB diesel treated with Viscon are the same as for neat CARB diesel. (Attachment 2, pages 5 and 6)

Conclusion

A release of Viscon to an aquatic ecosystem would pose less risk to that system than a release of CARB diesel fuel. A release of CARB diesel treated with Viscon would pose the same risk to an aquatic ecosystem as would a release of untreated CARB diesel.

IV. Effect on Human Health

Viscon is comprised of PIB and CARB diesel. The PIB component is a C_4H_8 hydrocarbon polymer. Its combination with CARB diesel, both in Viscon and in CARB diesel containing Viscon does not change the chemistry of CARB diesel. The PIB component is a food grade substance which is non toxic, tasteless, and odorless. Its combination with CARB diesel in Viscon and in CARB diesel treated with Viscon does not increase the toxicity of CARB diesel. (Attachment 2, pages 1 and 2)

The pathways for exposure of Viscon to human receptors are reduced when compared to exposure to CARB diesel, its major component. The pathways for exposure of CARB diesel treated with Viscon to human receptors are the same as the pathways for exposure for CARB diesel. (Attachment 2, pages 5 and 6)

Transportation on California highways associated with the production and use of Viscon is not a significant source of harmful exhaust emissions. Only 1% of the product is imported into California. The remainder is locally produced diesel fuel. Viscon is used at 1 oz. to 20 gallons of diesel. One 6000 gallon tanker truck will carry enough additive for 15.3 million gallons of CARB diesel. (Attachment 2, pages 1 and 2)

Production of Viscon is a simple dissolving process and does not involve reaction chemistry. (Attachment 2, page 2)

Addition of Viscon to CARB diesel reduces harmful exhaust emissions when compared to exhaust emissions from untreated CARB diesel. (Attachment 2, page 3)

Conclusion

There is no significant risk to human health resulting from production, transportation, handling, storage or use of Viscon in addition to the risk normally associated with the use of CARB diesel. There is a significant benefit to human health associated with the addition of Viscon to CARB diesel in reducing harmful exhaust emissions from California's diesel engine inventory.

V. Waste Management

Potential release scenarios for Viscon and CARB diesel treated with Viscon during production, transportation, handling, and storage are set forth in Appendix A (Release Scenario for Viscon) and Appendix B (Release Scenario for CARB Diesel Fuel Treated with Viscon). The release scenarios for Viscon are similar but more limited in scope than those for CARB diesel. The release scenarios for CARB diesel treated with Viscon are the same as for CARB diesel.

PIB does not add toxic properties to the CARB diesel component of Viscon nor to CARB diesel treated with Viscon, and therefore, will not contribute hazardous properties to waste resulting from releases of either Viscon or CARB diesel treated with Viscon. (Attachment 2, pages 5 and 6).

The impact from an accidental release of Viscon with regard to soil contamination will be less significant than the impact from a release of a similar volume of CARB diesel. The increased viscosity of Viscon resulting from the addition of PIB to CARB diesel will reduce the tendency of the release to spread over and contaminate soil, and will reduce its tendency to penetrate the soil. Attachment 2, page 5).

The impact of the addition of PIB to CARB diesel treated with Viscon on remediation of soil contaminated as a result of an accidental release is the subject of ongoing laboratory testing. (Attachment 5)

Conclusion

An accidental release of Viscon would not pose a significant adverse impact on waste management when compared to a release of CARB diesel.

The potential impact on waste management caused by an accidental release of CARB diesel treated with Viscon will be determined upon completion of ongoing laboratory testing. (Attachment 5)

VI. Risk/Benefit Analysis

Risk

The scope and type of risk to human health or environment caused by production, transportation, storage and use of Viscon not already associated with the distribution and use of CARB diesel will be determined upon completion of the test protocol contained in Attachment 5.

Benefit

The addition of Viscon to CARB diesel would provide a significant benefit to human health and the environment by reducing harmful exhaust emissions from diesel engines.

Appendix A: Release Scenarios for Viscon

Production:

Release scenario AST Release	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
This scenario assumes a 10,000 gallon release from an above ground bulk storage tank.	The Viscon production facility is on the site of a former refinery.	Moderate likelihood of occurrence at single production facility in California.	Toxicity to human and ecological receptors. Risk mitigated by viscosity of the product.	Site has engineered containment compliant with US EPA and California regulations.

Distribution:

Release scenario Bulk Transport	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
This scenario assumes a rupture of a tanker truck with a release of 5000 gallons to the soil or surface water	This scenario assumes a release onto a relatively pristine surface where liquid hydrocarbons are historically absent	Moderate likelihood of occurrence.All deliveries are made from and to California locations.	Toxicity to human and ecological receptors in direct contact with release, including potential impact to surface aquatic ecosystem. Risk would be mitigated by high viscosity and visco-elasticity of the product.	Tanker truck releases are typically treated as subject to emergency response. Viscoelasticity of the product will aid in containing and recovering the product.

Release scenario Storage at End User Facility	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
This scenario assumes a release of Viscon from a 10,000 gallon above ground storage tank	Hydrocarbon liquids are assumed to be historically present	Moderate likelihood of occurrence.	Potential interaction of product with hydrocarbon liquids historically present in the soil. Risk mitigated by the viscosity of the product.	Engineered containment to control release. Manage location to avoid known areas of liquid hydrocarbon releases. Remediate the liquid hydrocarbon releases in the area..

Appendix B: Examples of Release Scenarios for CARB Diesel Fuel Treated with Viscon

Distribution:

Release scenario Bulk Storage Tank at a Distribution Terminal	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
This scenario assumes a large volume release greater than 150,000 barrels of CARB diesel treated with Viscon from an above ground storage tank.	Liquid hydrocarbons are assumed to be historically present and may be present as free product trapped in the subsurface.	Moderate likelihood of occurrence.	The product is assumed to interact with soils contaminated with existing liquid hydrocarbons. Will addition of Viscon to the stored CARB diesel have an effect on existing immobile hydrocarbons causing them to be mobilized to the ground water? Will the addition of Viscon cause an existing hydrocarbon plume to be expanded?	Engineered containment to control release. SPCC Plans in place. Remediate the hydrocarbon release.

Release scenario CARB Diesel Treated With Viscon Release During Transport	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
This release scenario assumes that CARB diesel treated with Viscon is transported by tanker truck to a service station. A large volume, 5,000 gallons is released from the tanker truck to soils and surface and ground waters.	Releases occur into road side environments where liquid hydrocarbons are historically absent.	Moderate likelihood of occurrence.	The product is assumed to contaminate an environment in which heretofore liquid hydrocarbons had not been present. Would the presence of Viscon in CARB diesel complicate remediation.	Tanker truck releases are typically subject to emergency response and generally require no long term monitoring.

Appendix B - continued

Release Scenario Fueling Station Releases	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
This release scenario assumes that CARB diesel treated with Viscon is spilled during storage tank filling. A low volume, less than 50 gallons, of diesel could be released to soils and ground water.	Small amounts of liquid hydrocarbons are presumed to be historically present in the subsurface.	Common release scenario	The spilled diesel is assumed to interact with soils contaminated with existing liquid hydrocarbons.	For underground tanks upgraded UST requirements should minimize the releases. For above ground storage tanks engineered containment should be used to control release.
This scenario assumes a small puncture of the UST or associated pluming resulting in a low volume release of less than 3 gallons a day	Releases may occur into subsurface environments with possible historic liquid hydrocarbon presence..	A likely and common release scenario.	This scenario has the potential to release a large mass of diesel over time because of the potential for small leaks to be undetected.	Current requirements for USTs to use double walls reduces likelihood of occurrence.
This scenario assumes a large puncture of the UST or piping resulting in a high volume release, greater than 10 gallons a day.	Release may occur into subsurface environments with possible historic liquid hydrocarbon contamination.	Moderate likelihood of occurrence.	Typically larger UST leaks are detected early and correction action initiated.	Typically larger UST leaks are detected early and correction action initiated.

Attachment 1

Texas Commission on Environmental Quality Report on
Texas Low Emissions Diesel (TxLED)
July 20, 2005

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Olson-EcoLogic
Engine Testing Laboratories, LLC

ISO 9001:2000 Registered

FINAL REPORT

Exhaust Emission Equivalence Testing Comparing TxLed Reference Fuel To a No. 2 Diesel Candidate Fuel Treated with Viscon Polymer Additive (1 oz. to 20 gal.) Using a Cummins Model M-11 400 HP Diesel Engine

For

GTAT California
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The preparation of this report is based on work funded in part by the State of Texas through a Grant from the Texas Commission on Environmental Quality

Revised
July 20, 2005

By
Olson-EcoLogic Engine Testing Laboratory

Approved ____________________ Date __________

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Introduction

This final report documents the emission testing project conducted for GTAT California of Bakersfield, California. This project has the objective of showing exhaust emission equivalency between a candidate fuel treated with the proprietary Viscon polymer additive (1 oz. to 20 gal.) and the TxLed reference specification fuel when tested by the official EPA transient cycle emission test protocol. This project has been done in accordance with the detailed protocol and requirements specified by the Texas Commission for Environmental Quality in Austin, Texas.

Test Facility and Capability

Olson-EcoLogic as an independent emission test laboratory is an ISO 9001:2000 registered facility. It is officially recognized and listed by EPA and CARB as a capable emission test facility for the protocols conducted in this project. Dozens of transient cycle emission tests have been submitted to and accepted by CARB for other clients. Over the years literally thousands of emission tests have been conducted for CARB and in accordance with CARB and EPA requirements. All engine operation and transient cycle emission testing for this project was conducted at the Olson-EcoLogic Engine Test Laboratory in Fullerton, California on their 450 horsepower electric dynamometer in test cell no. 1. All test activity was under the direction and responsibility of Donel R. Olson. Mr. Olson is a California registered professional mechanical engineer with 40 years of experience in the measurement and analysis of engine emissions. Over twenty chassis and engine emission test laboratories in the United States and Germany have been under his past ownership and direction during the last 30 years. Mr. Olson is also the co-founder of Olson-Horiba Instruments and has been responsible for designing and providing dozens of complete emission test facilities around the world. Prior work experience included three years as an engineering project manager at Southwest Research Institute in Texas. He also started and managed Olson Laboratories, Inc. a public company that grew to be the largest independent emission measurement organization and provider of emission measurement systems in the world. This company was ultimately sold to Northrop Corporation in California.

The specific emission test cell for the project conducted here consists of the following instruments and equipment: Horiba gaseous analysis instruments for THC, CH4, CO and CO_2, Rosemont chemiluminescent analyzers for NOx and NO, Sierra Model BG-2 modified and upgraded particulate sampling system; the engine dynamometer is a Baldor computer controlled 450 horsepower full electric system. Fuel consumption was measured gravimetrically with use of a precision scale and simultaneously fuel consumption can be calculated by the standard carbon balance method for comparison. Custom computer capability based on modified Wonderware software is utilized for all control and data functions. Other details of the Olson-EcoLogic emission test facility capability can be viewed and obtained on the Olson-EcoLogic website at www.ecologiclabs.com. A copy of the Olson-EcoLogic ISO 9001:2000 Certificate and the CARB letter of emission testing capability is provided in the Appendix to this report.

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Engine and Instrumentation Preparation

The Cummins 2000 Model M-11 diesel test engine used in this project was provided as a recently rebuilt engine by the GTAT client. The rebuilt engine specifications and engine performance test data are provided in the Appendix. This on-road engine was originally built new to California exhaust emission standards (grams per bhp-hr) of 1.3 THC, 15.5 CO, 4.0 NOx and 0.25 PM. The engine was adapted with a soft coupling and connected to the electric engine dynamometer for 25 hours of stabilizing operation under representative load conditions for subsequent EPA transient cycle emission testing. Preparation of the engine prior to testing included thermocouple and pressure transducer installations in addition to installation of a Sierra air mass sensor to measure combustion air in real time and connection of the exhaust gas to the Olson-EcoLogic heavy-duty CVS (Constant Volume Sampler) for proper exhaust gas dilution under constant mass conditions.

Test Fuel

The TxLed reference fuel and the candidate fuel were provided by the client. The candidate fuel was treated with the proprietary Viscon polymer additive (1 oz. to 20 gal.). Fuel inspections are provided in the Appendix.

Emission Testing and Quality Control Protocols

Dilute exhaust gases from the CVS were continuously collected and routed to the gaseous analyzers for analysis by volume and for final calculation of corrected mass concentrations using temperature, barometric pressure and humidity. All variables were automatically integrated from the second by second raw data. Simultaneously and continuously exhaust samples were routed to the Sierra BG-2 particulate sampler for capture of dilute samples over the test cycle on a pre-weighed paper filter media and weighed again to determine the mass concentration of PM.

The computer software program captures and integrates all raw data continuously over the test cycle recording and correcting the data every second over the 1200 seconds of engine operation for each hot start transient test. These measured and recorded data, after correction, become the basis for the final mass per brake horsepower-hour data that are provided in the summary reports listed here. In addition to correction of the raw data for temperature, barometric pressure and humidity the data are corrected for any hydrocarbons and carbon monoxide present in the dilution air introduced through the CVS for the dilution air only. This is done by continuously collecting the dilution air sample over the test cycle in a bag for analysis of the dilution air at the end of the engine test cycle. The measured dilution air bag concentrations of HC, NOx and CO are subtracted from the continuously integrated dilute exhaust gas samples to provide the correct exhaust gas values.

The quality control function is accomplished by automatic triplicate zero and span gas checks at the beginning and end of each test cycle. The computer automatically corrects any drift or offset that may occur during the cycle to assure that real time data are compared to the correct instrument calibration curve. After the test is completed the quality audit function is accomplished by reviewing the real time 1200 seconds of data to be sure all control parameters are within specified and required values and that there are no obvious discrepancies in the 1200 seconds of all recorded data.

Test Protocol Sequence

The TCEQ test requirements involved the following testing sequence:

1. Operation of the test engine over a representative load cycle with the reference (baseline) fuel for 25 hours to stabilize the emissions was initially conducted.

2. Conduct of a hot start EPA 1200 second transient cycle no emission measurements) followed by an official engine MAP measurement of maximum engine power over the speed range with the reference fuel was conducted (this conditioning protocol was used and recorded prior to every fuel change and at the beginning of each test day – however, only the original reference fuel engine performance MAP was normalized and used in all subsequent emission testing).

3. Triplicate hot-start EPA transient cycle emission tests were conducted and repeated a second day using the reference fuel to obtain the baseline comparison data (a total of six baseline reference tests).

4. Upon completion of the reference fuel testing triplicate EPA transient cycle data were obtained with the candidate fuel only.

5. The Viscon polymer additive was then mixed with the candidate fuel by the client and the engine was operated for 70 hours over a representative load cycle to condition the engine with the Viscon treated candidate fuel – abbreviated measurement of emissions during this conditioning operation (not reported here) were conducted periodically to monitor the change in emissions.

6. Triplicate official hot-start EPA transient cycle emission tests operating with the Viscon treated candidate fuel were conducted each day for three separate days (nine tests total) to provide the final average data for comparison to the original six test average conducted with the baseline reference fuel.

7. Finally, immediately after completion of the testing with the Viscon treated fuel, (with no engine operation in between) triplicate hot-start EPA transient cycle emission tests were conducted with the reference fuel only to obtain some measure of residual emission effects caused by the Viscon treated candidate fuel.

Test Results

All of the exhaust emission test data accumulated in this project are chronologically listed in the Table 1 Summary in accordance with the TCEQ requirements. Table 1A summarizes the calculated changes in emissions between the Viscon treated candidate fuel and the tolerance adjusted TxLed reference fuel. Test validation criteria regression results for each test calculated in accordance with CFR 40 Part 86 Sec. 1341-90 are provided in Table 2. Detailed individual test results and engine MAPS are provided in the Appendix.

Discussion of Results:

The primary objective of this project was to demonstrate equivalency (or better) when comparing the Viscon treated candidate fuel to the TxLed baseline reference fuel under identical test conditions, especially for NOx , PM and fuel consumption. For these variables the Viscon treated candidate fuel was significantly better than the TxLed reference fuel thereby satisfying the TCEQ requirement of equivalency or better.

The TCEQ requirements specify equivalence calculations in a detailed format that uses a calculated tolerance level for the TxLed reference fuel emission results. Measurements of the Viscon treated candidate fuel emissions are then compared to the TxLed reference fuel results after the averages have been adjusted with the calculated tolerance adjustment. Data in Table 1A have been calculated in accordance with the TCEQ specified formulas and the results are summarized as follows:

	------------------Grams/bhp-hr-------------------			
	NOx	**THC**	**NMHC**	**PM**
Viscon treated candidate fuel average (1 oz. to 20 gal.)	4.811	0.1380	0.1040	0.1820
Reference fuel average after tolerance level calculation	5.017	0.1279	0.0616	0.2055
Percent improvement with Viscon treated fuel	**4.1 %**	**- 7.9 %**	**- 68.8 %**	**11.4 %**

In addition to the exhaust emission results the average fuel economy as measured gravimetrically was improved by 4.9% with the Viscon treated candidate fuel compared to the TxLed reference fuel.

Data variance was measured for every test using the official EPA-CFR calculations for regressions and slope intercept. These data are summarized in Table 2 and are all within EPA specified limits.

