

**Viscon Multi Media Evaluation
(Tier III)
Summary**

**Prepared for:
Aubrey Sideco
California Air Resources Board
Stationary Source Division
1001 I Street
Sacramento, CA 95814**

**Prepared by:
Viscon California, LLC
3121 Standard Street
Bakersfield, California 93308**

June 03, 2009

Table of Contents

1. **Summary**
2. **Attachment 1** – Texas Commission on Environmental Quality Report on Texas Low Emissions Diesel (TxLED) Dated 7/20/2005
3. **Attachment 2** – CARB Tier I Multi-Media Evaluation October 24, 2008 ●
4. **Attachment 3** – CARB Tier II Multi Media Evaluation March 16, 2009 ● ●
5. **Attachment 4** – Test Protocol

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 NO_x 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	NO _x	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, NO_x 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	NO _x	NO	CO ₂	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, CO2 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 CO2 was decreased by 8.68 g/bhp-hr. On a mass basis the reduction of CO2 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 CO2 would be 3,024,000 lbs. per year. If Viscon were used in 100,000 bbls, per day, the reduction of CO2 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

	<u>Baseline</u>	<u>Predurability</u>	<u>Postdurability</u>	<u>Postdurability/ Change</u>
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

<u>PAH's</u>	<u>Baseline</u>	<u>Viscon</u>	<u>Change</u>
Naphthalene	0.0000105330	0.0000046060	-56%
2-methylnaphthalene	0.0000097644	0.0000025767	-74%
acenaphthylene	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

	<u>Baseline</u>	<u>Predurability</u>	<u>Postdurability</u>	<u>Postdurability/ Change</u>
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 NO_x 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 grade 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 C₄H₈ 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	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
AST Release				
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	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
Bulk Transport				
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 viscoelasticity 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	Site Characteristics	Likelihood of Occurrence	Risk Assessment Issues	Risk Management Options
Storage at End User Facility				
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 plumbing 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

NTRD Program Disclaimers

1. Disclaimer of Endorsement:

The posting herein of progress reports and final reports provided to TCEQ by its NTRD Grant Agreement recipients does not necessarily constitute or imply an endorsement, recommendation, or favoring by TCEQ or the State of Texas. The views and opinions expressed in said reports do not necessarily state or reflect those of TCEQ or the State of Texas, and shall not be used for advertising or product endorsement purposes.

2. Disclaimer of Liability:

The posting herein of progress reports and final reports provided to TCEQ by its NTRD Grant Agreement recipients does not constitute by TCEQ or the State of Texas the making of any warranty, express or implied, including the warranties of merchantability and fitness for a particular purpose, and such entities do not assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights.

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
3121 Standard Street
Bakersfield, California 93308**

**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



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 CO₂, Rosemont chemiluminescent analyzers for NO_x 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.



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 NO_x 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, NO_x 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 NO_x, 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-----			
	<u>NO_x</u>	<u>THC</u>	<u>NMHC</u>	<u>PM</u>
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

Test No.	Date	Description	THC	NMHC	CO	NOx	NO	CO2	PM	Fuel	Work
		>>>>>>>>>>Grams per BHP-HR<<<<<<<<<<<<<<<									
		lb/bhp-hr hp-hr									
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

ISO 9001:2000 Registered
1370 South Acacia Avenue, Fullerton, California 92831
 Tel (714) 774-3385 Fax (714) 774-4036
 www.ecologiclabs.com



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**

	Average	Untreated Candidate Fuel		HD Engine Emission	
		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**

	Average	Untreated Candidate Fuel		HD Engine Emission	
		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*



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		TEST 4		TEST 5		TEST 6		TEST 7	
	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	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		TEST 20		TEST 21		TEST 22		TEST 45	
	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	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		TEST 47		TEST 49		TEST 50		TEST 51	
	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	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		TEST 56		TEST 57		TEST 59		TEST 60	
	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	Y.INT.	SLOPE	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	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.

¹Minimum.



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:

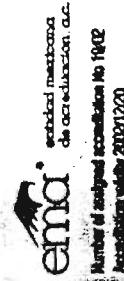
ISO 9001:2000

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



certified membership
de reconnaissance, O.C.
Number of assigned accreditation No 1902
accreditation validy 2003/12/20



