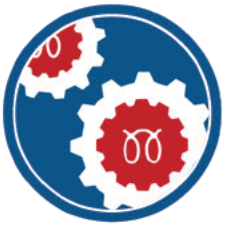
ADF Submission

Stage 1



OPTIMUS

TECHNOLOGIES

ADF STAGE 1 SUBMISSION

6/23/2021

Purpose:
Please find below Optimus Technologies' submission for a Stage 1 ADF EO. The goal of this program is to advance the commercialization of high blends of Biodiesel (B99/B100) to be used in an on-road setting in conjunction with Optimus Technologies Vector System. An overview of the Optimus Vector System is attached to this submission. The purpose of the Stage 1 pilot program will be to assess the impacts of the use of B99 on air quality, the environment and vehicular performance. Information to be collected over the course of this program will be guided by feedback from CARB.

(A) Expected program duration:
The program will last one year. This will allow for the testing of both the fuel and the on-road use of the Optimus Vector System throughout all seasons, in addition to maximizing the road miles accumulated during the allowable testing period.

(B) An estimate of the maximum number of vehicles or engines, engine certification levels, and vehicle types (e.g. urban bus, refuse hauler, line haul truck) involved in the program
Up to 80 vehicles are requested to be authorized for this portion of the ADF; assuming an average of 10,000 gallons of diesel fuel per vehicle, this consumption will fall well below the maximum 1 million diesel equivalent gallons allowable. All vehicles will use NTDEs equipped with DPF and SCR technologies. The initial 13 vehicles will utilize the Cummins/Paccar engine platform and the vehicle types will be Semi Tractors used to haul fuel trailers regionally. Currently, 13 of the 80 vehicles for this program have been identified by the end user; of the initial 13 vehicles selected, 6 vehicles will operate out of the identified Tracy, CA site and 7 vehicles will operate out of the identified Fresno, CA site. Vehicle information is included in appendix A.

(C) The estimated mileage duration per vehicle involved in this stage;
Please see the attached appendix A with fuel usage and mileage information.

(D) The quantity of fuel expected to be used in the pilot program, not to exceed the energy equivalent of one million gallons (approximately 35 million megajoules) of diesel fuel per year, per ADF total;
The total fuel consumption for the first 13 trucks of this program is expected to be approximately 125,000 gallons of B99. Since the energy content of Biodiesel is roughly 8 percent less by volume than that of Diesel, this would be a diesel gallon energy equivalent of 115,000 gallons.

(E) The site(s) in which the testing during this stage will be conducted (including the street address, city, county, and zip code)
The initially selected fleet vehicles to be used in this pilot program will be based out of two sites located in the San Joaquin Valley Air Pollution Control District. The addresses can be found below.

[redacted]

(F) The manner in which the distribution pumps will be labeled to ensure proper use of the test fuel and meet California's fuel labeling requirement in accordance with California Business and Professions Code, section 13480(a);
The distribution pumps for the fuel will be labeled as B99 according to CBP Code. The fuel will be located in a private lot, not available for retail sale. Additionally, the fuel will be controlled by Optimus' SMARTFuel RFID fuel management system and will only be permitted to be filled in vehicles which are equipped with the appropriate RFID ring tag. The ring tags are affixed to the vehicles and cannot be easily moved between vehicles; this ensures that the fuel will only be used in the B99 fuel tanks of the participating vehicles. Fuel transactions per truck will be logged via electronic pulse meter (see attached Fillrite pulser specification in Appendix C).

(G) The name, address, telephone number, title of the person(s) and the name of the company or organization requesting entry into a Stage 1 pilot program; and
Kevin Smyth
6901 Lynn Way, Pittsburgh PA 15208
(412)727-8228x5
Senior Mechanical Engineer
Optimus Technologies, Inc.

(H) If different from the information in (G) above, the name, address, telephone number and title of the person(s) and the name of the company or organization responsible for recording and making the information specified above available to the Executive Officer and the location in which such information will be maintained.
Same as above.

(I) Chemical and physical properties of the candidate ADF: complete chemical speciation, Chemical Abstract Services (CAS) numbers (if available), density, energy content, vapor pressure, oxidative potential, distillation curve, log Kow (water-octanol partition coefficient), and Henry's law coefficient.