Table 1
Summary of Emission Test Data
EPA Transient Cycle Test Protocol
GTAT California
Cummins Model M-11 400HP Diesel Engine
Olson-Ecologic Engine Testing Laboratory

			>>>>>>>>>>>>>>Grams per BHP-HR<<<<<<<<<<<<						lb/bhp-hr	hp-hr
Test No.	**Date**	**Description**	**THC**	**NMHC**	**CO**	**NOx**	**NO**	**CO2**	**PM**	**Fuel**	**Work**
LP Trans 01	6/3/2005	Conditioning and New Map Test									
LP Trans 03	6/3/2005	Test Aborted									
LP Trans 02	6/3/2005	Reference fuel only	0.140	0.079	1.684	5.081	4.638	568.24	0.249	0.3892	26.08
LP Trans 04	6/3/2005	Reference fuel only	0.126	0.067	1.754	4.887	4.437	566.65	0.251	0.3719	26.06
LP Trans 05	6/3/2005	Reference fuel only	0.109	0.046	1.703	4.989	4.555	565.98	0.221	0.3750	26.04
LP Trans 06	6/4/2005	Reference fuel only	0.124	0.064	1.660	5.139	4.749	569.23	0.153	0.3778	26.09
LP Trans 07	6/4/2005	Reference fuel only	0.127	0.060	1.652	4.998	4.629	561.29	0.186	0.3777	26.08
LP Trans 08	6/4/2005	Reference fuel only	0.162	0.096	1.463	5.146	4.674	566.35	0.219	0.3775	26.07
		Average	**0.131**	**0.069**	**1.653**	**5.040**	**4.614**	**566.29**	**0.213**	**0.3782**	**26.07**
		Standard Deviation	0.016	0.016	0.091	0.092	0.098	2.506	0.035	0.005	0.016
		95% Conf. Limit	0.013	0.013	0.073	0.073	0.078	2.005	0.028	0.004	0.013
	6/9/2005	Conditioning and New Map Test									
LP Trans 20	6/9/2005	Candidate Fuel	0.174	0.103	1.491	5.482	5.031	570.47	0.257	0.3630	27.66
LP Trans 21	6/9/2005	Candidate Fuel	0.159	0.066	1.816	5.259	4.927	582.60	0.305	0.3731	26.02
LP Trans 22	6/9/2005	Candidate Fuel	0.093	0.023	1.594	5.431	5.001	571.96	0.201	0.3683	26.08
		Average	**0.142**	**0.064**	**1.634**	**5.391**	**4.986**	**575.01**	**0.254**	**0.3681**	**26.59**
		Standard Deviation	0.043	0.040	0.166	0.117	0.054	6.615	0.052	0.005	0.930
		95% Conf. Limit	0.049	0.046	0.188	0.132	0.061	7.486	0.059	0.006	1.052
	6/28/2005	Conditioning and New Map Test									
LP Trans 45	6/28/2005	Cand. w/ Viscon	0.158	0.124	1.743	4.881	4.587	531.61	0.205	0.3501	26.18
LP Trans 46	6/28/2005	Cand. w/ Viscon	0.136	0.102	1.540	4.952	4.582	527.23	0.166	0.3565	26.16
LP Trans 47	6/28/2005	Cand. w/ Viscon	0.123	0.088	1.729	4.819	4.468	542.76	0.170	0.3593	26.10
LP Trans 48	6/28/2005	Conditioning and New Map Test									
LP Trans 49	6/28/2005	Cand. w/ Viscon	0.140	0.106	1.753	5.098	4.660	554.38	0.183	0.3668	26.11
LP Trans 50	6/28/2005	Cand. w/ Viscon	0.145	0.114	1.603	4.684	4.367	556.07	0.184	0.3615	26.10
LP Trans 51	6/28/2005	Cand. w/ Viscon	0.143	0.109	1.780	4.936	4.479	546.96	0.200	0.3602	26.11
LP Trans 54	6/29/2005	Conditioning and New Map Test									
LP Trans 55	6/29/2005	Cand. w/ Viscon	0.113	0.081	1.655	4.788	4.283	541.17	0.200	0.3604	26.13
LP Trans 56	6/29/2005	Cand. w/ Viscon	0.137	0.103	1.876	4.492	4.226	541.12	0.160	0.3610	26.13
LP Trans 57	6/29/2005	Cand. w/ Viscon	0.143	0.107	1.560	4.654	4.308	548.66	0.167	0.3614	26.14
		Average	**0.138**	**0.104**	**1.693**	**4.811**	**4.440**	**543.33**	**0.182**	**0.3597**	**26.13**
		Standard Deviation	0.012	0.012	0.105	0.172	0.144	9.021	0.016	0.004	0.027
		95% Conf. Limit	0.008	0.008	0.069	0.112	0.094	5.894	0.010	0.003	0.018
LP Trans 58	6/29/2005	Conditioning and New Map Test									
LP Trans 59	6/29/2005	Reference Fuel Only	0.119	0.087	1.757	4.988	4.654	544.08	0.202	0.3592	26.11
LP Trans 60	6/29/2005	Reference Fuel Only	0.080	0.045	1.754	4.899	4.581	547.54	0.201	0.3594	26.13
LP Trans 61	6/29/2005	Reference Fuel Only	0.171	0.134	1.577	5.069	4.604	543.70	0.185	0.3602	26.11
		Average	**0.123**	**0.089**	**1.696**	**4.985**	**4.613**	**545.11**	**0.196**	**0.3596**	**26.12**
		Standard Deviation	0.046	0.044	0.103	0.085	0.037	2.118	0.010	0.0005	0.013
		95% Conf. Limit	0.052	0.050	0.117	0.096	0.042	2.397	0.011	0.001	0.015

Table 1A

TxLED Alternative Diesel Fuel Formulation Test Data Comparison Calculations

GTAT California

2000 Cummins Model M-11 400 hp Test Engine
Olson-Ecologic Engine Testing Laboratory
All Emission Data are in gms/bhp-hr

Average emissions during testing with the treated candidate fuel

		Untreated Candidate Fuel		HD Engine Emission	
	Average	**Average**	**Percent Change**	**Standard**	**Percent of Standard**
NOx	4.811	5.391	11%	4.0	120%
THC	0.138	0.142	3%	1.3	11%
NMHC	0.104	0.064	-63%		
PM	0.182	0.254	28%	0.25	73%

Average emissions during testing with the reference fuel

		Untreated Candidate Fuel		HD Engine Emission	
	Average	**Average**	**Percent Change**	**Standard**	**Percent of Standard**
NOx	5.04	5.391	7%	4.0	126%
THC	0.131	0.142	8%	1.3	10%
NMHC	0.069	0.064	-8%		
PM	0.213	0.254	16%	0.25	85%

Pooled Standard Deviation:

NOx	0.189787274
THC	0.014906694
NMHC	0.022729674
PM	0.030508703

Number of Tests of candidate and reference fuels: 15

Comparison Results	**NOx**	**THC**	**NMHC**	**PM**
Candidate Fuel Average- as tested	**4.8110**	**0.1380**	**0.1040**	**0.1820**
Reference Fuel Average - as tested	**5.0400**	**0.1310**	**0.0690**	**0.2130**
Tolerance Level	0.0504	0.0026	0.0014	0.0043
Pooled Standard Deviation	0.1898	0.0149	0.0227	0.0305
Sqrt of 2/n	0.3651	0.3651	0.3651	0.3651
t(a,2n-2)	1.0560	1.0560	1.0560	1.0560
Reference Fuel Average - as calculated	**5.0172**	**0.1279**	**0.0616**	**0.2055**
Percent Difference from Reference Fuel	**4.1%**	**-7.9%**	**-68.8%**	**11.4%**
**negative value = greater emissions*				

1370 South Acacia Avenue, Fullerton, California 92831
Tel (714) 774-3385 Fax (714) 774-4036
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Table 2

Regression Results

GTAT California

E.P.A. Hot Start Transient Cycle Emissions Tests

From CFR 40 Part 86 Sec. 86.1341-90 Test cycle validation criteria

	TEST 2 SLOPE	TEST 2 Y.INT.	TEST 4 SLOPE	TEST 4 Y.INT.	TEST 5 SLOPE	TEST 5 Y.INT.	TEST 6 SLOPE	TEST 6 Y.INT.	TEST 7 SLOPE	TEST 7 Y.INT.
HP.	0.9783	0.0894	0.9792	0.069	0.9788	-0.0563	0.9785	0.103	0.9786	0.0766
RPM.	0.9906	11.5262	0.9906	11.6004	0.9905	11.6798	0.9846	19.5754	0.9846	19.5699
TORQUE.	0.9712	2.2145	0.9723	1.3589	0.9729	1.0426	0.9714	1.4061	0.9712	1.4909

	TEST 8 SLOPE	TEST 8 Y.INT.	TEST 20 SLOPE	TEST 20 Y.INT.	TEST 21 SLOPE	TEST 21 Y.INT.	TEST 22 SLOPE	TEST 22 Y.INT.	TEST 45 SLOPE	TEST 45 Y.INT.
HP.	0.98	0.0425	0.9785	-0.0439	0.9797	0.0685	0.9805	0.0766	0.9789	0.1267
RPM.	0.9848	19.3713	0.9905	11.7319	0.9904	11.8002	0.9904	11.7338	0.9847	19.4636
TORQUE.	0.9725	1.4933	0.9731	1.2334	0.9756	0.942	0.9764	0.6994	0.9755	1.1877

	TEST 46 SLOPE	TEST 46 Y.INT.	TEST 47 SLOPE	TEST 47 Y.INT.	TEST 49 SLOPE	TEST 49 Y.INT.	TEST 50 SLOPE	TEST 50 Y.INT.	TEST 51 SLOPE	TEST 51 Y.INT.
HP.	0.9808	0.1007	0.9802	0.0166	0.9803	0.0596	0.9812	0.0145	0.9812	0.0413
RPM.	0.9905	11.7065	0.9906	11.5914	0.9905	11.6599	0.9906	11.6141	0.9905	11.6455
TORQUE.	0.9764	1.3898	0.9762	1.0802	0.9764	1.3284	0.9763	1.3735	0.9762	1.3723

	TEST 55 SLOPE	TEST 55 Y.INT.	TEST 56 SLOPE	TEST 56 Y.INT.	TEST 57 SLOPE	TEST 57 Y.INT.	TEST 59 SLOPE	TEST 59 Y.INT.	TEST 60 SLOPE	TEST 60 Y.INT.
HP.	0.9807	0.0613	0.9801	0.1436	0.9799	0.1521	0.9809	-0.089	0.9805	-0.0201
RPM.	0.9848	19.3864	0.9905	11.6086	0.9905	11.7368	0.9905	11.6825	0.9905	11.6426
TORQUE.	0.9758	1.3358	0.9752	1.3126	0.9751	1.1318	0.9753	1.2286	0.9749	1.4877

	TEST 61 SLOPE	TEST 61 Y.INT.
HP.	0.9809	-0.0237
RPM.	0.9905	11.7039
TORQUE.	0.9755	1.1318

	Speed	Torque	BHP
Regression Line Tolerances			
Petroleum-fueled and methanol-fueled diesel engines			
Standard error of estimate (SE) of Y on X	100 rpm	13 pct. of power map maximum engine torque	8 pct. of power map maximum BHP.
Slope of the regression line, m	0.970 to 1.030	0.83–1.03 (hot), 0.77–1.03 (cold)	0.89–1.03 (hot), 0.87–1.03 (cold).
Coefficient of determination, r^2	[1] 0.9700	[1] 0.8800 (hot), [1] 0.8500 (cold)	[1] 0.9100.
Y intercept of the regression line, b	50 rpm	15 ft-lb	5.0
Gasoline-fueled and methanol-fueled Otto-cycle engines			
Standard error of estimate (SE) of Y on X	100 rpm	10% (hot), 11% (cold) of power map max. engine torque.	5% (hot), 6% (cold) of power map maximum BHP.
Slope of the regression line, m	0.980 to 1.020	0.92–1.03 (hot), 0.88–1.03 (cold)	0.93–1.03 (hot), 0.89–1.03 (cold).
Coefficient of determination, r^2	[1] 0.9700	[1] 0.9300 (hot), [1] 0.9000 (cold)	[1] 0.9400 (hot), [1] 0.9300 (cold).
Y intercept of the regression line, b	25 (hot), 40 (cold)	4% (hot), 5 (cold) of power map max. engine torque.	2.0% (hot), 2.5% (cold) of power map BHP.

[1] Minimum.

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www.ecologiclabs.com

APPENDIX

Table of Contents

1. ISO 9001:2000 Certificate
2. CARB List of Recognized Labs and CARB Letter of Approval
3. Test Engine Report and Specifications
4. Test Fuel Specifications
5. Engine MAPS
6. Individual Test Results
7. EPA email (Jim Caldwell) specifying that Viscon is not subject to the registration requirements for a fuel additive at 40 CFR 79
8. Viscon technical data for diesel applications and MSDS information

UNE DIVISION DU GROUPE CSA

QMI
90 Burnhamthorpe Ouest, Suite 300
Mississauga, Ontario, Canada L5B 3C3
Téléphone: (905) 272-3920
Télécopieur: (905) 272-3942

CERTIFICAT D'ENREGISTREMENT

QMI issues this certificate to:

Olson-ECOlogic Engine Testing Laboratories, LLC

1370 South Acacia Avenue
Fullerton, California
92831 USA

which has demonstrated that its Quality Management System is in compliance with:

ISO 9001:2000

The following scope of registration applies:

Engine and Vehicle Testing.

** Further clarification regarding the scope of this certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting this organization*

Certificate Number:	**013357**
SIC Number:	**8734**
Date of Original Registration:	**July 1, 2003**
Date of Current Registration:	**July 1, 2003**

ANSI-RAB ACCREDITED QMS

ema entidad mexicana de acreditación, a.c.
Number of assigned accreditation No 19/02
Accreditation validity 2002/12/20

QMI REGISTERED MANAGEMENT SYSTEM

Wendy J. Tilford
President

INDEPENDENT LABORATORIES EQUIPPED TO CONDUCT EXHAUST/EVAPORATIVE EMISSIONS TESTS

While the California Air Resources Board (ARB) does not currently approve laboratories for compliance testing, certain independent commercial laboratories have become accepted, based on information submitted to the ARB, as being properly equipped to perform specialized tests, in accordance with applicable Federal and California test procedures. Their equipment is similar or equivalent to that used at the Haagen-Smit Laboratory. However, these private laboratories are neither inspected nor supervised by the ARB to determine if candidate devices for Vehicle Code (VC) Section 27156 exemption are tested in strict adherence to ARB's test letter and relevant test procedures. For this reason, ARB relies on confirmatory tests conducted at its Haagen-Smit Laboratory for a final determination of the emission performance of add-on devices. Listed below are several such commercial laboratories.

Laboratory Name	Location Address	Contact Personnel	Telephone	Special Testing Capabilities	Comments
Arizona					
Automotive Testing Laboratory, Inc.	263 S. Mulberry Street Mesa, AZ 85202	Mr. Dennis McClement	(480) 649-7906	Enhance Evap. Emission test SFTP-US06, AC2 (alternative)	
California					
Automobile Club of Southern California – Automotive Research Center	1577 S. Valley Vista Dr. Diamond Bar, CA 91765	Mr. Steve Mazor	(909) 612-2560	SFTP – US06, AC2 (alternative)	
Automotive Testing & Development Services, Inc. (ATDS)	400 S. Etiwanda Avenue Ontario, CA 91761	Mr. Linwood Farmer	(909) 390-1100	SFTP-US06, Enhanced Evap. Emission test, Diesel vehicle test, Motorcycle test	
California Analytical Instrument Corp. (CAI)	1238 West Grove Ave Orange, CA 92665	Mr. Pete Furton	(714) 974-5560	Enhanced Evap. Emission test	
California Environmental Engineering (CEE)	3231 S. Birch Street Santa Ana, CA 92707	Mr. Joe Jones	(714) 545-9822	Diesel vehicles, motorcycles, & CNG/LPG vehicles, Enhanced Evap., SORE emission test	Engine Dyno 13-Mode Steady-State test is available, if required
Center for Environmental Research & Technology (CE-CERT)	University of California, Riverside 1084 Columbia Ave Riverside, CA 92507	Mr. Dave Martis	(909) 781-5737	SFTP – US06, AC2 (alternative)	
Olson-Ecologic Engine Testing Laboratories, LLC.	1370 South Acacia Ave Fullerton, CA 92831	Mr. Donel R. Olson	(714) 774-3385	Heavy-duty diesel engine transient test, SORE emission test, CVS-75 FTP on LDVs/MDVs & motorcycles (including CNG/LPG vehicles)	Engine Dyno 13-Mode Steady-State test is available, if required
Edelbrock Corporation – Emissions Laboratory	2700 California Street P.O. Box 2936 Torrance, CA 90503	Mr. Jack Mayberry	(310) 781-2222		
Mercedes-Benz Service Corporation – Los Angeles Technology Center	4035 Via Oro Avenue Long Beach, CA 90803	Mr. Kenneth Griggs	(310) 549-7600	SFTP-US06	
Northern Calif. Diagnostic Lab., Inc.	2748 Jefferson Street Napa, CA 94558	Mr. Mike Spencer-Smith	(707) 258-1753	Motorcycle test	
Quantum Technologies Emissions Laboratory	25242 Arctic Ocean Dr. Lake Forest, CA 92630	Mr. David Carson Dcarson@qtww.com	(949) 930-3476	SFTP-US06, AC2 (alternative)	
University of California Riverside Veh. Emissions Research Lab	1200 Columbia Ave Riverside, CA 92507	Mr. Dave Martis	(909) 781-5737	Diesel vehicle test	
Colorado					
Colorado Inst. For Fuel & High Altitude Eng. Research – Colorado School of Mines	1500 Illinois Street Golden, CO 80401-1887	Mr. Michael S. Graboski	(303) 273-3973	Heavy-duty Engine Dyno test Diesel vehicle test	
Environmental Testing Corp	1859 Jasper Street Aurora, CO 80011	Mr. Bob Begue	(303) 344-5470	Diesel vehicle test	
National Center for Veh. Emissions Control & Safety-Dept of Industrial Sciences	Colorado State University Fort Collins, CO 80523	Ms. Birgit H. Wolff	(303) 491-7240		

Air Resources Board

Alan C. Lloyd, Ph.D.
Agency Secretary

9480 Telstar Avenue, Suite 4
El Monte, California 91731 www.arb.ca.gov

Arnold Schwarzenegger
Governor

Reference No. A-2005-079

April 13, 2005

Mr. Donel R. Olson, President
Olson-Ecologic Engine Testing Laboratories, LLC
1370 South Acacia Avenue
Fullerton, CA 92831

Dear Mr. Olson:

This is in response to your letter dated March 29, 2005, regarding your request for the Air Resources Board (ARB) to amend its list of independent laboratories in order to update the testing capabilities of Olson-Ecologic Engine Testing Laboratories, LLC (Olson-Ecologic). Specifically, you would like the list to show that Olsen-Ecologic is now capable of performing transient heavy-duty diesel engine testing and emission testing on small off-road engines (SORE).