W. J. Tilford
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

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



Alan C. Lloyd, Ph.D.
Agency Secretary

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

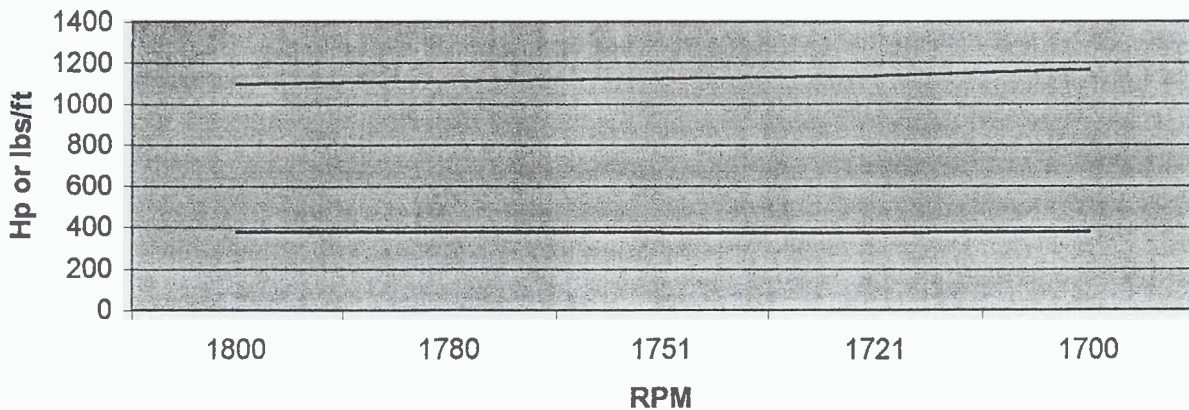
Rod Bearings: NEW STD.

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

Dyno Graph



— Series1 — Series2

VALERO
MARKETING AND SUPPLY COMPANY

Ultra Low Sulfur Diesel

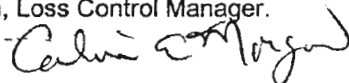
Date: June 8, 2005

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 Gravity 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