Fatty Acid Methyl Esters (CAS 67762-26-9)
Relative Density: 0.87-0.89 @ 25°C
Energy Content (Lower Heating Value): 119,550 Btu/gal
Vapor Pressure: <2 mmHg
Oxidative Potential: Please refer to the CARB Multimedia Report (attached as Appendix F to this submission), which states in Appendix E: "In conclusion, OEHHA cannot determine with certainty whether replacing PD by BD or BD-PD blends for on-road motor vehicle use will reduce adverse human health impacts attributable to oxidative stress and inflammation from toxic chemicals in diesel-engine emissions. The reduction in carcinogen emissions indicates a reduction in cancer risk from use of BD."

Distillation Curve:
Distillation Curve, Degrees F (Degrees C):

IBP	602.20 F	(316.78 C)
10 % recovered	622.80 F	(328.22 C)
50 % recovered	630.70 F	(332.61 C)
90 % recovered	647.50 F	(341.94 C)
End Point	665.20 F	(351.78 C)
Recovery, vol %	98.85	
Residue, vol %	0.71	
Loss, vol %	0.51	

Log Kow (Water-Octanol Partition Coefficient): 7.45
Henry's Law Coefficient: 0.014 atm-cu m/mole

This information was compiled from the following sources:

- The attached SDS of REG-produced biodiesel in Appendix D
- The fifth edition of the Biodiesel Use and Handling guide produced by DOE/NREL (also attached to this submission as Appendix E)
- Log-Kow and Henry's Law Coefficient Sourced from: https://pubchem.ncbi.nlm.nih.gov/compound/Methyl-oleate#section=LogP
- Distillation Curve provided by results derived from samples analyzed as part of the Diesel National Exchange Program on Cetane Number, Courtesy of the NBB

(J) Environmental information about the ADF: Material Safety Data Sheet(s) (MSDS) for all components of the candidate ADF, production process diagram, identification of potential human health or environmental effects, lifecycle flow diagram (including all stages of the process-raw material extraction, manufacturing, distribution, use and disposal including all intervening transportation steps), and potential release scenarios during production (including by-products), transportation and use.
Please refer to the CARB Multimedia Report (attached as Appendix F). The above information can be found as follows:

- Production Process Diagram: Page I-15
- Potential Human Health/Environmental Health Effects: Summarized conclusions on pages 17-18
- Lifecycle Flow Diagram: Page I-68
- Potential Release Scenarios: Pages 12-17

(K) A statement whether the fuel will be blended with diesel, whether it can be used as a neat fuel, or whether it can be used either way.
Biodiesel can be used neat or blended at any concentration with conventional diesel fuel. For the purposes of this pilot program, the fuel will consist of 99% biodiesel meeting the ASTM D6751 standard and 1% CARB Diesel meeting the ASTM D975 standard.

(L) Plan for commercialization under this regulation.

[redacted]

(M) Emissions testing completed on criteria pollutants.
Emissions testing on biodiesel has been completed on a number of different engine platforms. However, testing on a modern, SCR-equipped engine is limited. All participating vehicles in this project will be NTDE's. That being said, the CARB Multimedia Report includes the following conclusions on biodiesel emissions of non-NTDE engines (found on Page 17):

- Biodiesel reduces PM emissions in diesel exhaust.
- Biodiesel reduces emissions and health risk from PM in diesel exhaust, a toxic air contaminant identified by ARB.
- Biodiesel reduces CO emissions in diesel exhaust.
- Biodiesel reduces THC emissions in diesel exhaust.
- Biodiesel at certain blend levels increases NOx emissions in diesel exhaust.

Additionally, the CARB Multimedia Report cites NREL's research on SCR-equipped engines and states (found on Page 12):

"Engines that meet the latest emission standards through the use of Selective Catalytic Reduction (SCR) systems have been shown to have no significant difference in NOx emissions based on the fuel used. A study conducted by the National Renewable Energy Laboratory looked at two Cummins ISL engines equipped with SCR systems. Results showed that the use of SCR was effective at reducing NOx to near the detection limit on all duty cycles and fuels, including B100."