Based on the information you provided, we have amended the list of independent laboratories (see enclosed) to include transient heavy-duty diesel engine testing and SORE emission testing on Olson-Ecologic's testing capabilities.

Please be reminded that the list of independent laboratories is maintained solely for the purpose of providing Vehicle Code Section 27156 exemption applicants with laboratories that could perform proper emissions testing for aftermarket parts evaluation. Inclusion of a laboratory on the list is not an approval or accreditation of the laboratory by ARB, nor does it guarantee acceptance in any special test projects run by ARB. The laboratory must qualify for participation based on specific criteria set for the project.

If you have any questions regarding this letter, please contact Mr. Paul Betterman, staff engineer, Aftermarket Parts Section, at (626) 575-6778.

Sincerely,

Allen Lyons, Chief
Mobile Source Operations Division

Enclosure

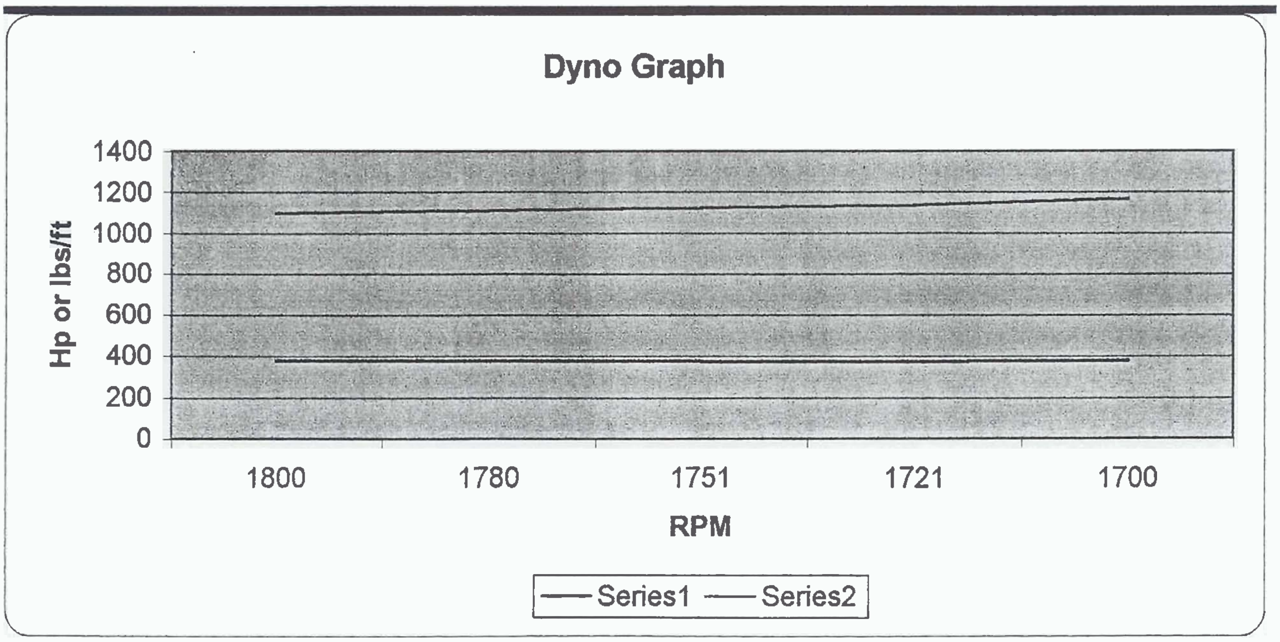
Valley Truck Parts & Equipment
3395 E Malaga Ave
Fresno, CA 93725

Dynomometer Test Report

Technician	SAMMY
Date:	4/27/05 14:43
Customer:	VTP
Order #:	S83022
Engine:	CUM.M11-400E+
CPL:	2037
Serial #:	34989531
HP:	400@1800

Description	Half Load	Full Load
Engine RPM	0	1680
Torque	0	1250
Horsepower	0	400
Oil Pressure (Idle)	0	35
Oil Pressure (Full)	0	42
Water Temperature	0	180
Blow-By	0 4"	

Total Miles N/A
Accessories 0
Rod Bearings: NEW STD.
Main Bearings: NEW STD.
Cam: NEW
Comments: Ran engine on dyno for one hour.Engine had 4" of blowby ran at 185degrees water temp.Had 400 horsepower at 1250 foot pounds of torque 1680 RPM.Engine was a V.T.P. overhaul



VALERO MARKETING AND SUPPLY COMPANY

Ultra Low Sulfur Diesel
Date: June 8, 2005
Sample: Tank 304 sample from Valero Three Rivers Texas
Sample Date: May 25, 2005
Test Results per BSI Inspectorate, Los Angeles, Lab # LAC05-8736

Prepared by: Calvin Morgan, Loss Control Manager.

Sample meets specifications for 2-D-S15 Diesel under ASTM D-975-04

TEST	UNITS	METHOD	RESULTS	SPECS
Flash Point	°C	D-93	86.8	52 min
Water & Sediment	%vol	D-1796	<0.025	0.05 max
Distillation:	°C	D-86		
I.B.P.			207.4	
10% Rec.			230.4	
50% Rec.			262.5	
90% Rec.			307.8	282-338°C
FBP			336	
Residue			0.7	
Loss			0.4	
Viscosity @40°C	cst	D-445	3.059	1.9 - 4.1
Ash	%wt	D-482	<0.001	0.01 max
Sulfur	ppm	D-5453	<1	15 max
Copper Strip Corrosion	rating	D-130	1A	No. 3 max
Cetane Index		D-4737	49.2	40 min
Cloud Point	°C	D-2500	< -21	
Carbon Residue 10%	%wt	D-524	<0.1	0.35 max
Lubricity, HFRR @60°C	micron	D-6079	291	520 max

Sample meets TxLED Regulations Rule §144.315(c)(3)

TEST	UNITS	METHOD	RESULTS	SPECS
Sulfur	ppm	D-5453	<1	15 max
Total Aromatic Hydrocarbon	%vol	D-5186	8.6	10 max
Polycyclic Aromatic Hydrocarbon	%wt	D-5186	0.6	1.4 max
Nitrogen	ppm	D-4629	9	10 max
Cetane Number		D-613	52.8	48 min
API Graivity Index		D-287	36.7	33-39
Viscosity @40°C	cst	D-445	3.059	2.0 - 4.1
Flash Point	°F	D-93	188.3	130 min
Distillation:	°F	D-86		
I.B.P.			405.3	340 - 420
10% Rec.			446.7	400 - 490
50% Rec.			504.6	470 - 560
90% Rec.			586.1	550 - 610
End Point			636.8	580 - 660

BSI INSPECTORATE

CERTIFICATE OF ANALYSIS

JOB NO.	115976
LAB NO.	LAC05-8736

VESSEL	SAMPLING AND ANALYSIS	REPORT DATE	06/03/05
PRODUCT	ULTRA LOW SULFUR DIESEL		
TERMINAL/PORT	OLSSON - ECOLOGIC		
SAMPLE FROM	TANK 304	DATE SAMPLED	06/02/05
SAMPLE SUBMITTED BY	BSI INSPECTORATE		
ANALYSIS PERFORMED BY	BSI INSPECTORATE		
CLIENT(S) REF.	198501		

TEST	METHOD REFERENCED		RESULTS
GRAVITY, API	D-287		36.7
VISCOSITY AT 40 DEG C. cst	D-445-01		3.059
SULFUR, PPM	D5453		<1
FLASH DEG F PMCC	D-93-00B		188.3
CLOUD POINT DEG C	D-2500		<-21
SEDIMENT & WATER VOL. %	D-1796-97		<0.025
COPPER STRIP 3 HRS. @ 50 DEG. C	D-130		1A
AROMATICS , SFC , WT% / VOL%	D-5186		7.9 / 8.6
PNA IN DIESEL, SFC , WT%	D-5186		0.6
CETANE INDEX	D-4737		49.2
CETANE NUMBER	D-613		52.8
CARBON RESIDUE , MCRT , WT% (10% BTMS)	D-4530		<0.1
RAMSBOTTOM , BY CORRELATION, WT% (10 % BTMS)	D-524		<0.1
NITROGEN CONTENT, TOTAL , PPM	D-4629		9
ASH CONTENT , WT%	D-482		<0.001
LUBRICITY, UM	D-6079		291
DISTILLATION , DEG. F.	D-86	I.B.P.	405.3
		10% REC.	446.7
		50% REC.	504.6
		90% REC.	586.1
		95% REC.	609.5
		F.B.P.	636.8
		RES.	0.7
		LOSS	0.4

JH
Q-ANAL
REV #3 -

BSI INSPECTORATE

VALERO MARKETING AND SUPPLY COMPANY

Low Sulfur Diesel
Date: June 8, 2005
Sample: Tank 333 sample from Valero Three Rivers Texas
Sample Date: May 25, 2005
Test Results per BSI Inspectorate, Los Angeles, Lab # LAC05-8737

Prepared by: Calvin Morgan, Loss Control Manager.

Sample meets specifications for 2-D-S500 Diesel under ASTM D-975-04

TEST	UNITS	METHOD	RESULTS	SPECS
Flash Point	°C	D-93	88	52 min
Water & Sediment	%vol	D-1796	<0.025	0.05 max
Distillation:	°C	D-86		
I.B.P.			194.2	
10% Rec.			229.2	
50% Rec.			269.2	
90% Rec.			314.8	282-338°C
FBP			344.2	
Residue			0.7	
Loss			1.5	
Viscosity @40°C	cst	D-445	3.178	1.9 - 4.1
Ash	%wt	D-482	<0.001	0.01 max
Sulfur	%mass	D-5453	0.0126	0.05 max
Copper Strip Corrosion	rating	D-130	1A	No. 3 max
Cetane Index		D-4737	43.4	40 min
Cloud Point	°C	D-2500	< -21	
Carbon Residue 10%	%wt	D-524	<0.1	0.35 max
Lubricity, HFRR @60°C	micron	D-6079	518	520 max

Sample does not meet TxLED Regulations Rule §144.315(c)(3)

TEST	UNITS	METHOD	RESULTS	SPECS
Sulfur	ppm	D-5453	126	15 max
Total Aromatic Hydrocarbon	%vol	D-5186	29.3	10 max
Polycyclic Aromatic Hydrocarbon	%wt	D-5186	11.0	1.4 max
Nitrogen	ppm	D-4629	29	10 max
Cetane Number		D-613	43.2	48 min
API Graivity Index		D-287	32.3	33-39
Viscosity @40°C	cst	D-445	3.178	2.0 - 4.1
Flash Point	°F	D-93	190.4	130 min
Distillation:	°F	D-86		
I.B.P.			381.5	340 - 420
10% Rec.			444.6	400 - 490
50% Rec.			516.5	470 - 560
90% Rec.			598.7	550 - 610
End Point			651.6	580 - 660

CERTIFICATE OF ANALYSIS

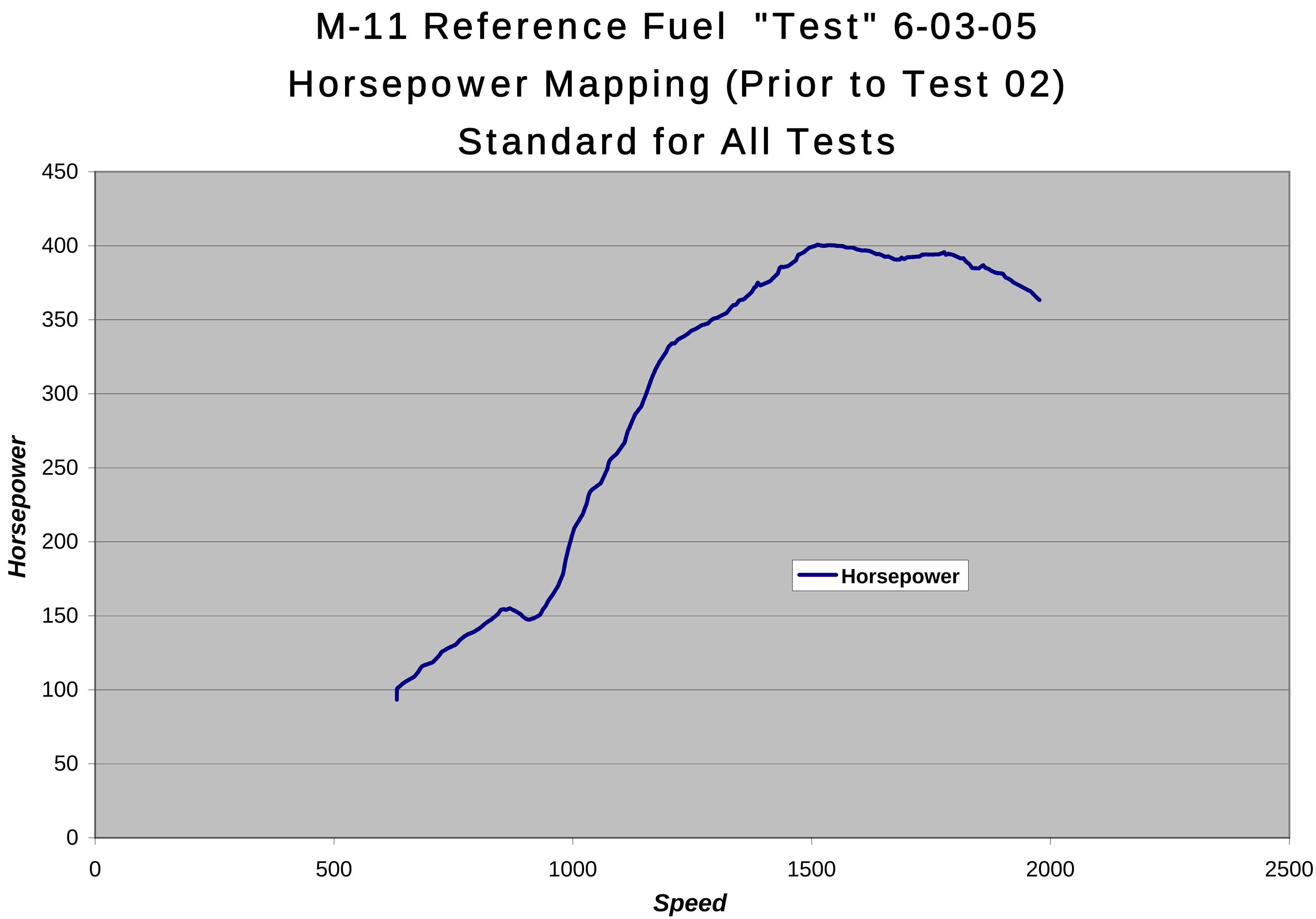
JOB NO.	115976
LAB NO.	LAC05-8737

VESSEL	SAMPLING AND ANALYSIS	REPORT DATE	06/03/05
PRODUCT	LOW SULFUR DIESEL		
TERMINAL/PORT	OLSSON - ECOLOGIC		
SAMPLE FROM	TANK 333	DATE SAMPLED	06/02/05
SAMPLE SUBMITTED BY	BSI INSPECTORATE		
ANALYSIS PERFORMED BY	BSI INSPECTORATE		
CLIENT(S) REF.	198501		