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



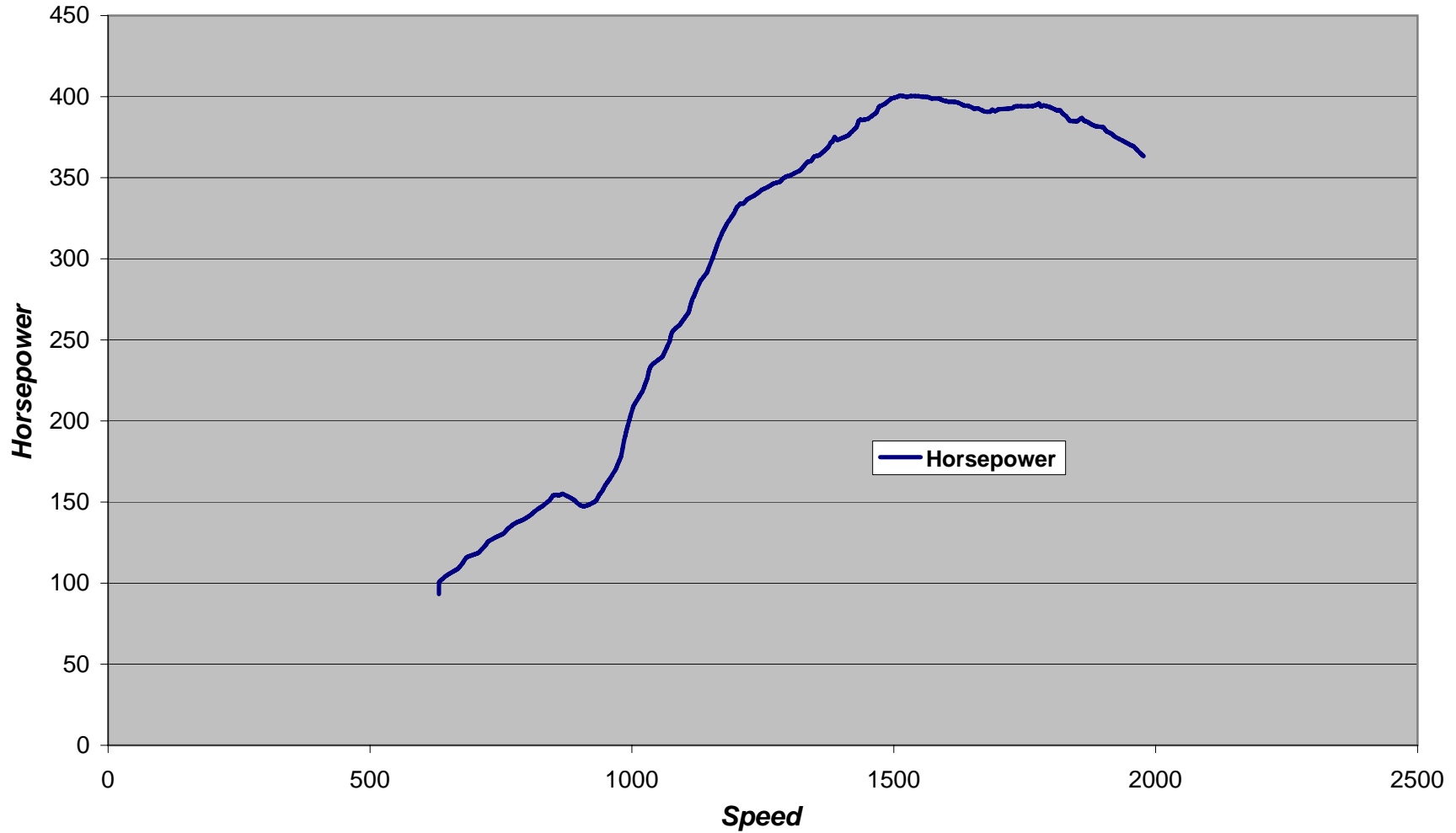
CERTIFICATE OF ANALYSIS

JOB NO.	115976
LAB NO.	LAC05-8737

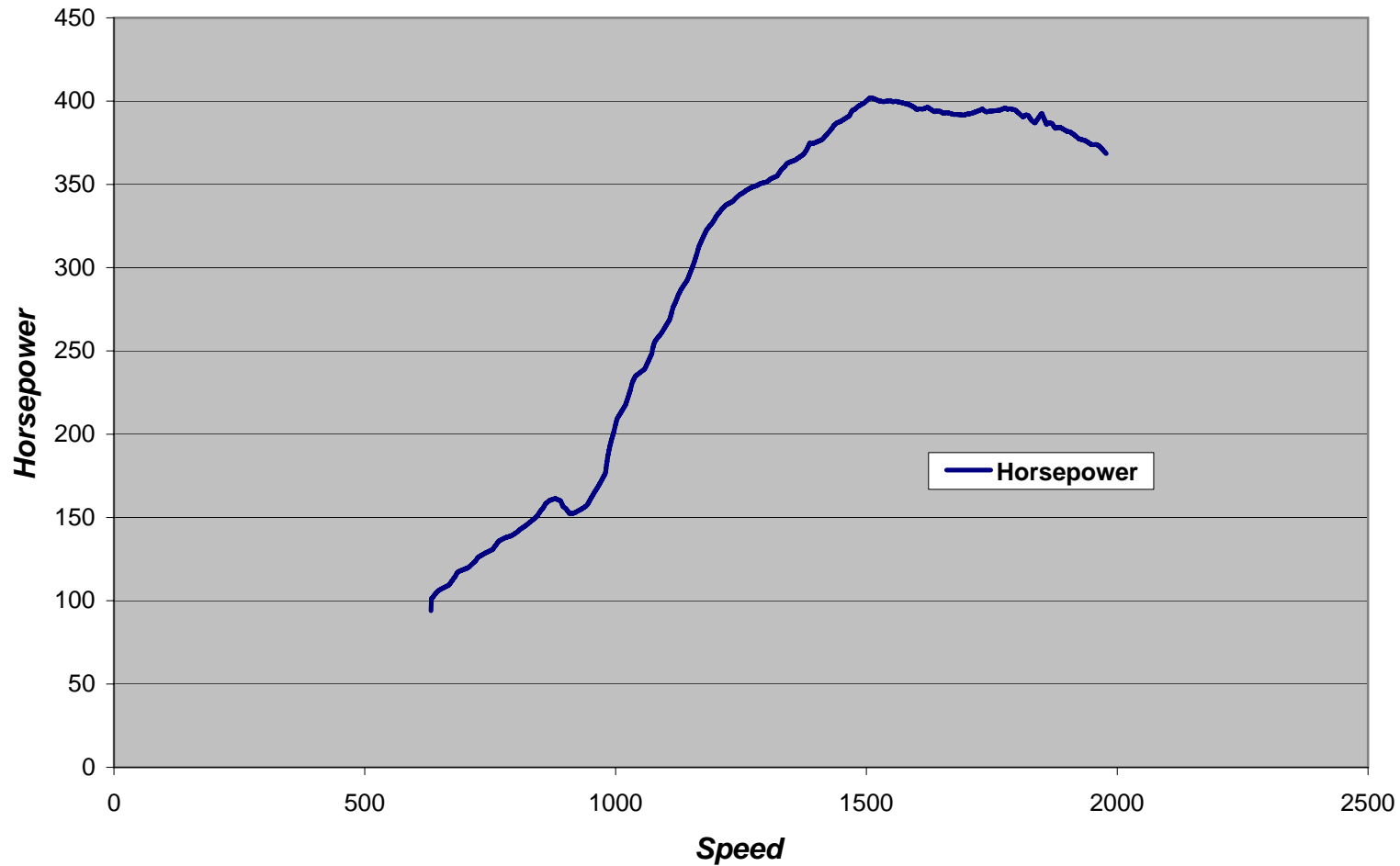
VESSEL	SAMPLING AND ANALYSIS	REPORT DATE	06/03/05
PRODUCT	LOW SULFUR DIESEL		
TERMINAL/PORT	OLSSON - ECOLOGIC		
SAMPLE FROM	TANK 333	DATE SAMPLED	06/02/05
SAMPLE SUBMITTED BY	BSI INSPECTORATE		
ANALYSIS PERFORMED BY	BSI INSPECTORATE		
CLIENT(S) REF.	198501		

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

M-11 Reference Fuel "Test" 6-03-05
Horsepower Mapping (Prior to Test 02)
Standard for All Tests