TEST	METHOD REFERENCED	RESULTS	
GRAVITY, API	D-287		32.3
VISCOSITY AT 40 DEG C. cst	D-445-01		3.178
SULFUR, PPM	D-5453		126
FLASH DEG F PMCC	D-93-00B		190.4
CLOUD POINT DEG C	D-2500		<-21
SEDIMENT & WATER VOL. %	D-1796		<0.025
COPPER STRIP 3 HRS. @ 50 DEG. C	D-130		1A
AROMATICS , SFC , WT% / VOL%	D-5186		30.5 / 29.3
PNA IN DIESEL, SFC , WT%	D-5186		11.0
CETANE INDEX	D-4737		43.4
CETANE NUMBER	D-613		43.2
CARBON RESIDUE , MCRT , WT% (10 % BTMS)	D-4530		<0.1
RAMSBOTTOM , BY CORRELATION, WT% (10% BTMS)	D-524		<0.1
NITROGEN CONTENT, TOTAL ,PPM	D-4629		29
ASH CONTENT , WT%	D-482		<0.001
LUBRICITY, UM	D-6079		518
DISTILLATION , DEG. F.	D-86	I.B.P.	381.5
		10% REC.	444.6
		50% REC.	516.5
		90% REC.	598.7
		95% REC.	630.2
		F.B.P.	651.6
		RES.	0.7
		LOSS	1.5

JH
Q-ANAL
REV #3 -

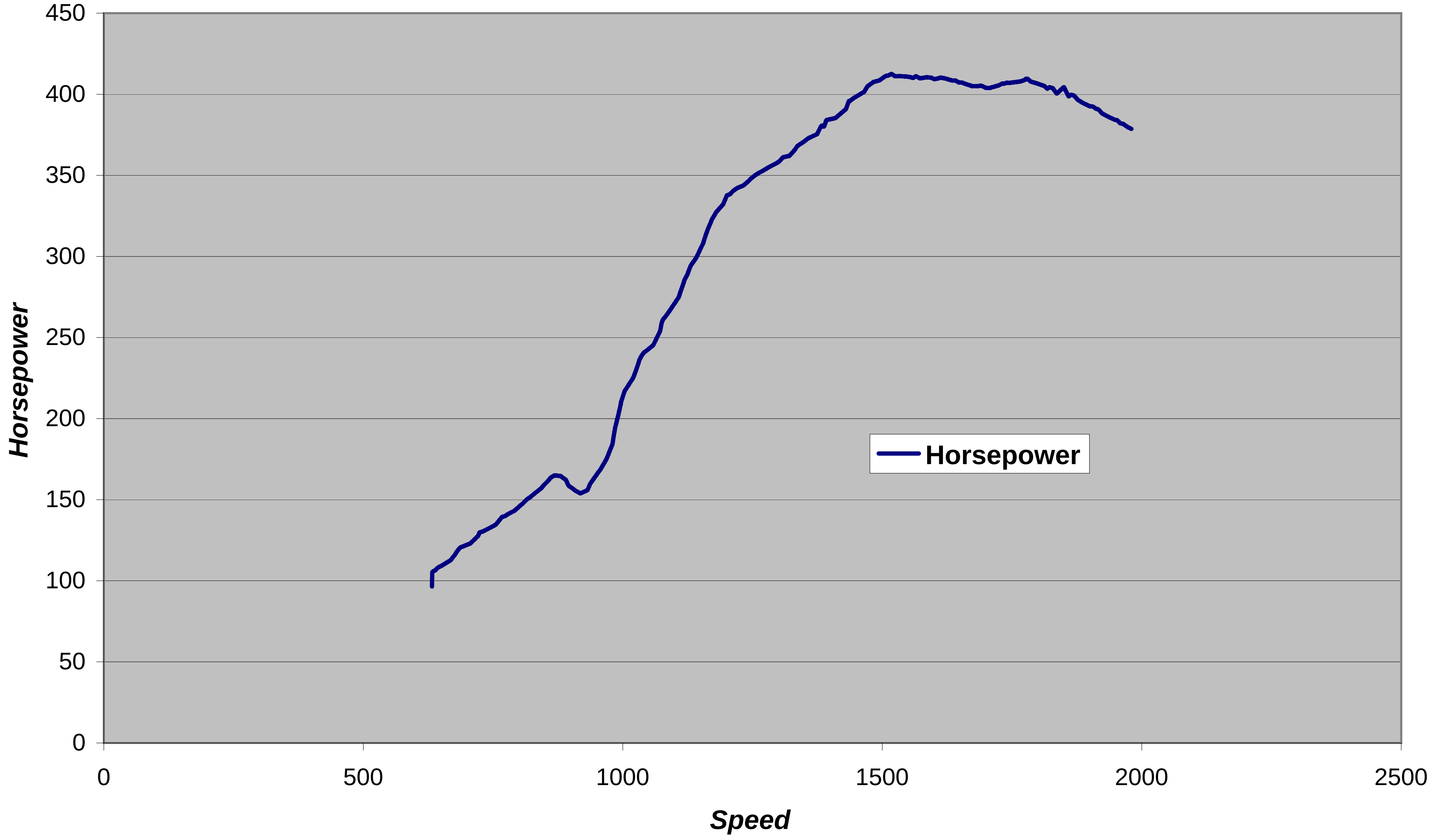
BSI INSPECTORATE

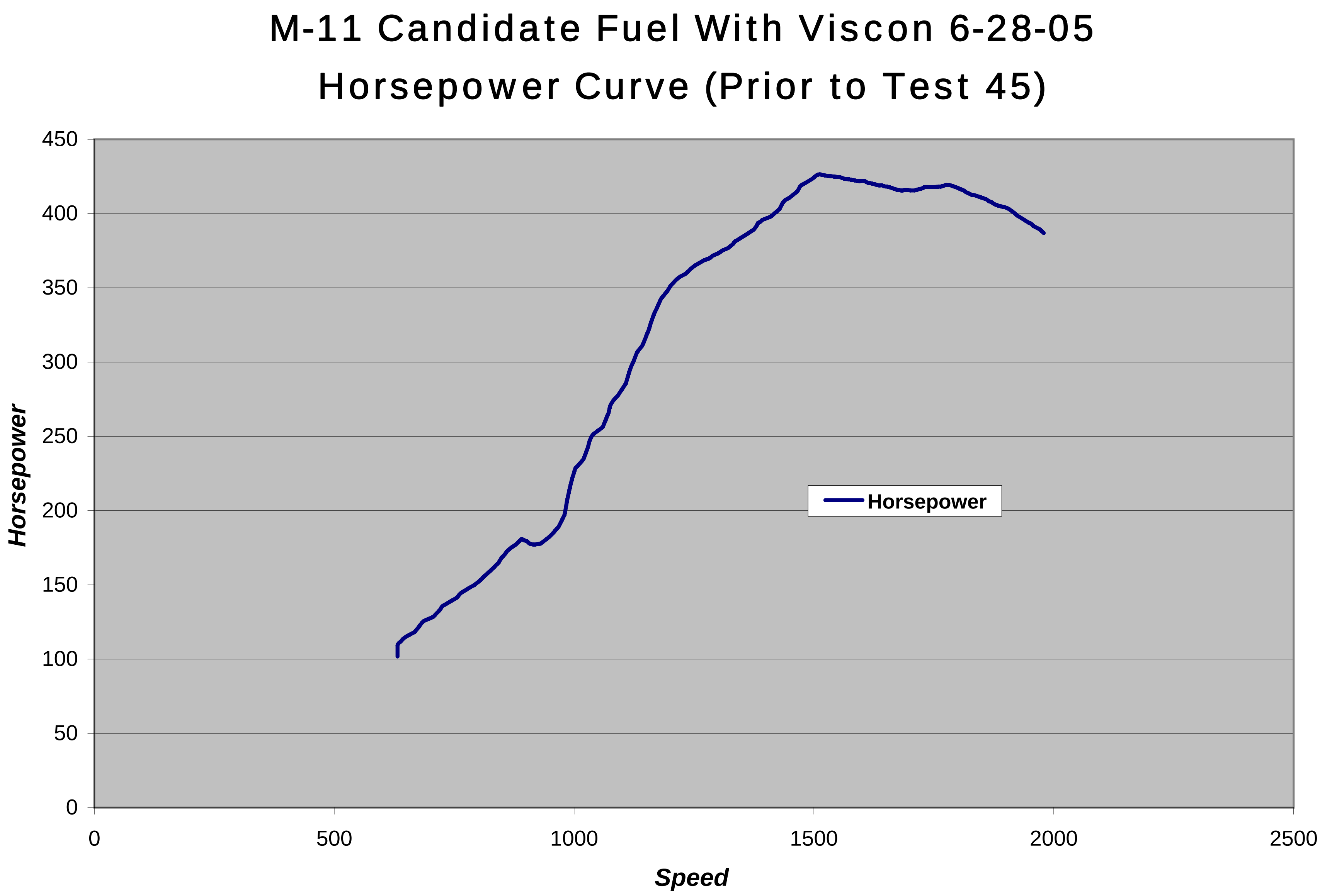


M-11 Reference Fuel "Test" 6-03-05
Horsepower Mapping (Prior to Test 02)
Standard for All Tests
Horsepower
Speed
450
400
350
300
250
200
150
100
50
0
0
500
1000
1500
2000
2500
Horsepower

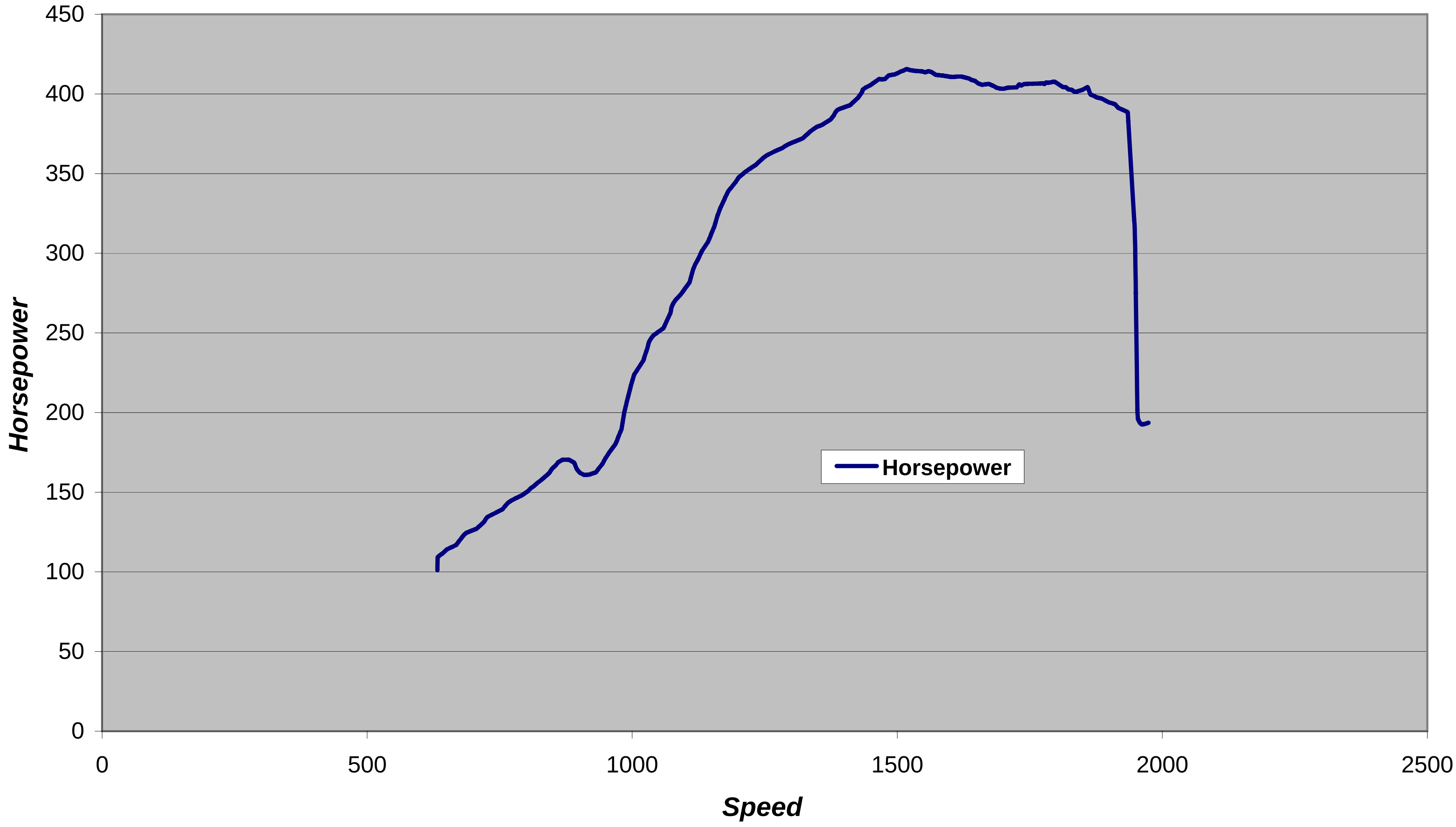
M-11 Reference Fuel 6-04-05
Horsepower Mapping (Prior to Test 06)

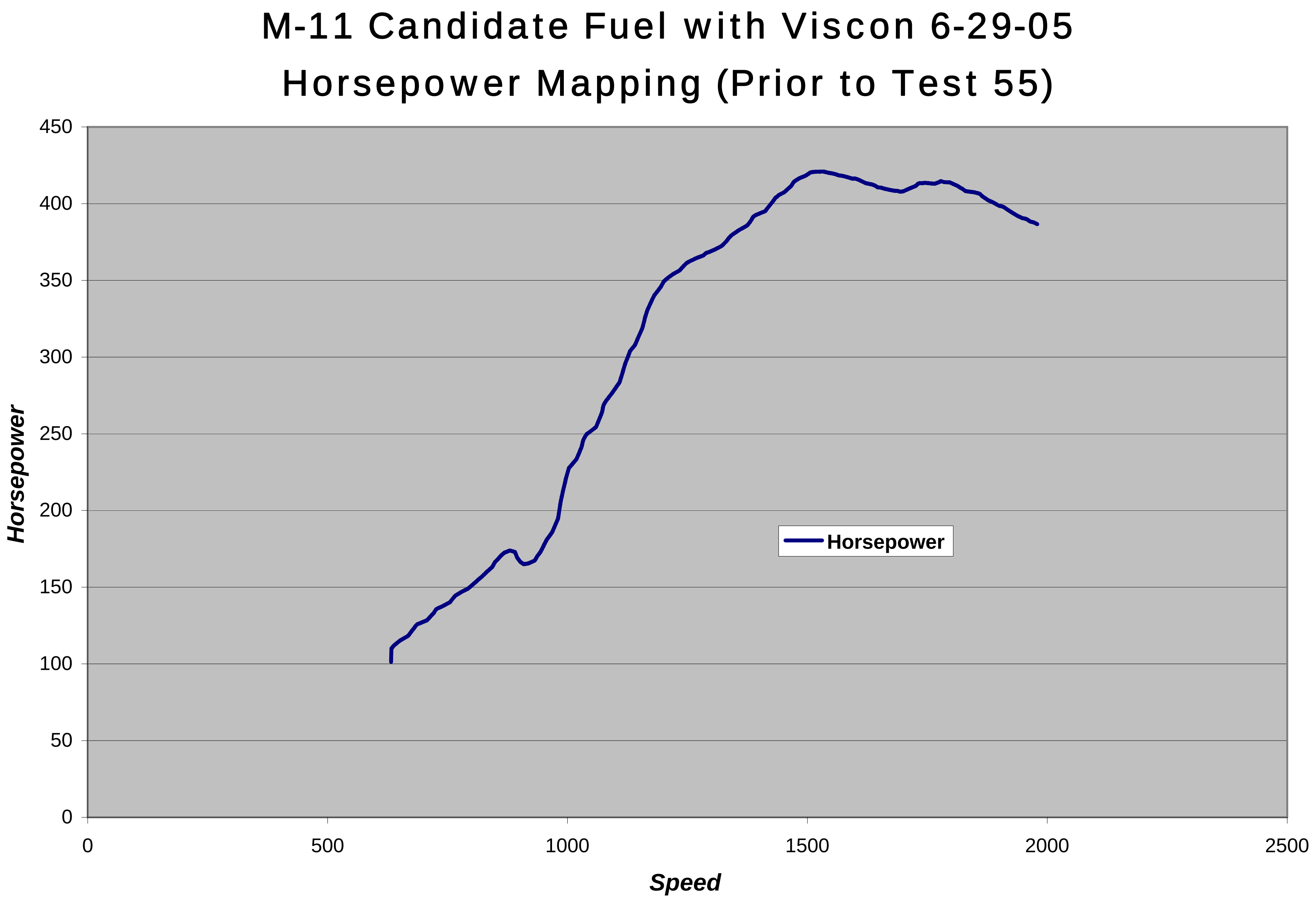
M-11 Candidate Fuel with Viscon 6-09-05
Horsepower Curve (Prior to Test 20)




M-11 Candidate Fuel With Viscon 6-28-05
Horsepower Curve (Prior to Test 45)
Horsepower
450
400
350
300
250
200
150
100
50
0
0
500
1000
1500
2000
2500
Speed
Horsepower