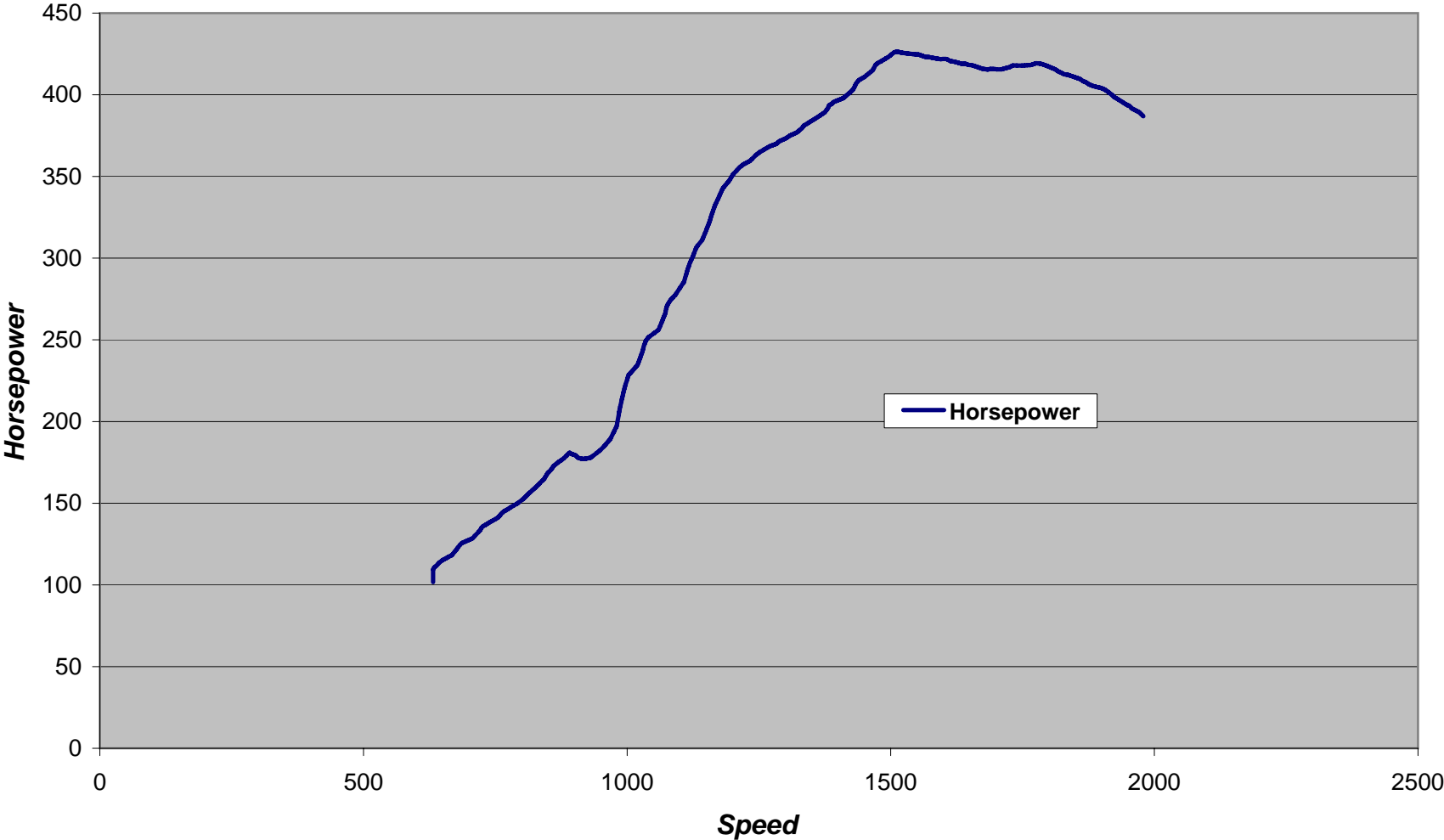
M-11 Reference Fuel 6-04-05
Horsepower Mapping (Prior to Test 06)