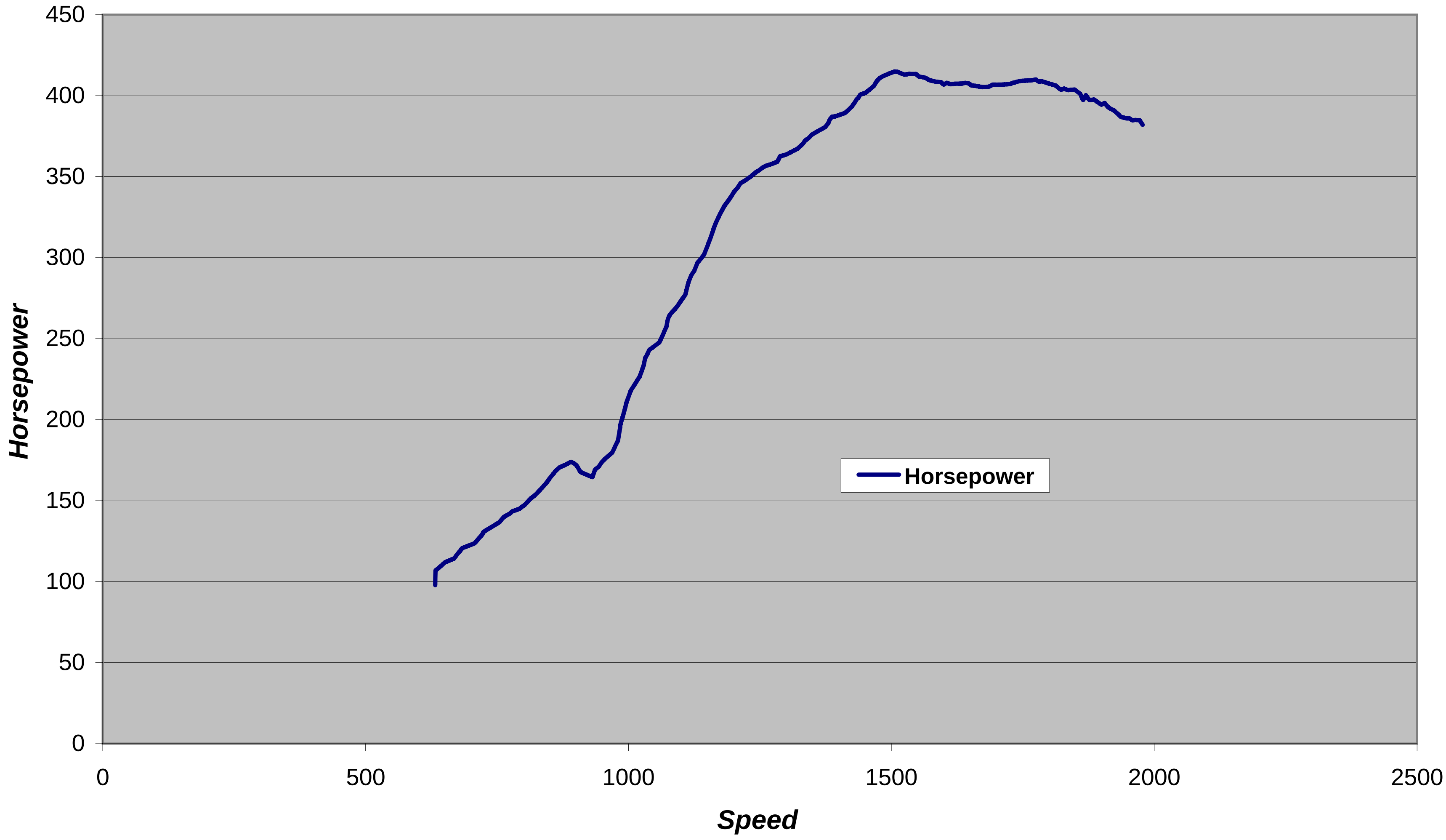
M-11 Candidate Fuel With Viscon II 6-28-05
Horsepower Mapping (Prior to Test 49)





M-11 Candidate Fuel with Viscon 6-29-05
Horsepower Mapping (Prior to Test 55)
Horsepower
Speed
450
400
350
300
250
200
150
100
50
0
0
500
1000
1500
2000
2500
Horsepower

M-11 Reference Fuel 6-29-05
Horsepower Mapping (Prior to Test 59)



Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS02   Phase 1

Test Information

Test ID	LPTRANS02
Date	Fri, Jun 03, 2005
Time	3:06 PM
Fuel Specification	DIESEL
Test Comments:	LAS PALMAS REF.FUEL TRANS.TEST

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.601974	ppm
NOx Bag Conc	33.324459	ppm
NO Bag Conc	27.853804	ppm
CO2 Bag Conc	0.442402	percent
CO Bag Conc	26.723844	ppm
Methane Bag Conc	3.558223	ppm

Bag Background Concentrations

HC Bag Ambient	0.436328	ppm
NOx Bag Ambient	-0.153947	ppm
NO Bag Ambient	0.287121	ppm
CO2 Bag Ambient	0.045000	percent
CO Bag Ambient	8.498626	ppm
Methane Bag Ambient	3.073521	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.159047	ppm
NOx Conc	35.818035	ppm
NO Conc	32.606275	ppm
CO2 Conc	0.402498	percent
CO Conc	18.892626	ppm

Dilution/Engine Air Data

Barometric Pressure	29.824566	inHg
Relative Humidity	38.551407	percent
Engine Inlet Air Temp	79.498166	deg F
Absoute Humidity	57.767642	gr/lb

Mass Emissions

HC Mass	3.654880	grams
NOx Mass	132.501763	grams
NO Mass	120.954320	grams
CO2 Mass	14817.616033	grams
CO Mass	43.905647	grams
Methane Bag Mass	1.580862	grams

Brake Specific Emissions

HC	0.140160	g/bhp-hr
NOx	5.081283	g/bhp-hr
NO	4.638452	g/bhp-hr
CO2	568.237690	g/bhp-hr
CO	1.683729	g/bhp-hr
Non-Methane HC	0.079536	g/bhp-hr

Correction Factors

NOx Humidity CF	0.957798	Kh
Dry to Wet CF	0.987728	Kw
Dilution Factor	108.050839	df

Sample Flow Data

Total Volume (Vmix)	71418.433336	scf
Dilution Flow	64402.262427	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.076440	bhp-hr
Reference Work	24.102550	bhp-hr

Fuel Data

Fuel Usage	4604.500000	grams
BSFC	0.389286	lb/bhp-hr

Particulate	0.249	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:32 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS04 Phase 1

Test Information

Test ID	LPTRANS04
Date	Fri, Jun 03, 2005
Time	5:49 PM
Fuel Specification	DIESEL
Test Comments:	LAS PALMAS REF.FUEL TRANS.TEST

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	2.824722	ppm
NOx Bag Conc	32.899860	ppm
NO Bag Conc	28.017521	ppm
CO2 Bag Conc	0.442858	percent
CO Bag Conc	26.011447	ppm
Methane Bag Conc	4.181793	ppm

Bag Background Concentrations

HC Bag Ambient	1.725096	ppm
NOx Bag Ambient	0.138907	ppm
NO Bag Ambient	0.502581	ppm
CO2 Bag Ambient	0.044718	percent
CO Bag Ambient	7.888850	ppm
Methane Bag Ambient	3.729158	ppm

Integrated Concentrations Corrected for Background

HC Conc	2.874388	ppm
NOx Conc	34.239675	ppm
NO Conc	30.920991	ppm
CO2 Conc	0.401099	percent
CO Conc	19.646913	ppm

Dilution/Engine Air Data

Barometric Pressure	29.724486	inHg
Relative Humidity	40.723153	percent
Engine Inlet Air Temp	78.863592	deg F
Absoute Humidity	60.035467	gr/lb

Mass Emissions

HC Mass	3.288323	grams
NOx Mass	127.373647	grams
NO Mass	115.643652	grams
CO2 Mass	14769.382778	grams
CO Mass	45.724081	grams
Methane Bag Mass	1.553557	grams

Brake Specific Emissions

HC	0.126161	g/bhp-hr
NOx	4.886858	g/bhp-hr
NO	4.436821	g/bhp-hr
CO2	566.646822	g/bhp-hr
CO	1.754265	g/bhp-hr
Non-Methane HC	0.066551	g/bhp-hr

Correction Factors

NOx Humidity CF	0.963269	Kh
Dry to Wet CF	0.987221	Kw
Dilution Factor	109.512416	df

Sample Flow Data

Total Volume (Vmix)	71420.848559	scf
Dilution Flow	64441.226571	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.064529	bhp-hr
Reference Work	24.093032	bhp-hr

Fuel Data

Fuel Usage	4396.500000	grams
BSFC	0.371870	lb/bhp-hr

Particulate	0.251	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:34 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS05 Phase 1

Test Information

Test ID	LPTRANS05
Date	Fri, Jun 03, 2005
Time	7:46 PM
Fuel Specification	DIESEL
Test Comments:	LAS PALMAS REF.FUEL TRANS.TEST

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	2.139144	ppm
NOx Bag Conc	33.922188	ppm
NO Bag Conc	27.956823	ppm
CO2 Bag Conc	0.439334	percent
CO Bag Conc	26.184497	ppm
Methane Bag Conc	3.800169	ppm

Bag Background Concentrations

HC Bag Ambient	1.033651	ppm
NOx Bag Ambient	0.485275	ppm
NO Bag Ambient	0.554677	ppm
CO2 Bag Ambient	0.041930	percent
CO Bag Ambient	7.448219	ppm
Methane Bag Ambient	3.298262	ppm

Integrated Concentrations Corrected for Background

HC Conc	2.478805	ppm
NOx Conc	34.620029	ppm
NO Conc	31.420016	ppm
CO2 Conc	0.400151	percent
CO Conc	19.046661	ppm

Dilution/Engine Air Data

Barometric Pressure	29.724486	inHg
Relative Humidity	48.821019	percent
Engine Inlet Air Temp	75.074465	deg F
Absoute Humidity	63.499041	gr/lb

Mass Emissions

HC Mass	2.848369	grams
NOx Mass	129.899070	grams
NO Mass	118.604990	grams
CO2 Mass	14737.399535	grams
CO Mass	44.339709	grams
Methane Bag Mass	1.645195	grams

Brake Specific Emissions

HC	0.109390	g/bhp-hr
NOx	4.988685	g/bhp-hr
NO	4.554943	g/bhp-hr
CO2	565.979721	g/bhp-hr
CO	1.702836	g/bhp-hr
Non-Methane	0.046207	g/bhp-hr

Correction Factors

NOx Humidity CF	0.971675	Kh
Dry to Wet CF	0.986448	Kw
Dilution Factor	114.466207	df

Sample Flow Data

Total Volume (Vmix)	71418.117337	scf
Dilution Flow	64460.722748	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.038741	bhp-hr
Reference Work	24.104291	bhp-hr

Fuel Data

Fuel Usage	4429.000000	grams
BSFC	0.374990	lb/bhp-hr

Particulate	0.221	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:35 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS06   Phase 1

Test Information

Test ID	LPTRANS06
Date	Sat, Jun 04, 2005
Time	11:33 AM
Fuel Specification	DIESEL
Test Comments:	LAS PALMAS REF.FUEL TRANS.TEST

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	2.899431	ppm
NOx Bag Conc	33.379402	ppm
NO Bag Conc	27.960699	ppm
CO2 Bag Conc	0.446980	percent
CO Bag Conc	25.871809	ppm
Methane Bag Conc	4.042669	ppm

Bag Background Concentrations

HC Bag Ambient	1.756562	ppm
NOx Bag Ambient	0.036344	ppm
NO Bag Ambient	0.027346	ppm
CO2 Bag Ambient	0.046024	percent
CO Bag Ambient	7.627336	ppm
Methane Bag Ambient	3.586189	ppm

Integrated Concentrations Corrected for Background

HC Conc	2.824007	ppm
NOx Conc	34.843905	ppm
NO Conc	32.187686	ppm
CO2 Conc	0.403396	percent
CO Conc	18.614687	ppm

Dilution/Engine Air Data

Barometric Pressure	29.724486	inHg
Relative Humidity	57.021747	percent
Engine Inlet Air Temp	74.687136	deg F
Absoute Humidity	73.371686	gr/lb

Mass Emissions

HC Mass	3.229030	grams
NOx Mass	134.089332	grams
NO Mass	123.909670	grams
CO2 Mass	14851.000954	grams
CO Mass	43.299689	grams
Methane Bag Mass	1.554190	grams

Brake Specific Emissions

HC	0.123766	g/bhp-hr
NOx	5.139548	g/bhp-hr
NO	4.749369	g/bhp-hr
CO2	569.228186	g/bhp-hr
CO	1.659646	g/bhp-hr
Non-Methane	0.064195	g/bhp-hr

Correction Factors

NOx Humidity CF	0.996470	Kh
Dry to Wet CF	0.984249	Kw
Dilution Factor	106.968275	df

Sample Flow Data

Total Volume (Vmix)	71428.072419	scf
Dilution Flow	64466.629257	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.089715	bhp-hr
Reference Work	24.125953	bhp-hr

Fuel Data

Fuel Usage	4471.000000	grams
BSFC	0.377807	lb/bhp-hr

Particulate	0.153	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:35 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS07 Phase 1

Test Information

Test ID	LPTRANS07
Date	Sat, Jun 04, 2005
Time	12:42 PM
Fuel Specification	DIESEL
Test Comments:	LAS PALMAS REF.FUEL TRANS.TEST

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	2.877134	ppm
NOx Bag Conc	34.187424	ppm
NO Bag Conc	28.439358	ppm
CO2 Bag Conc	0.446916	percent
CO Bag Conc	25.205154	ppm
Methane Bag Conc	4.071627	ppm

Bag Background Concentrations

HC Bag Ambient	1.676271	ppm
NOx Bag Ambient	0.542130	ppm
NO Bag Ambient	0.449581	ppm
CO2 Bag Ambient	0.047213	percent
CO Bag Ambient	7.682533	ppm
Methane Bag Ambient	3.539098	ppm

Integrated Concentrations Corrected for Background

HC Conc	2.895602	ppm
NOx Conc	34.712190	ppm
NO Conc	31.993024	ppm
CO2 Conc	0.397449	percent
CO Conc	18.514717	ppm

Dilution/Engine Air Data

Barometric Pressure	29.724486	inHg
Relative Humidity	54.997958	percent
Engine Inlet Air Temp	71.636763	deg F
Absoute Humidity	63.732143	gr/lb

Mass Emissions

HC Mass	3.314331	grams
NOx Mass	130.348366	grams
NO Mass	120.729336	grams
CO2 Mass	14638.925967	grams
CO Mass	43.087565	grams
Methane Bag Mass	1.754413	grams

Brake Specific Emissions

HC	0.127079	g/bhp-hr
NOx	4.997851	g/bhp-hr
NO	4.629036	g/bhp-hr
CO2	561.289518	g/bhp-hr
CO	1.652075	g/bhp-hr
Non-Methane	0.059811	g/bhp-hr

Correction Factors

NOx Humidity CF	0.972289	Kh
Dry to Wet CF	0.986396	Kw
Dilution Factor	113.679866	df

Sample Flow Data

Total Volume (Vmix)	71417.177078	scf
Dilution Flow	64370.110185	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.080882	bhp-hr
Reference Work	24.121165	bhp-hr

Fuel Data

Fuel Usage	4468.000000	grams
BSFC	0.377681	lb/bhp-hr

Particulate	0.186	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:38 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS08 Phase 1

Test Information

Test ID	LPTRANS08
Date	Sat, Jun 04, 2005
Time	1:51 PM
Fuel Specification	DIESEL
Test Comments:	LAS PALMAS REF.FUEL TRANS.TEST

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	2.210639	ppm
NOx Bag Conc	33.908382	ppm
NO Bag Conc	28.860918	ppm
CO2 Bag Conc	0.442196	percent
CO Bag Conc	25.932428	ppm
Methane Bag Conc	3.852710	ppm

Bag Background Concentrations

HC Bag Ambient	0.951934	ppm
NOx Bag Ambient	-0.072570	ppm
NO Bag Ambient	0.247275	ppm
CO2 Bag Ambient	0.044610	percent
CO Bag Ambient	8.704456	ppm
Methane Bag Ambient	3.322564	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.638907	ppm
NOx Conc	35.636784	ppm
NO Conc	32.287714	ppm
CO2 Conc	0.397338	percent
CO Conc	16.300997	ppm

Dilution/Engine Air Data

Barometric Pressure	29.724486	inHg
Relative Humidity	53.093072	percent
Engine Inlet Air Temp	71.903037	deg F
Absoute Humidity	62.067206	gr/lb

Mass Emissions

HC Mass	4.231084	grams
NOx Mass	134.168745	grams
NO Mass	121.852825	grams
CO2 Mass	14764.750500	grams
CO Mass	38.133558	grams
Methane Bag Mass	1.739059	grams

Brake Specific Emissions

HC	0.162298	g/bhp-hr
NOx	5.146517	g/bhp-hr
NO	4.674096	g/bhp-hr
CO2	566.354211	g/bhp-hr
CO	1.462747	g/bhp-hr
Non-Methane	0.09559	g/bhp-hr

Correction Factors

NOx Humidity CF	0.968176	Kh
Dry to Wet CF	0.986767	Kw
Dilution Factor	112.641607	df

Sample Flow Data

Total Volume (Vmix)	71983.918099	scf
Dilution Flow	64886.421292	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.069817	bhp-hr
Reference Work	24.114332	bhp-hr

Fuel Data

Fuel Usage	4464.000000	grams
BSFC	0.377503	lb/bhp-hr

Particulate	0.219	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:39 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS20   Phase 1

Test Information

Test ID	LPTRANS20
Date	Thu, Jun 09, 2005
Time	11:56 AM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	2.119693	ppm
NOx Bag Conc	40.959324	ppm
NO Bag Conc	34.174927	ppm
CO2 Bag Conc	0.493935	percent
CO Bag Conc	39.047825	ppm
Methane Bag Conc	4.016525	ppm

Bag Background Concentrations

HC Bag Ambient	0.742797	ppm
NOx Bag Ambient	0.076741	ppm
NO Bag Ambient	0.141820	ppm
CO2 Bag Ambient	0.047028	percent
CO Bag Ambient	16.880663	ppm
Methane Bag Ambient	3.414088	ppm

Integrated Concentrations Corrected for Background

HC Conc	4.173564	ppm
NOx Conc	41.309090	ppm
NO Conc	37.858940	ppm
CO2 Conc	0.428527	percent
CO Conc	17.995421	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	42.896805	percent
Engine Inlet Air Temp	74.685384	deg F
Absoute Humidity	54.584765	gr/lb

Mass Emissions

HC Mass	4.823965	grams
NOx Mass	151.658446	grams
NO Mass	139.168735	grams
CO2 Mass	15780.231354	grams
CO Mass	41.240159	grams
Methane Bag Mass	1.965771	grams

Brake Specific Emissions

HC	0.174390	g/bhp-hr
NOx	5.482573	g/bhp-hr
NO	5.031060	g/bhp-hr
CO2	570.467865	g/bhp-hr
CO	1.490864	g/bhp-hr
Non-Methane HC	0.1033	g/bhp-hr

Correction Factors

NOx Humidity CF	0.950279	Kh
Dry to Wet CF	0.988441	Kw
Dilution Factor	103.880950	df

Sample Flow Data

Total Volume (Vmix)	71437.097364	scf
Dilution Flow	64461.731609	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	27.661911	bhp-hr
Reference Work	25.571281	bhp-hr

Fuel Data

Fuel Usage	4554.500000	grams
BSFC	0.362988	lb/bhp-hr

Particulate	0.256	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:40 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS21 Phase 1

Test Information

Test ID	LPTRANS21
Date	Thu, Jun 09, 2005
Time	5:37 PM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	2.368175	ppm
NOx Bag Conc	36.735130	ppm
NO Bag Conc	32.038666	ppm
CO2 Bag Conc	0.458587	percent
CO Bag Conc	30.007247	ppm
Methane Bag Conc	3.627730	ppm

Bag Background Concentrations

HC Bag Ambient	0.605105	ppm
NOx Bag Ambient	0.062468	ppm
NO Bag Ambient	0.384249	ppm
CO2 Bag Ambient	0.044319	percent
CO Bag Ambient	8.467410	ppm
Methane Bag Ambient	2.827934	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.577543	ppm
NOx Conc	37.181885	ppm
NO Conc	34.712537	ppm
CO2 Conc	0.411669	percent
CO Conc	20.315949	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	47.590013	percent
Engine Inlet Air Temp	72.162215	deg F
Absoute Humidity	55.701577	gr/lb

Mass Emissions

HC Mass	4.135472	grams
NOx Mass	136.831486	grams
NO Mass	128.205005	grams
CO2 Mass	15158.593987	grams
CO Mass	47.249910	grams
Methane Bag Mass	2.416614	grams

Brake Specific Emissions

HC	0.158940	g/bhp-hr
NOx	5.258897	g/bhp-hr
NO	4.927352	g/bhp-hr
CO2	582.596073	g/bhp-hr
CO	1.815974	g/bhp-hr
Non-Methane HC	0.0660	g/bhp-hr

Correction Factors

NOx Humidity CF	0.952960	Kh
Dry to Wet CF	0.988191	Kw
Dilution Factor	106.701534	df

Sample Flow Data

Total Volume (Vmix)	71411.669573	scf
Dilution Flow	64478.346451	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.019046	bhp-hr
Reference Work	24.101156	bhp-hr

Fuel Data

Fuel Usage	4403.000000	grams
BSFC	0.373071	lb/bhp-hr

Particulate	0.304	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:41 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS22   Phase 1

Test Information			**Engine Information**		
Test ID	LPTRANS22		Engine Manufacturer	Cummins	
Date	Thu, Jun 09, 2005		Engine Model	M11 400E	
Time	7:34 PM		Engine Serial Number	34989531	
Fuel Specification	DIESEL				
Test Comments:	CANDIDATE FUEL				

Bag Emissions Concentrations			**Bag Background Concentrations**		
HC Bag Conc	1.837237	ppm	HC Bag Ambient	0.615093	ppm
NOx Bag Conc	38.242493	ppm	NOx Bag Ambient	-0.007998	ppm
NO Bag Conc	32.508038	ppm	NO Bag Ambient	0.350623	ppm
CO2 Bag Conc	0.452355	percent	CO2 Bag Ambient	0.043771	percent
CO Bag Conc	28.418339	ppm	CO Bag Ambient	9.799233	ppm
Methane Bag Conc	3.500378	ppm	Methane Bag Ambient	2.918870	ppm

Integrated Concentrations Corrected for Background			**Dilution/Engine Air Data**		
HC Conc	2.104980	ppm	Barometric Pressure	29.924649	inHg
NOx Conc	39.556453	ppm	Relative Humidity	40.960499	percent
NO Conc	36.312680	ppm	Engine Inlet Air Temp	69.963830	deg F
CO2 Conc	0.404945	percent	Absoute Humidity	44.323140	gr/lb
CO Conc	17.927017	ppm			

Mass Emissions			**Brake Specific Emissions**		
HC Mass	2.426931	grams	HC	0.093057	g/bhp-hr
NOx Mass	141.653238	grams	NOx	5.431484	g/bhp-hr
NO Mass	130.437081	grams	NO	5.001417	g/bhp-hr
CO2 Mass	14916.649859	grams	CO2	571.956836	g/bhp-hr
CO Mass	41.575786	grams	CO	1.594162	g/bhp-hr
Methane Bag Mass	1.834564	grams	Non-Methane HC	0.0227	g/bhp-hr

Correction Factors			**Sample Flow Data**		
NOx Humidity CF	0.926819	Kh	Total Volume (Vmix)	71450.811179	scf
Dry to Wet CF	0.990745	Kw	Dilution Flow	64446.771550	scf
Dilution Factor	110.984275	df			

Test Cycle Data			**Fuel Data**		
Hot-Cold Test	2.000000	1=Cold, 2=Hot	Fuel Usage	4357.000000	grams
Test Time	1213.000000	sec	BSFC	0.368310	lb/bhp-hr
Total Work	26.080027	bhp-hr			
Reference Work	24.101789	bhp-hr			

Particulate	0.200	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:42 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS45   Phase 1

Test Information

Test ID	LPTRANS45
Date	Tue, Jun 28, 2005
Time	9:31 AM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.170845	ppm
NOx Bag Conc	35.179276	ppm
NO Bag Conc	28.075714	ppm
CO2 Bag Conc	0.424538	percent
CO Bag Conc	28.473354	ppm
Methane Bag Conc	3.677748	ppm

Bag Background Concentrations

HC Bag Ambient	-0.480782	ppm
NOx Bag Ambient	0.674172	ppm
NO Bag Ambient	0.053193	ppm
CO2 Bag Ambient	0.044149	percent
CO Bag Ambient	10.010111	ppm
Methane Bag Ambient	3.152554	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.498144	ppm
NOx Conc	34.915343	ppm
NO Conc	32.780026	ppm
CO2 Conc	0.375027	percent
CO Conc	19.410418	ppm

Dilution/Engine Air Data

Barometric Pressure	30.024732	inHg
Relative Humidity	45.428049	percent
Engine Inlet Air Temp	70.533716	deg F
Absoute Humidity	50.051326	gr/lb

Mass Emissions

HC Mass	4.127948	grams
NOx Mass	127.778166	grams
NO Mass	120.082204	grams
CO2 Mass	13915.918189	grams
CO Mass	45.616469	grams
Methane Bag Mass	0.871024	grams

Brake Specific Emissions

HC	0.157695	g/bhp-hr
NOx	4.881341	g/bhp-hr
NO	4.587342	g/bhp-hr
CO2	531.611443	g/bhp-hr
CO	1.742626	g/bhp-hr
Non-Methane HC	0.124420	g/bhp-hr

Correction Factors

NOx Humidity CF	0.939786	Kh
Dry to Wet CF	0.989458	Kw
Dilution Factor	118.879153	df

Sample Flow Data

Total Volume (Vmix)	72407.349128	scf
Dilution Flow	65472.980163	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.176860	bhp-hr
Reference Work	27.510623	bhp-hr

Fuel Data

Fuel Usage	4157.000000	grams
BSFC	0.350104	lb/bhp-hr

Particulate	0.205	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:42 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS46 Phase 1

Test Information

Test ID	LPTRANS46
Date	Tue, Jun 28, 2005
Time	10:26 AM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.232938	ppm
NOx Bag Conc	34.063335	ppm
NO Bag Conc	27.255125	ppm
CO2 Bag Conc	0.430984	percent
CO Bag Conc	27.805577	ppm
Methane Bag Conc	3.793911	ppm

Bag Background Concentrations

HC Bag Ambient	-0.404456	ppm
NOx Bag Ambient	-0.231246	ppm
NO Bag Ambient	-0.173696	ppm
CO2 Bag Ambient	0.046206	percent
CO Bag Ambient	10.147407	ppm
Methane Bag Ambient	3.249809	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.056549	ppm
NOx Conc	35.482582	ppm
NO Conc	32.892309	ppm
CO2 Conc	0.373999	percent
CO Conc	17.340847	ppm

Dilution/Engine Air Data

Barometric Pressure	30.024732	inHg
Relative Humidity	44.771247	percent
Engine Inlet Air Temp	71.994809	deg F
Absoute Humidity	51.851288	gr/lb

Mass Emissions

HC Mass	3.565019	grams
NOx Mass	129.525195	grams
NO Mass	119.855292	grams
CO2 Mass	13789.653336	grams
CO Mass	40.273256	grams
Methane Bag Mass	0.892972	grams

Brake Specific Emissions

HC	0.136304	g/bhp-hr
NOx	4.952215	g/bhp-hr
NO	4.582500	g/bhp-hr
CO2	527.228126	g/bhp-hr
CO	1.539792	g/bhp-hr
Non-Methane HC	0.102162	g/bhp-hr

Correction Factors

NOx Humidity CF	0.943928	Kh
Dry to Wet CF	0.989054	Kw
Dilution Factor	122.988258	df

Sample Flow Data

Total Volume (Vmix)	71538.494640	scf
Dilution Flow	64553.208459	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.155003	bhp-hr
Reference Work	27.496686	bhp-hr

Fuel Data

Fuel Usage	4230.000000	grams
BSFC	0.356549	lb/bhp-hr

Particulate	0.166	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:43 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS47 Phase 1

Test Information

Test ID	LPTRANS47
Date	Tue, Jun 28, 2005
Time	11:26 AM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.670630	ppm
NOx Bag Conc	33.987423	ppm
NO Bag Conc	26.520603	ppm
CO2 Bag Conc	0.428053	percent
CO Bag Conc	27.665300	ppm
Methane Bag Conc	3.582931	ppm

Bag Background Concentrations

HC Bag Ambient	-0.022302	ppm
NOx Bag Ambient	-0.035786	ppm
NO Bag Ambient	-0.181803	ppm
CO2 Bag Ambient	0.043172	percent
CO Bag Ambient	9.205391	ppm
Methane Bag Ambient	3.012833	ppm

Integrated Concentrations Corrected for Background

HC Conc	2.718653	ppm
NOx Conc	34.160667	ppm
NO Conc	31.714619	ppm
CO2 Conc	0.380789	percent
CO Conc	19.091698	ppm

Dilution/Engine Air Data

Barometric Pressure	30.024732	inHg
Relative Humidity	47.151848	percent
Engine Inlet Air Temp	70.162079	deg F
Absoute Humidity	51.322501	gr/lb

Mass Emissions

HC Mass	3.218448	grams
NOx Mass	125.770166	grams
NO Mass	116.586750	grams
CO2 Mass	14163.740112	grams
CO Mass	45.123178	grams
Methane Bag Mass	0.934222	grams

Brake Specific Emissions

HC	0.123332	g/bhp-hr
NOx	4.819553	g/bhp-hr
NO	4.467641	g/bhp-hr
CO2	542.759005	g/bhp-hr
CO	1.729134	g/bhp-hr
Non-Methane HC	0.08752	g/bhp-hr

Correction Factors

NOx Humidity CF	0.942734	Kh
Dry to Wet CF	0.989173	Kw
Dilution Factor	116.579037	df

Sample Flow Data

Total Volume (Vmix)	72866.206899	scf
Dilution Flow	65869.025749	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.095818	bhp-hr
Reference Work	27.496445	bhp-hr

Fuel Data

Fuel Usage	4253.000000	grams
BSFC	0.359301	lb/bhp-hr

Particulate	0.170	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:44 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS49 Phase 1

Test Information

Test ID	LPTRANS49
Date	Tue, Jun 28, 2005
Time	4:16 PM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.557551	ppm
NOx Bag Conc	38.216518	ppm
NO Bag Conc	27.928102	ppm
CO2 Bag Conc	0.436047	percent
CO Bag Conc	29.146514	ppm
Methane Bag Conc	3.451803	ppm

Bag Background Concentrations

HC Bag Ambient	-0.106473	ppm
NOx Bag Ambient	0.137914	ppm
NO Bag Ambient	0.243798	ppm
CO2 Bag Ambient	0.043769	percent
CO Bag Ambient	10.365651	ppm
Methane Bag Ambient	2.908527	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.134297	ppm
NOx Conc	36.176509	ppm
NO Conc	32.990862	ppm
CO2 Conc	0.392613	percent
CO Conc	19.699705	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	49.918457	percent
Engine Inlet Air Temp	70.472702	deg F
Absoute Humidity	55.174525	gr/lb

Mass Emissions

HC Mass	3.645782	grams
NOx Mass	133.079809	grams
NO Mass	121.663280	grams
CO2 Mass	14472.584975	grams
CO Mass	45.780534	grams
Methane Bag Mass	0.877712	grams

Brake Specific Emissions

HC	0.139654	g/bhp-hr
NOx	5.097695	g/bhp-hr
NO	4.660378	g/bhp-hr
CO2	554.380281	g/bhp-hr
CO	1.753648	g/bhp-hr
Non-Methane HC	0.106033	g/bhp-hr

Correction Factors

NOx Humidity CF	0.951723	Kh
Dry to Wet CF	0.988309	Kw
Dilution Factor	106.664145	df

Sample Flow Data

Total Volume (Vmix)	71501.107421	scf
Dilution Flow	64532.534456	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.105880	bhp-hr
Reference Work	27.506581	bhp-hr

Fuel Data

Fuel Usage	4344.000000	grams
BSFC	0.366848	lb/bhp-hr

Particulate	0.183	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:46 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS50 Phase 1

Test Information

Test ID	LPTRANS50
Date	Tue, Jun 28, 2005
Time	5:47 PM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.005460	ppm
NOx Bag Conc	34.614365	ppm
NO Bag Conc	27.240602	ppm
CO2 Bag Conc	0.434486	percent
CO Bag Conc	28.186847	ppm
Methane Bag Conc	3.593572	ppm

Bag Background Concentrations

HC Bag Ambient	-0.634467	ppm
NOx Bag Ambient	0.049467	ppm
NO Bag Ambient	-0.093353	ppm
CO2 Bag Ambient	0.043942	percent
CO Bag Ambient	9.813229	ppm
Methane Bag Ambient	3.048004	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.233331	ppm
NOx Conc	34.969765	ppm
NO Conc	32.619752	ppm
CO2 Conc	0.392612	percent
CO Conc	17.934192	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	28.842440	percent
Engine Inlet Air Temp	71.546936	deg F
Absoute Humidity	32.876379	gr/lb

Mass Emissions

HC Mass	3.790155	grams
NOx Mass	122.270435	grams
NO Mass	113.969234	grams
CO2 Mass	14513.202681	grams
CO Mass	41.840313	grams
Methane Bag Mass	0.890003	grams

Brake Specific Emissions

HC	0.145220	g/bhp-hr
NOx	4.684812	g/bhp-hr
NO	4.366750	g/bhp-hr
CO2	556.075802	g/bhp-hr
CO	1.603119	g/bhp-hr
Non-Methane HC	0.111119	g/bhp-hr

Correction Factors

NOx Humidity CF	0.901987	Kh
Dry to Wet CF	0.993329	Kw
Dilution Factor	107.001689	df

Sample Flow Data

Total Volume (Vmix)	71774.214133	scf
Dilution Flow	64774.354469	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.099324	bhp-hr
Reference Work	27.493794	bhp-hr

Fuel Data

Fuel Usage	4279.500000	grams
BSFC	0.361491	lb/bhp-hr

Particulate	0.184	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:47 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS51 Phase 1

Test Information

Test ID	LPTRANS51
Date	Tue, Jun 28, 2005
Time	7:35 PM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.361247	ppm
NOx Bag Conc	34.742508	ppm
NO Bag Conc	27.650505	ppm
CO2 Bag Conc	0.432310	percent
CO Bag Conc	28.285602	ppm
Methane Bag Conc	3.790324	ppm

Bag Background Concentrations

HC Bag Ambient	-0.131273	ppm
NOx Bag Ambient	-0.680644	ppm
NO Bag Ambient	0.069750	ppm
CO2 Bag Ambient	0.044011	percent
CO Bag Ambient	9.298912	ppm
Methane Bag Ambient	3.259084	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.190977	ppm
NOx Conc	36.824478	ppm
NO Conc	33.401227	ppm
CO2 Conc	0.386548	percent
CO Conc	19.884505	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	29.890836	percent
Engine Inlet Air Temp	70.934171	deg F
Absoute Humidity	33.379307	gr/lb

Mass Emissions

HC Mass	3.730600	grams
NOx Mass	129.033051	grams
NO Mass	117.074518	grams
CO2 Mass	14296.973178	grams
CO Mass	46.542119	grams
Methane Bag Mass	0.879681	grams

Brake Specific Emissions

HC	0.142723	g/bhp-hr
NOx	4.936465	g/bhp-hr
NO	4.478963	g/bhp-hr
CO2	546.964526	g/bhp-hr
CO	1.780579	g/bhp-hr
Non-Methane HC	0.109069	g/bhp-hr

Correction Factors

NOx Humidity CF	0.903052	Kh
Dry to Wet CF	0.993215	Kw
Dilution Factor	112.618414	df

Sample Flow Data

Total Volume (Vmix)	71828.210583	scf
Dilution Flow	64825.698263	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.138758	bhp-hr
Reference Work	27.492311	bhp-hr

Fuel Data

Fuel Usage	4271.000000	grams
BSFC	0.360229	lb/bhp-hr

Particulate	0.200	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:47 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS55 Phase 1

Test Information

Test ID	LPTRANS55
Date	Wed, Jun 29, 2005
Time	11:35 AM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON; H.S.