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

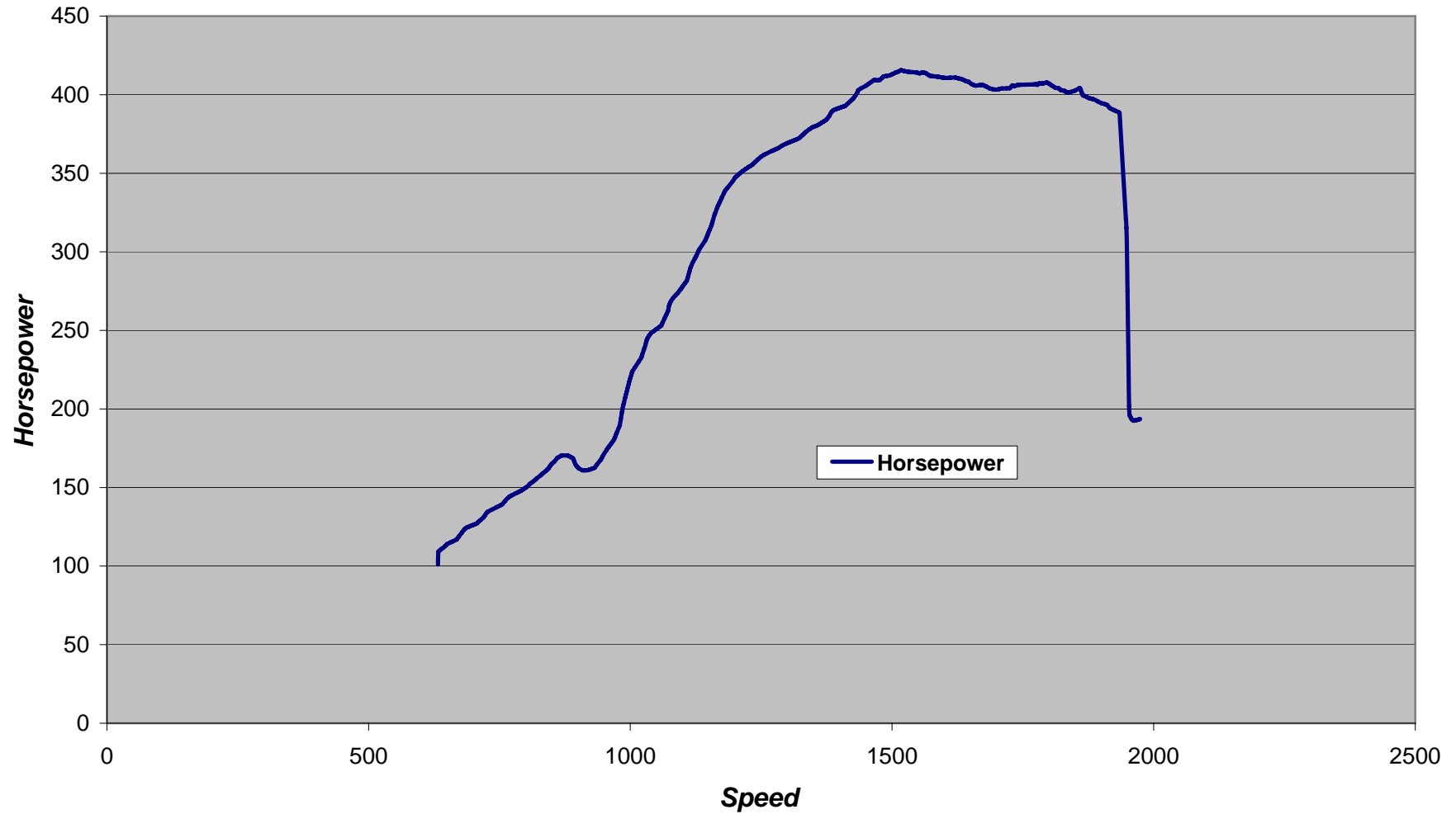


M-11 Candidate Fuel With Viscon 6-28-05
Horsepower Curve (Prior to Test 45)

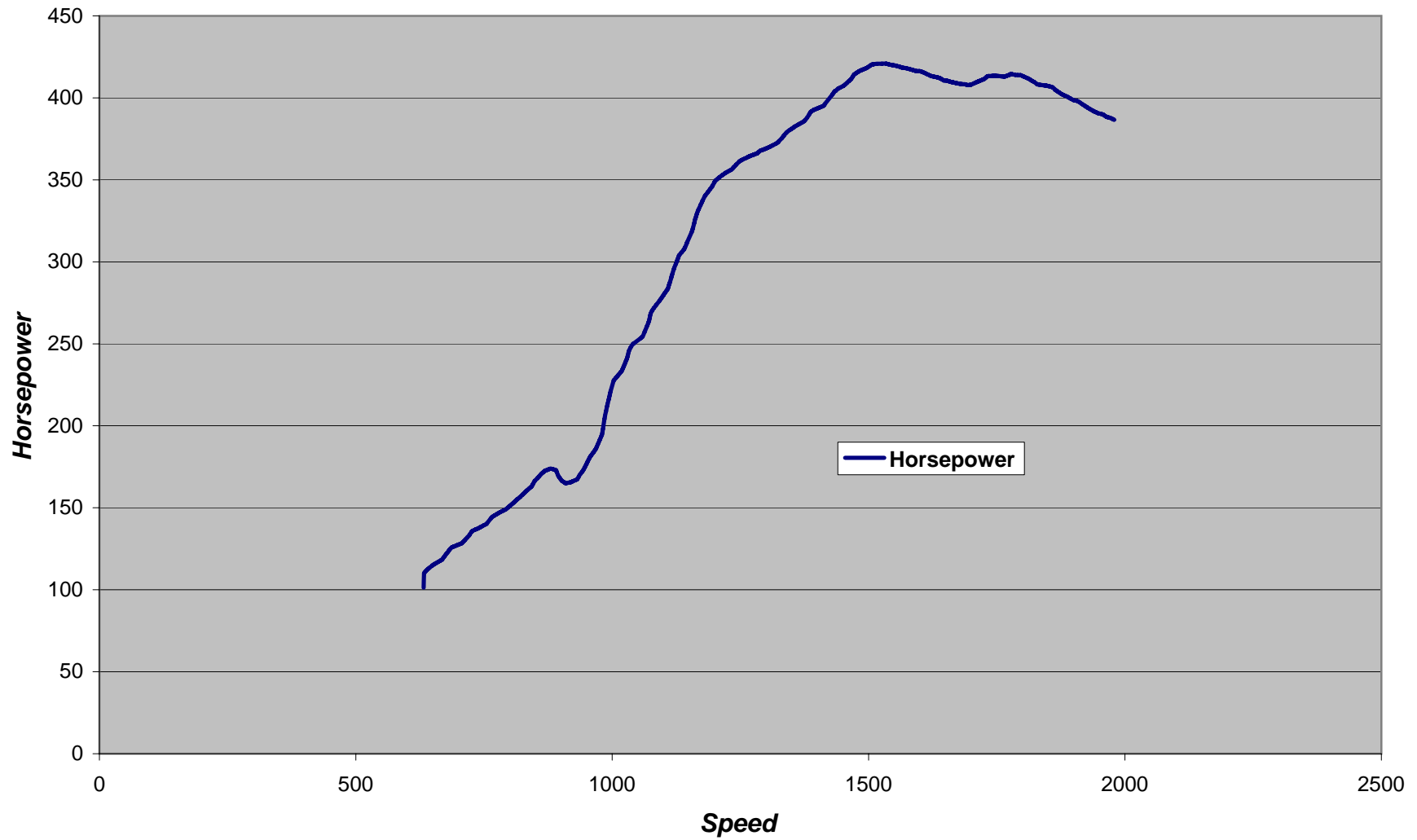


M-11 Candidate Fuel With Viscon II 6-28-05

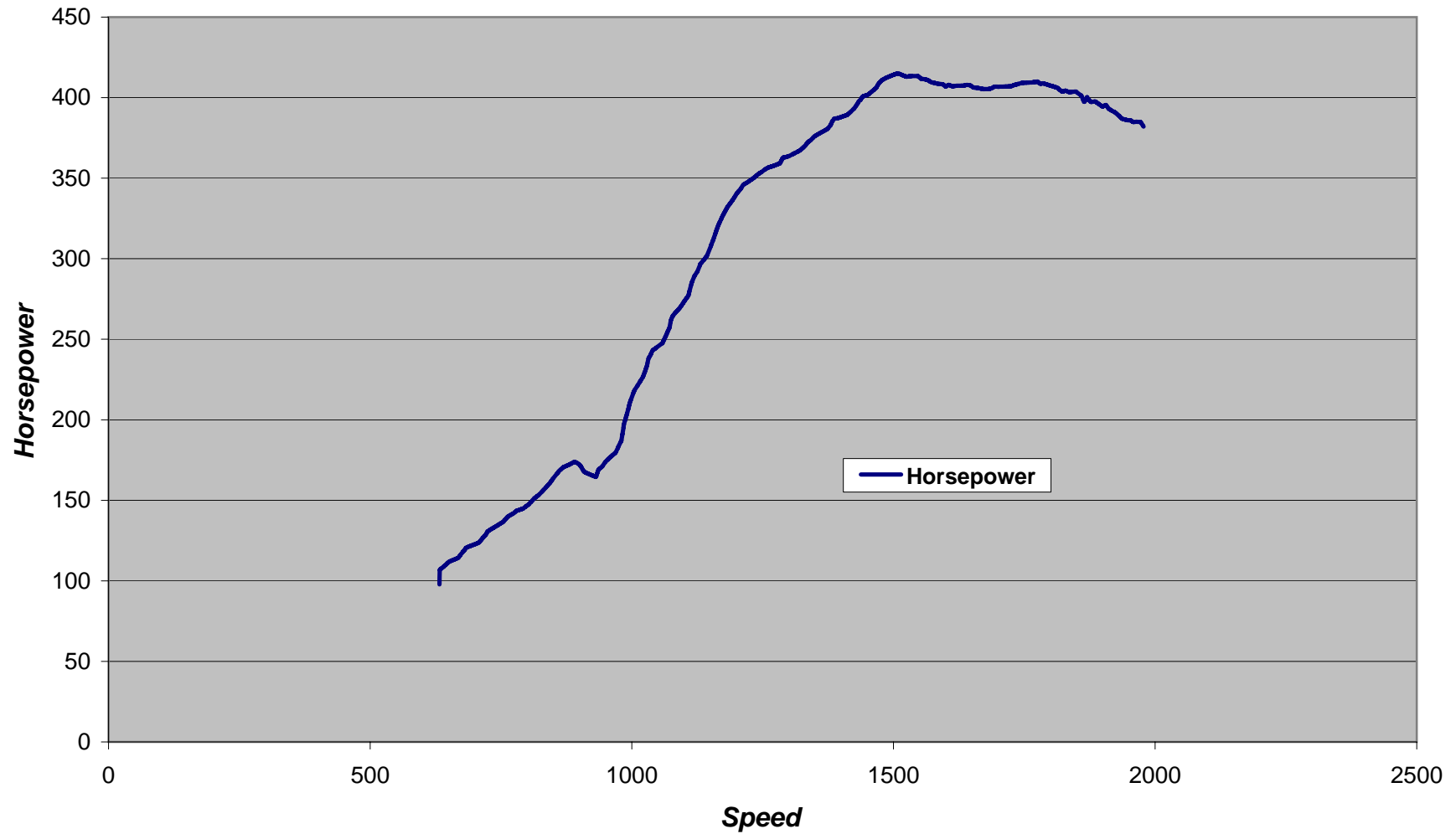
Horsepower Mapping (Prior to Test 49)