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.744559	ppm
NOx Bag Conc	34.304047	ppm
NO Bag Conc	26.835037	ppm
CO2 Bag Conc	0.436426	percent
CO Bag Conc	29.079829	ppm
Methane Bag Conc	3.645158	ppm

Bag Background Concentrations

HC Bag Ambient	0.431757	ppm
NOx Bag Ambient	-0.044555	ppm
NO Bag Ambient	0.227383	ppm
CO2 Bag Ambient	0.044909	percent
CO Bag Ambient	10.122647	ppm
Methane Bag Ambient	3.128281	ppm

Integrated Concentrations Corrected for Background

HC Conc	2.555551	ppm
NOx Conc	35.988729	ppm
NO Conc	32.124590	ppm
CO2 Conc	0.383852	percent
CO Conc	18.621034	ppm

Dilution/Engine Air Data

Barometric Pressure	30.124815	inHg
Relative Humidity	27.057165	percent
Engine Inlet Air Temp	72.453382	deg F
Absoute Humidity	31.648071	gr/lb

Mass Emissions

HC Mass	2.956861	grams
NOx Mass	125.080040	grams
NO Mass	111.900612	grams
CO2 Mass	14138.547295	grams
CO Mass	43.228159	grams
Methane Bag Mass	0.851105	grams

Brake Specific Emissions

HC	0.113178	g/bhp-hr
NOx	4.787620	g/bhp-hr
NO	4.283158	g/bhp-hr
CO2	541.173362	g/bhp-hr
CO	1.654620	g/bhp-hr
Non-Methane HC	0.080601	g/bhp-hr

Correction Factors

NOx Humidity CF	0.899436	Kh
Dry to Wet CF	0.993607	Kw
Dilution Factor	116.566603	df

Sample Flow Data

Total Volume (Vmix)	71471.109903	scf
Dilution Flow	64460.292167	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.125727	bhp-hr
Reference Work	27.505873	bhp-hr

Fuel Data

Fuel Usage	4271.000000	grams
BSFC	0.360409	lb/bhp-hr

Particulate	0.200	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:50 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS56 Phase 1

Test Information			**Engine Information**		
Test ID	LPTRANS56		Engine Manufacturer	Cummins	
Date	Wed, Jun 29, 2005		Engine Model	M11 400E	
Time	12:32 PM		Engine Serial Number	34989531	
Fuel Specification	DIESEL				
Test Comments:	CANDIDATE FUEL W/VISCON.				

Bag Emissions Concentrations			**Bag Background Concentrations**		
HC Bag Conc	1.433621	ppm	HC Bag Ambient	0.074383	ppm
NOx Bag Conc	31.563009	ppm	NOx Bag Ambient	0.456323	ppm
NO Bag Conc	24.176653	ppm	NO Bag Ambient	-0.170750	ppm
CO2 Bag Conc	0.396525	percent	CO2 Bag Ambient	0.044019	percent
CO Bag Conc	26.885455	ppm	CO Bag Ambient	9.238004	ppm
Methane Bag Conc	3.560192	ppm	Methane Bag Ambient	3.064902	ppm

Integrated Concentrations Corrected for Background			**Dilution/Engine Air Data**		
HC Conc	2.806701	ppm	Barometric Pressure	30.024732	inHg
NOx Conc	30.616832	ppm	Relative Humidity	26.151604	percent
NO Conc	28.849822	ppm	Engine Inlet Air Temp	71.666111	deg F
CO2 Conc	0.345720	percent	Absoute Humidity	29.802140	gr/lb
CO Conc	19.375105	ppm			

Mass Emissions			**Brake Specific Emissions**		
HC Mass	3.579929	grams	HC	0.137027	g/bhp-hr
NOx Mass	117.345402	grams	NOx	4.491560	g/bhp-hr
NO Mass	110.400782	grams	NO	4.225745	g/bhp-hr
CO2 Mass	14137.246579	grams	CO2	541.122968	g/bhp-hr
CO Mass	49.021487	grams	CO	1.876366	g/bhp-hr
Methane Bag Mass	0.876260	grams	Non-Methane HC	0.103487	g/bhp-hr

Correction Factors			**Sample Flow Data**		
NOx Humidity CF	0.895535	Kh	Total Volume (Vmix)	77704.757131	scf
Dry to Wet CF	0.994025	Kw	Dilution Flow	70540.516985	scf
Dilution Factor	119.735601	df			

Test Cycle Data			**Fuel Data**		
Hot-Cold Test	2.000000	1=Cold, 2=Hot	Fuel Usage	4278.500000	grams
Test Time	1213.000000	sec	BSFC	0.361041	lb/bhp-hr
Total Work	26.125756	bhp-hr			
Reference Work	27.499970	bhp-hr			

Particulate	0.160	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:50 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS57 Phase 1

Test Information

Test ID	LPTRANS57
Date	Wed, Jun 29, 2005
Time	1:22 PM
Fuel Specification	DIESEL
Test Comments:	CANDIDATE FUEL W/VISCON

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.147952	ppm
NOx Bag Conc	35.282188	ppm
NO Bag Conc	27.093840	ppm
CO2 Bag Conc	0.431772	percent
CO Bag Conc	28.291375	ppm
Methane Bag Conc	3.530399	ppm

Bag Background Concentrations

HC Bag Ambient	-0.250132	ppm
NOx Bag Ambient	0.454717	ppm
NO Bag Ambient	0.212570	ppm
CO2 Bag Ambient	0.043751	percent
CO Bag Ambient	9.893855	ppm
Methane Bag Ambient	2.957901	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.165524	ppm
NOx Conc	34.800162	ppm
NO Conc	32.132139	ppm
CO2 Conc	0.385913	percent
CO Conc	17.379943	ppm

Dilution/Engine Air Data

Barometric Pressure	30.024732	inHg
Relative Humidity	26.401141	percent
Engine Inlet Air Temp	72.231740	deg F
Absoute Humidity	30.685147	gr/lb

Mass Emissions

HC Mass	3.727325	grams
NOx Mass	121.640859	grams
NO Mass	112.607398	grams
CO2 Mass	14341.300458	grams
CO Mass	40.777391	grams
Methane Bag Mass	0.928778	grams

Brake Specific Emissions

HC	0.142598	g/bhp-hr
NOx	4.653668	g/bhp-hr
NO	4.308071	g/bhp-hr
CO2	548.661426	g/bhp-hr
CO	1.560039	g/bhp-hr
Non-Methane HC	0.107065	g/bhp-hr

Correction Factors

NOx Humidity CF	0.897382	Kh
Dry to Wet CF	0.993825	Kw
Dilution Factor	112.405986	df

Sample Flow Data

Total Volume (Vmix)	72281.386719	scf
Dilution Flow	65263.947407	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.138707	bhp-hr
Reference Work	27.492154	bhp-hr

Fuel Data

Fuel Usage	4285.000000	grams
BSFC	0.361411	lb/bhp-hr

Particulate	0.167	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:51 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS59 Phase 1

Test Information

Test ID	LPTRANS59
Date	Wed, Jun 29, 2005
Time	4:20 PM
Fuel Specification	DIESEL
Test Comments:	REFERENCE FUEL

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	0.893580	ppm
NOx Bag Conc	34.745804	ppm
NO Bag Conc	27.829479	ppm
CO2 Bag Conc	0.433836	percent
CO Bag Conc	30.077464	ppm
Methane Bag Conc	3.486097	ppm

Bag Background Concentrations

HC Bag Ambient	-0.412537	ppm
NOx Bag Ambient	0.120001	ppm
NO Bag Ambient	0.160872	ppm
CO2 Bag Ambient	0.044252	percent
CO Bag Ambient	10.579368	ppm
Methane Bag Ambient	2.970753	ppm

Integrated Concentrations Corrected for Background

HC Conc	2.664362	ppm
NOx Conc	34.992654	ppm
NO Conc	32.595868	ppm
CO2 Conc	0.385389	percent
CO Conc	19.752188	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	53.120629	percent
Engine Inlet Air Temp	70.959861	deg F
Absoute Humidity	59.791450	gr/lb

Mass Emissions

HC Mass	3.107121	grams
NOx Mass	130.207570	grams
NO Mass	121.494823	grams
CO2 Mass	14203.832173	grams
CO Mass	45.880715	grams
Methane Bag Mass	0.841459	grams

Brake Specific Emissions

HC	0.119018	g/bhp-hr
NOx	4.987599	g/bhp-hr
NO	4.653858	g/bhp-hr
CO2	544.077609	g/bhp-hr
CO	1.757460	g/bhp-hr
Non-Methane HC	0.086786	g/bhp-hr

Correction Factors

NOx Humidity CF	0.962754	Kh
Dry to Wet CF	0.987276	Kw
Dilution Factor	115.382845	df

Sample Flow Data

Total Volume (Vmix)	71497.483217	scf
Dilution Flow	64590.918791	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.106261	bhp-hr
Reference Work	27.502168	bhp-hr

Fuel Data

Fuel Usage	4254.000000	grams
BSFC	0.359242	lb/bhp-hr

Particulate	0.202	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:52 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS60   Phase 1

Test Information

Test ID	LPTRANS60
Date	Wed, Jun 29, 2005
Time	5:13 PM
Fuel Specification	DIESEL
Test Comments:	REFERENCE FUEL

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	1.712905	ppm
NOx Bag Conc	34.435295	ppm
NO Bag Conc	27.563353	ppm
CO2 Bag Conc	0.433983	percent
CO Bag Conc	28.471768	ppm
Methane Bag Conc	3.513423	ppm

Bag Background Concentrations

HC Bag Ambient	0.313582	ppm
NOx Bag Ambient	0.366918	ppm
NO Bag Ambient	-0.023676	ppm
CO2 Bag Ambient	0.043947	percent
CO Bag Ambient	9.879357	ppm
Methane Bag Ambient	2.957788	ppm

Integrated Concentrations Corrected for Background

HC Conc	1.800650	ppm
NOx Conc	34.412807	ppm
NO Conc	32.177971	ppm
CO2 Conc	0.388288	percent
CO Conc	19.713927	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	52.966538	percent
Engine Inlet Air Temp	71.091315	deg F
Absoute Humidity	59.909480	gr/lb

Mass Emissions

HC Mass	2.082679	grams
NOx Mass	128.018063	grams
NO Mass	119.713600	grams
CO2 Mass	14307.923725	grams
CO Mass	45.832938	grams
Methane Bag Mass	0.895859	grams

Brake Specific Emissions

HC	0.079701	g/bhp-hr
NOx	4.899076	g/bhp-hr
NO	4.581276	g/bhp-hr
CO2	547.544671	g/bhp-hr
CO	1.753964	g/bhp-hr
Non-Methane HC	0.045418	g/bhp-hr

Correction Factors

NOx Humidity CF	0.963056	Kh
Dry to Wet CF	0.987250	Kw
Dilution Factor	110.744641	df

Sample Flow Data

Total Volume (Vmix)	71469.574182	scf
Dilution Flow	64497.988724	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.131062	bhp-hr
Reference Work	27.517209	bhp-hr

Fuel Data

Fuel Usage	4260.500000	grams
BSFC	0.359449	lb/bhp-hr

Particulate	0.201	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:53 PM

Olson-Ecologic Engine Testing Laboratories, LLC
Heavy Duty Transient Test Results
LPTRANS61 Phase 1

Test Information

Test ID	LPTRANS61
Date	Wed, Jun 29, 2005
Time	6:12 PM
Fuel Specification	DIESEL
Test Comments:	REFERENCE FUEL

Engine Information

Engine Manufacturer	Cummins
Engine Model	M11 400E
Engine Serial Number	34989531

Bag Emissions Concentrations

HC Bag Conc	0.593764	ppm
NOx Bag Conc	34.243477	ppm
NO Bag Conc	27.245707	ppm
CO2 Bag Conc	0.433920	percent
CO Bag Conc	28.507571	ppm
Methane Bag Conc	3.576957	ppm

Bag Background Concentrations

HC Bag Ambient	-0.813489	ppm
NOx Bag Ambient	-0.162701	ppm
NO Bag Ambient	-0.113992	ppm
CO2 Bag Ambient	0.044270	percent
CO Bag Ambient	10.665273	ppm
Methane Bag Ambient	2.970471	ppm

Integrated Concentrations Corrected for Background

HC Conc	3.831396	ppm
NOx Conc	35.679534	ppm
NO Conc	32.445993	ppm
CO2 Conc	0.385046	percent
CO Conc	17.754635	ppm

Dilution/Engine Air Data

Barometric Pressure	29.924649	inHg
Relative Humidity	52.667796	percent
Engine Inlet Air Temp	70.506592	deg F
Absoute Humidity	58.401759	gr/lb

Mass Emissions

HC Mass	4.473315	grams
NOx Mass	132.347699	grams
NO Mass	120.208864	grams
CO2 Mass	14196.710820	grams
CO Mass	41.169298	grams
Methane Bag Mass	0.966153	grams

Brake Specific Emissions

HC	0.171318	g/bhp-hr
NOx	5.068625	g/bhp-hr
NO	4.603734	g/bhp-hr
CO2	543.702697	g/bhp-hr
CO	1.576693	g/bhp-hr
Non-Methane HC	0.134316	g/bhp-hr

Correction Factors

NOx Humidity CF	0.959456	Kh
Dry to Wet CF	0.987587	Kw
Dilution Factor	115.677212	df

Sample Flow Data

Total Volume (Vmix)	71460.510138	scf
Dilution Flow	64510.044902	scf

Test Cycle Data

Hot-Cold Test	2.000000	1=Cold, 2=Hot
Test Time	1213.000000	sec
Total Work	26.111165	bhp-hr
Reference Work	27.495921	bhp-hr

Fuel Data

Fuel Usage	4266.000000	grams
BSFC	0.360188	lb/bhp-hr

Particulate	0.185	g/bhp-hr

Data processed on Wednesday, July 13, 2005 1:53 PM

----- Original Message -----
From: <Caldwell.Jim@epamail.epa.gov>
To: "stephanie/mike anfinson" <anfinson@fea.net>
Cc: <porter@a-logic.com>
Sent: Monday, April 26, 2004 7:44 AM
Subject: Re: Regarding the facts concerning VISCON

>
>
>
>
> Mike,
>
> A substance composed solely of carbon and/or hydrogen does not meet the
> definition of an additive at 40 CFR 79.2(e), and thus is not subject to
> the registration requirements for a fuel additive at 40 CFR 79.
>
> A fuel manufacturer is defined at 40 CFR 79.2(d). This definition is
> not relevant to whether a substance is required to be registered as a
> fuel additive.
>
> Under the health-effects testing regulations at 40 CFR 79, compounds
> that are solely hydrocarbon are grouped in the baseline category. In
> general, the evaporative and combustion emissions from the approximately
> 300 hydrocarbon compounds in fuels are considered to pose a comparable
> risk to the public. However, not all have been tested and there may be
> some hydrocarbon compounds, in addition to benzene, aromatics, and
> olefins, which are controlled in gasoline, with evaporative or
> combustion emissions that might merit control in the future.
>
> Jim Caldwell
> (202) 343-9303
>
>

MSDS SHEET

GTA Technologies, Inc. Technical Data Sheet #1103

Viscon^R For Diesel Applications

How it functions

GTAT's proprietary Viscon technology improves the performance of compression ignition engines.

It is well known that the physical properties of diesel fuel interfere with creating a uniform air/fuel mixture in the cylinder. Viscon, unlike other fuel additives, modifies the physical behavior of diesel fuel during injection creating a more uniform air/fuel mixture at ignition and during burn.

Diesel fuel is a Newtonian Fluid and as such has physical properties which work against preparation of a uniform air/fuel mixture:

- Spray from an injector nozzle contains a population of superfine, vapor-like droplets which ignite in advance of the main body of fuel and prior to complete spray droplet penetration and mixing.

- The outer edge of the injector spray cone shears into smaller droplets which loose momentum and have poor penetration into the pressurized gas in the cylinder.

- Droplets in the center area of the injector spray cone grow by collision and coalescence as they contact the slower moving droplets at the leading edge of the spray.

- Droplets which reach the cylinder walls splatter and coat creating a cooled liquid film.

GTAT's Viscon technology uses a scientific phenomenon called extensional viscosity to modify the physical properties of diesel fuel during injection and mixture formation. Viscon eliminates the formation of superfine satellite droplets which cause early ignition before spray jet penetration and mixing has progressed. Diesel fuel droplets containing Viscon resist shear on the edge of the spray cone and therefore maintain momentum for better penetration. Viscon containing droplets resist growth by collision and have a tendency to rebound and reflect from the cylinder wall back into the gas in the cylinder limiting wall coating and cooling.

Benefits

Viscon increases engine power, reduces combustion gas temperatures, reduces fuel consumption and reduces emissions of unburned hydrocarbons and NOx.

These benefits derived from:

- A more uniform distribution of droplet size across the cross section of the diesel spray cone.
- Reduction of the mean volume diameter of the diesel injector spray.
- A more even distribution of the fuel distributed across the cross section of the spray cone.
- Elimination of superfine satellite droplets which cause early ignition.
- Improved spray jet penetration.
- Reduced wall wetting.

MSDS

FUEL ADDITIVE DIESEL
CAS# 64742-47-8 CONTAINS PETROLEUM DISTILLATES
DANGER! COMBUSTIBLE
CAUSES EYE & SKIN IRRITATION.
MAYBE HARMFUL IF SWALLOWED.
VAPOR MAY BE IRRITTATING IF INHALED.
MAY CAUSE CENTRAL NERVOUS SYSTEM DAMAGE.
MAY CAUSE DIZZINESS & DROWSINESS

GTAT CALIFORNIA INC.
3121 STANDARD ST.
BAKERSFIELD, CA 93311
(661) 327-7451

BEFORE USING THIS PRODUCT, READ THIS MATERIAL SAFETY DATA SHEET

AVOID CONTACT WITH EYES, SKIN AND CLOHTING
DO NOT TASTE OR SWALLOW
AVOID BREATHING VAPOR
USE WITH ADEQUATE VENTILATION
WASH THOROUGHLY AFTER HANDLING
DO NOT TRANSFER TO UNLABELED CONTAINERS

FIRST AID:

IN CASE OF EYE CONTACT FLUSH EYES WITH LARGE AMOUNTS OF WATER UNTIL IRRITATION SUBSIDES. IF IRRITATION PERSISTS, GET MEDICAL ATTENTION.

IN CASE OF CONTACT: FOR SKIN WASH AFFECTED AREAS WITH SOAP AND WATER. REMOVE AND LAUNDER CONTAMINATED CLOTHING BEFORE REUSE. IF IRRITATION DEVELOPS; CONSULT A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING. KEEP AT REST. GET PROMT MEDICAL ATTENTION.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN, CALL A PHYSICIAN.

SPILLS OR LEAKS:

ELIMINATE ALL SOURCES OF IGNITION.
SMALL SPILLS-SOAK UP WITH ABSORBENT MATERIAL & SCOOP INTO DRUMS.
LARGE SPILLS-DIKE & PUMP INTODRUM, PREVENT MATERIAL FROM ENTERING DRAINS, SEWERS OR WATERWAYS.
DISPOSE OF IN ACCORDANCE WITH LOCAL, STATE & FEDERAL REGULATIONS.

IN CASE OF FIRE:

USE FOAM, CARBON DIOXIDE, DRY CHEMICAL OR WATER FOG OR SPRAY.
DANGER
AFTER THIS CONTAINER HAS BEEN EMPTIED, IT MAY CONTAIN EXPLOSIVE AND HARMFUL VAPORS AND RESIDUE.
KEEP AWAY FROM HEAT, SPARKS, AND FLAMES. DO NOT CUT, PUNCTURE OR WELD ON OR NEAR THIS CONTAINER.
DO NOT REUSE CONTAINER FOR ANY PURPOSE UNTIL COMMERCIALLY CLEANED.

USAGE DIRECTIONS
Use one ounce of Viscon to 20 gallons of fuel.
For best results, change/clean the fuel filter before applying Viscon.
Do not overdose – more is not better.

STORAGE AND HANDLING
Electrostatic Accumulation Hazard: Yes, use proper bonding and/or grounding procedure. Additional information regarding safe handling of products with static accumulation potential can be ordered by contacting the American Petroleum Institute (API) for API Recommended Practice 2003, entitled "Protection Against Ignitions Arising Out of Static, Lighting, and Stray Currents" (American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005), or the National Fire Protection Association (NFPA) for NFPA 77 entitled "Static Electricity" (National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101).

Storage Temperature, Deg F: Ambient

Loading/Unloading Temperature, Deg F: Ambient

Storage/Transport Pressure, mmHg: Atmospheric

Storage and Handling: Keep container closed. Handle and open containers with care. Store in a cool and well ventilated place away from incompatible materials. DO NOT allow prolonged exposure to direct sunlight. DO NOT handle or store near an open flame, heat or other sources of ignition. Protect material from direct sunlight. Material will accumulate static charges that may cause an electrical spark (ignition source). Use proper bonding and/or grounding procedures. DO NOT pressurize, cut, heat, or weld containers. Empty product containers may contain product residue. DO NOT reuse empty containers without commercial cleaning or reconditioning.

HEALTH HAZARD DATA
Eye Contact: Slightly irritating but does not injure eye tissue.

Skin Contact: Low order of toxicity. Frequent or prolonged contact may irritate and cause dermatitis. Skin contact may aggravate an existing dermatitis condition.

Inhalation: High vapor concentrations are irritating to the eyes and the respiratory tract, may cause headaches, dizziness, anesthesia, drowsiness, unconsciousness, and other central nervous system effects, including death.

Ingestion: Small amounts of this product aspirated into the respiratory system during ingestion or vomiting may cause mild to severe pulmonary injury, possibly progressing to death.

EMERGENCY AND FIRST AID PROCEDURES:
Eye Contact: Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

Skin Contact: Flush with large amounts of water, use soap if available. Remove grossly contaminated clothing, including shoes and launder before reuse.

Inhalation: Using proper respiratory protection, immediately remove the affected victim from exposure. Administer artificial respiration if breathing is stopped. Keep at rest. Call for prompt medical attention.

Ingestion: If swallowed, DO NOT induce vomiting. Keep at rest. Get prompt medical attention.

Attachment 2

CARB Tier I

Viscon Multi-Media Evaluation (Tier I)
October 24, 2008

Report Attached Separately

Attachment 3

CARB Tier II

Viscon Multi-Media Evaluation (Tier II)
March 16, 2009

Report Attached Separately

Attachment 4

Viscon Test Protocol

Effect of Fuel Additive Viscon on the Environmental Fate of Diesel Fuel

Effect of Fuel Additive Viscon on the Environmental Fate of Diesel Fuel

Principal Investigators

Sayed M. Hassan, Ph.D.
Research Scientist and Director
Lab. For Environmental Analysis

William P. Miller, Ph.D.
Professor of Soil Chemistry

Department of Crop and Soil Sciences

University of Georgia

Athens, GA 30602

2009

To be Submitted to
The California Environmental Protection Agency

Through:
VISCON CALIFORNIA, LLC
3121 Standard Street
Bakersfield, CA 93308

Revised 9/23/09

Statement of Work:

Viscon is diesel fuel additive used to reduce emissions and promote uniform combustion in diesel engines. The base chemical of Viscon is a high-molecular weight hydrocarbon polymer of isobutylene known as poly-isobutylene or PIB. Viscon has been shown to modify the physical properties of fuel resulting in a more uniform mixture of air and fuel components at the molecular level in the cylinder prior to ignition. Reported advantages of mixing diesel or gasoline with viscon are: reduction of harmful emissions and improvement of air quality and fuel combustion. It also reduces operating temperatures and fuel consumption.

However, knowledge gaps pertaining to fate, transport, biodegradation and potential soil cleanup impacts of viscon and viscon-treated diesel have been identified by the Multimedia Working Group of California Environmental Protection Agency. To address these gaps, laboratory tests for biodegradability and fate and transport in soil must be carried out. In addition, information on potential impacts on soil cleanup must be provided.

Introduction:

Diesel fuel consists of approximately 75% alkanes and 25% aromatics (Kostecki and Calabrese, 1992). The alkanes usually consist of a mixture of linear, branched and cyclic compounds. The aromatic fraction usually contains benzene, toluene, ethylbenzene and xylenes (BTEX) compounds and polyaromatic compounds (PAHs) in addition to others.

The literature refers to certain patterns by which biodegradation of different diesel components takes place. Saturated normal alkanes are the most readily degraded in a mixture (Atlas, 1981; Bossert and Bartha, 1984). Lower molecular weight compounds are preferentially used by microbes (Chaineau *et al.*, 1995), but there is evidence that n-alkanes up to C_{44} have undergone microbial degradation (Atlas, 1981). In one batch study using a mixture of linear and branched alkanes, the linear alkanes were degraded fastest with the highest yield (Geerdink *et al.*, 1996). The branched alkanes were not consumed until most of the linear alkanes disappeared. Methyl branching and substitution generally increases the resistance of hydrocarbons to microbial attack (Atlas, 1981; Chaineau *et al.*, 1995). One study found that the degradation rate of branched alkanes was 2 times lower than n-alkanes (Chaineau *et al.*, 1995). However, there is some evidence that suggests that degradation of substituted cyclic alkanes occurs more readily than unsubstituted forms (Atlas, 1981). Compound classes in order of decreasing susceptibility to biodegradation are n-alkanes > branched alkanes > low molecular weight aromatics > cyclic alkanes. In one study, branched alkanes all degraded readily on their own, but when introduced as a mixture, degradation proceeded more slowly. This suggests a competition effect in mixtures (Kampbell and Wilson, 1991). On the contrary, there is much evidence, suggesting that for some compounds degradation is more rapid when present in a mixture than individually (Smith, 1990).

The object of this proposal is to design experiments and carry out the laboratory tests needed to address the knowledge gaps identified by the California Environmental

Protection Agency Multimedia Working Group. Three sets of paired comparison experiments, simultaneously carried out, are needed to determine if addition of Viscon at the recommended concentration would significantly affect the characteristics of the treated diesel and to qualitatively and quantitatively record such changes. Qualitative change can be studied by applying EPA method 8015m and looking at the general profile known as DRO (Diesel Range Organics) as well as calculating Total Petrolium Hydrocarbon (TPH). Quantitative analysis of C12 to C24 hydrocarbons (characteristic of the diesel range) will be determined using GC/MS analysis as described under Methods of Analysis.

Objective #1:
Study of the effect of Viscon® on biodegradability of diesel:
We recommend a sandy loam soil from Georgia with some organic material to be used in this study. The sand/silt/clay and organic carbon content in addition to bulk density, porosity, water content and pH will determined before testing and at the end. Nutrient addition was required to adjust the C:N:P ratio to 200:10:1 as described in a similar study (Zytner *et al.*, 2000). To ensure the microbes have adequate nitrogen, it will be assumed that none of the natural soil nitrogen (C:N = 6.5:1) is plant available. Ammonium nitrate (NH_4NO_3) and potassium phosphate (KH_2PO_4) will be used as sources of nitrogen and phosphorous, at levels that, when spiked, would result in the desired C:N:P ratio

The effect of viscon on biodegradability of diesel fuel will be studied by running 6 sets of batch experiments to be carried out in 1 liter glass bottles equipped as shown in Fig. 1. Five hundred g of nutrient amended soil are introduced in each bottle followed by 25 g of viscon spiked and non-spiked diesel. We recommened at least 3 replications for each of the diesel categories to get meaningful statistics. Four g samples will be cautiously withdrawn, with minimum system disturbance, every 3 weeks during the course of incubation. The samples will be extracted and subjected to GC/MS analysis for the general profile DRO, TPH and individual diesel hydrocarbons. Headspace analysis of CO_2 by GC analysis will be used as a measure of biological activity, using samples collected at regular intervals during incubation . The reactor will be regularly aerated by blowing air thru the system. The reactors will be operated for 6 to 8 months. Statistical tests will be used to compare Viscon-amended fuel degradation with the un-amended fuel

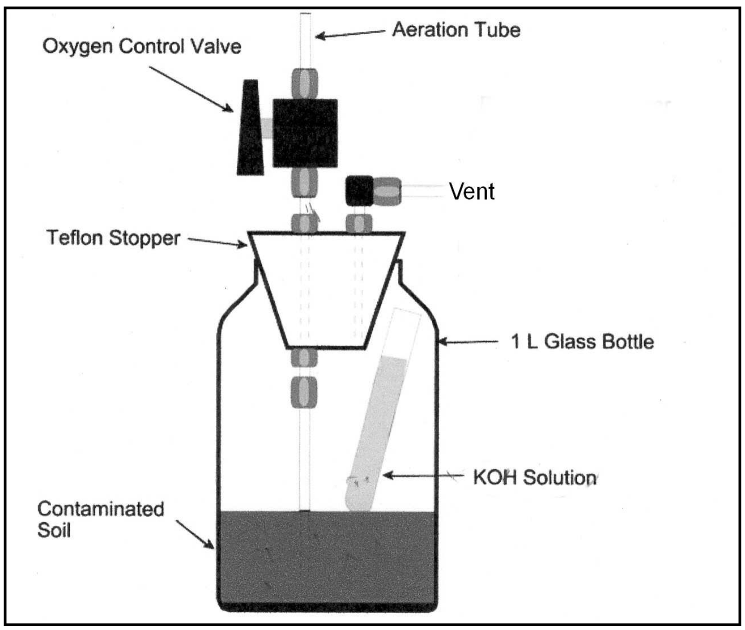


Figure 1. Bioreactor schematic
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(Zytner *et al.*, 2000)

NB: In view of drawbacks of using a tube of KOH to absorb carbon dioxide for titrimetirc analysis, the current authors prefer the more sensitive GC analysis as mentioned above. Thus a reactor without KOH tube will be used in the proposed study.

Objective #2:
Study of the effect of Viscon on diesel transport in soils:
The impact of Viscon on diesel transport and soil permeability will be conducted through column studies. Glass columns will be used, 50 cm long and 10 cm internal diameter with sampling ports at the bottom. Columns will be packed with a sandy loam soil having moisture content of 2% (air-dry) and 15% (field capacity). Initial bulk density and porosity will be determined. All columns will be kept upright to allow continuous vertical flow of diesel. Three replicate columns will be used for each treatment. Multichannel peristaltic pumps will be used to transfer a flow of diesel to the top of each column at a rate to be determined based on the experimental conditions in the lab, with this rate approaching the maximum flow capacity of the columns. Preliminary testing will establish suitable column parameters, and a summary of those parameters will be provided to Viscon and interested regulatory agencies for approval before detailed testing of the Viscon-amended diesel.

Half of the columns will be treated with CARB diesel while the other half will be treated with the same quantity of Viscon treated diesel. Column effluents will be collected separately over discrete periods, using a fraction collector. Columns will be operated for 8 hours then flow shut down overnight, for a duration of at least 5 days (to be extended if deemed appropriate). Collected effluent fractions will be analyzed by GC/MS as described under objective #1. Permeability changes of the soil will be assessed by changes in flow velocity (volume/time) through the columns and from changes in bulk density and porosity of the soil.

Methods of Analysis:

Determination of Diesel Hydrocarbons:
A Hewlett-Packard 5890 Series II gas chromatograph with a mass spectrum detector (GC-MSD) equipped with an auto-sampler will be used to analyze the samples. A 30 m, 0.32 mm ID DB-5 capillary column with a 0.25 m:m film thickness will be used. The oven program is held at 40°C for 2 min, before being ramped up to 100°C at 8°C/min. This is followed by a second ramp of 4°C/min up to 300°C, where that temperature is held for 5 min. Table (1) shows a list of straight chain diesel hydrocarbons and their retention times. Aromatic constituents falling in the diesel range will be determined as well.

Table 1. Diesel hydrocarbons and retention times

Hydrocarbon	NO. of C atoms	Retention Time (min)
Dodecane	12	9.24
Tridecane	13	10.67
Tetradecane	14	12.0
Pentadecane	15	13.26
Hexadecane	16	15.55
Heptadecane	17	15.60
Octadecane	18	16.67
Nonadecane	19	17.69
Eicosane	20	18.68
Heneicosane	21	19.60
Docosane	22	20.50

Tricosane	23	21.35
Tetracosane	24	22.18

Analysis of Carbon Dioxide:

A HP 6890 gas chromatograph will be used gas analysis with manual injection. The oven temperature starts at 40 ^{0}C for 1 min. then ramped at 25 degrees per min. to 100 ^{0}C then at 30 deg. Per min. till 200 ^{0}C and stay there for 25 min. The splitless inlet is kept at 150 ^{0}C, the thermal conductivity detector is kept at 250 ^{0}C and helium as the eluent gas.

Separation of carbon dioxide will be done using a HP-PLOT molecular sieve 5A column, dimensions are 15 m long, 0.53 mm I.D. and 25 um film thickness. Using a gas-tight syringe, supplied with an inert gas sampling valve and a suitable blunt needle, measure 1 ml of the headspace of the reaction medium. Inject the sample into the injection port of the GC and start analysis by hitting the start button. Identify the carbon dioxide peak by its retention time (about 12 minutes) and compare the integrated area with that of a standard carried out under the same conditions.

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