M-11 Candidate Fuel with Viscon 6-29-05 Horsepower Mapping (Prior to Test 55)



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

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

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
 Absolute 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

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

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
 Absolute 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

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
 Absolute 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

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
 Absolute 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

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
 Absolute 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

Olson-Ecologic Engine Testing Laboratories, LLC

Heavy Duty Transient Test Results

LPTRANS22 Phase 1

Test Information

Test ID LPTRANS22
 Date Thu, Jun 09, 2005
 Time 7:34 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 1.837237 ppm
 NOx Bag Conc 38.242493 ppm
 NO Bag Conc 32.508038 ppm
 CO2 Bag Conc 0.452355 percent
 CO Bag Conc 28.418339 ppm
 Methane Bag Conc 3.500378 ppm

Bag Background Concentrations

HC Bag Ambient 0.615093 ppm
 NOx Bag Ambient -0.007998 ppm
 NO Bag Ambient 0.350623 ppm
 CO2 Bag Ambient 0.043771 percent
 CO Bag Ambient 9.799233 ppm
 Methane Bag Ambient 2.918870 ppm

Integrated Concentrations Corrected for Background

HC Conc 2.104980 ppm
 NOx Conc 39.556453 ppm
 NO Conc 36.312680 ppm
 CO2 Conc 0.404945 percent
 CO Conc 17.927017 ppm

Dilution/Engine Air Data

Barometric Pressure 29.924649 inHg
 Relative Humidity 40.960499 percent
 Engine Inlet Air Temp 69.963830 deg F
 Absolute Humidity 44.323140 gr/lb

Mass Emissions

HC Mass 2.426931 grams
 NOx Mass 141.653238 grams
 NO Mass 130.437081 grams
 CO2 Mass 14916.649859 grams
 CO Mass 41.575786 grams
 Methane Bag Mass 1.834564 grams

Brake Specific Emissions

HC 0.093057 g/bhp-hr
 NOx 5.431484 g/bhp-hr
 NO 5.001417 g/bhp-hr
 CO2 571.956836 g/bhp-hr
 CO 1.594162 g/bhp-hr
 Non-Methane HC 0.0227 g/bhp-hr

Correction Factors

NOx Humidity CF 0.926819 Kh
 Dry to Wet CF 0.990745 Kw
 Dilution Factor 110.984275 df

Sample Flow Data

Total Volume (Vmix) 71450.811179 scf
 Dilution Flow 64446.771550 scf

Test Cycle Data

Hot-Cold Test 2.000000 1=Cold, 2=Hot
 Test Time 1213.000000 sec
 Total Work 26.080027 bhp-hr
 Reference Work 24.101789 bhp-hr

Fuel Data

Fuel Usage 4357.000000 grams
 BSFC 0.368310 lb/bhp-hr

Particulate 0.200 g/bhp-hr

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
 Absolute 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

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
 Absolute 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

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
 Absolute 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

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
 Absolute 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

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
 Absolute 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

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
 Absolute 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

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

Olson-Ecologic Engine Testing Laboratories, LLC

Heavy Duty Transient Test Results

LPTRANS56 Phase 1

Test Information

Test ID LPTRANS56
 Date Wed, Jun 29, 2005
 Time 12:32 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 1.433621 ppm
 NOx Bag Conc 31.563009 ppm
 NO Bag Conc 24.176653 ppm
 CO2 Bag Conc 0.396525 percent
 CO Bag Conc 26.885455 ppm
 Methane Bag Conc 3.560192 ppm

Bag Background Concentrations

HC Bag Ambient 0.074383 ppm
 NOx Bag Ambient 0.456323 ppm
 NO Bag Ambient -0.170750 ppm
 CO2 Bag Ambient 0.044019 percent
 CO Bag Ambient 9.238004 ppm
 Methane Bag Ambient 3.064902 ppm

Integrated Concentrations Corrected for Background

HC Conc 2.806701 ppm
 NOx Conc 30.616832 ppm
 NO Conc 28.849822 ppm
 CO2 Conc 0.345720 percent
 CO Conc 19.375105 ppm

Dilution/Engine Air Data

Barometric Pressure 30.024732 inHg
 Relative Humidity 26.151604 percent
 Engine Inlet Air Temp 71.666111 deg F
 Absoute Humidity 29.802140 gr/lb

Mass Emissions

HC Mass 3.579929 grams
 NOx Mass 117.345402 grams
 NO Mass 110.400782 grams
 CO2 Mass 14137.246579 grams
 CO Mass 49.021487 grams
 Methane Bag Mass 0.876260 grams

Brake Specific Emissions

HC 0.137027 g/bhp-hr
 NOx 4.491560 g/bhp-hr
 NO 4.225745 g/bhp-hr
 CO2 541.122968 g/bhp-hr
 CO 1.876366 g/bhp-hr
 Non-Methane HC 0.103487 g/bhp-hr

Correction Factors

NOx Humidity CF 0.895535 Kh
 Dry to Wet CF 0.994025 Kw
 Dilution Factor 119.735601 df

Sample Flow Data

Total Volume (Vmix) 77704.757131 scf
 Dilution Flow 70540.516985 scf

Test Cycle Data

Hot-Cold Test 2.000000 1=Cold, 2=Hot
 Test Time 1213.000000 sec
 Total Work 26.125756 bhp-hr
 Reference Work 27.499970 bhp-hr

Fuel Data

Fuel Usage 4278.500000 grams
 BSFC 0.361041 lb/bhp-hr

Particulate 0.160 g/bhp-hr

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
 Absolute 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

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

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
 Absolute 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

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

----- 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:

- o 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.

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

- o 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.

- o 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:

- o A more uniform distribution of droplet size across the cross section of the diesel spray cone.
- o Reduction of the mean volume diameter of the diesel injector spray.
- o A more even distribution of the fuel distributed across the cross section of the spray cone.
- o Elimination of superfine satellite droplets which cause early ignition.
- o Improved spray jet penetration.
- o 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 IRRITATING 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 CLOTHING
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 ARTIFICIAL 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 COMMERCIALY 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 laundry 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 C₄₄ 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 Petroleum 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:

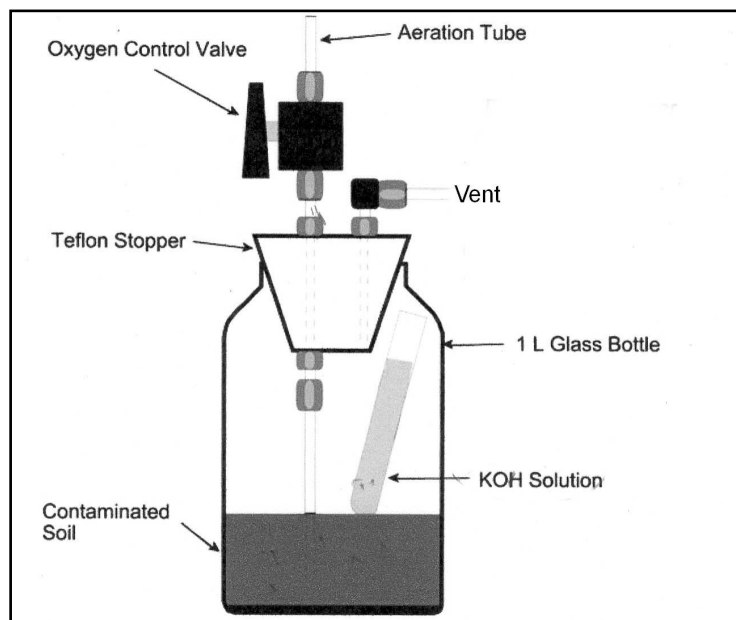
We recommend a sandy loam soil from Georgia with some organic material to be used in this study. The sand/silt/clay and organic carbon content in addition to bulk density, porosity, water content and pH will be determined before testing and at the end. Nutrient addition was required to adjust the C:N:P 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 recommended 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

([Zytner et al., 2000](#))

NB: In view of drawbacks of using a tube of KOH to absorb carbon dioxide for titrimetric 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 μ 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 °C for 1 min. then ramped at 25 degrees per min. to 100 °C

then at 30 deg. Per min. till 200 °C and stay there for 25 min. The splitless inlet is kept at

150 °C, the thermal conductivity detector is kept at 250 °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.

References

- Atlas, R. M. (1981) Microbial degradation of petroleum hydrocarbons: an environmental perspective. *Microbiology Review* pp. 180-209.
- Bossert, I. and Bartha, R. Atlas, R. M. (ed) (1984) The fate of petroleum in soil ecosystems. *Petroleum Microbiology* pp. 453-474. Macmillan Publishing , New York, NY.
- Chaineau, C. H., Morel, J. L. and Oudot, J. (1995) Microbial degradation in soil microcosms of fuel oil hydrocarbons from drilling cuttings. *Enviro. Sci. and Tech.* 29 , pp. 1615-1621.
- Geerdink, M. J., van Loosdrecht, M. C.M. and Luyben, K. Ch.A.M. (1996) Biodegradability of diesel oil. *Biodegradation* 7, pp. 73-81.
- Goudar, C.T and Strevett,KA (1998). *J. Ind. Microbiol. Biotechnol.* 21: 11-18
- Kampbell, D. H. and Wilson, J. T. (1991) Bioventing to treat fuel spills from underground storage tanks. *J. Hazardous Materials* 28 , pp. 75-80.
- KostECKI, P. T. and Calabrese, E. J. (1992) *Contaminated Soils: Diesel Fuel Contamination* Lewis , Boca Raton, FL
- Smith, M. R. (1990) The biodegradation of aromatic hydrocarbons by bacteria. *Biodegradation* 1 , pp. 191-206.