The CARB multimedia report is attached to this submission.

(M con't)
Appendix J includes proprietary emissions testing conducted at WVU CAFEE by Optimus Technologies over the road using a PEMs unit.

Additionally, the studies below are current literature examples of criteria emissions testing completed utilizing biodiesel with NTDEs.

Karavalakis et al., Emissions and Fuel Economy from Two Current Technology Heavy-Duty Trucks Operated on HVO and FAME Blends, SAE Int. J Fuels Lubr., 9(1):2016

Lammert et al., Effect of B20 and Low Aromatic Diesel on Transit Bus NOx emissions Over Driving Cycles with a Range of Kinetic Intensity, SAE Int. J Fuels Lubr., 5(3):2012

Gysel et al., Emissions and Redox Activity of Biodiesel Blends Obtained from Different Feedstocks from a Heavy-Duty Vehicle Equipped with DPF/SCR Aftertreatment and a Heavy-Duty Vehicle without Control Aftertreatment, SAE 2014-01-1400 Published 04/01/2014

McWilliam et al., Emission and Performance Implications of Biodiesel Use in an SCR-equipped Caterpillar C6.6 2010-012157 Published 10/25/2010

Mizushima et al., Effect of Biodiesel on NOx Reduction Performance of Urea-SCR System 2010-01- 2278 Published 10/25/2010

Walkowicz et al., On-Road and In-Laboratory Testing to Demonstrate Effects of ULSD, B20, and B99 on a Retrofit Urea-SCR Aftertreatment System, SAE Int. 2009-01-2733

(N) Attestation that the vehicles to be used in the pilot program are owned by the applicant or the applicant has received written consent from their owners.
Please see appendix B for a signed confirmation of the fleet agreement.

(O) The vehicle identification number (VIN) of each vehicle participating in the pilot program, if known.
Please find this information in Appendix A.

(P) Affirmative statement that the owner(s) of all vehicles to be used in the applicant's pilot program are aware of any possible warranty issues that may arise from the use of the candidate ADF or candidate ADF/CARB diesel blend in their engines.
Please see appendix B for confirmation of the end user's awareness of associated risks.

(Q) One of the following:
Attachment A: Final Regulation Order Page A-9/A-40
1. A declaration that a fuel standard has been approved for the ADF pursuant to Chapter 14 of the Business and Professions Code (section 13400 et seq.); or if no such standard exists,
2. A copy of the developmental fuel variance application that the applicant has submitted to the California Department of Food and Agriculture pursuant to Business and Professions Code section 13405, proof of its approval, and a declaration that:
a. The requirements of Business and Professions Code sections 12001– 13800, other than those pertaining to fuel quality, have been met, and

b. The California Department of Food and Agriculture received a copy of the application required to be submitted under 13 CCR 2293.5.
Please see the attached fuel variance letter (Appendix G) and the attached fuel variance application (Appendix H).

(R) Proof that the candidate fuel complies with the U.S. Environmental Protection Agency requirements at 40 Code of Federal Regulations part 79.
Biodiesel is a registered fuel under 40 CFR 79. A list of all registered Biodiesel can be found on the EPA's website. Please find the link below. The fuel used for this program will be a registered fuel from this list.

https://www3.epa.gov/otaq/fuels1/ffars/web-biodiesel.htm#R

(S) It is the responsibility of the applicant to identify any specific portion of the information submitted above as trade secret. Any such trade secret information identified by the applicant shall be treated pursuant to 17 CCR 91000—91022 and the California Public Records Act (Government Code section 6250 et seq.).

Optimus Technologies would request that section L, in addition to appendices A, B, and J remain trade secret.

Submitted By:

Kevin Smyth, Senior Mechanical Engineer

ADF Submission

Appendix A

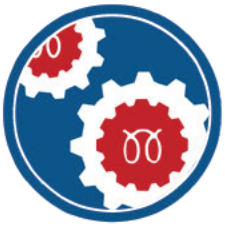
OPTIMUS

TECHNOLOGIES

Location 1: [redacted]									
Truck #	Year	Make	Model	VIN #	Engine Make	Engine Model	Description of Truck/Use	Estimated Fuel Volume Annually	Estimated Mileage Annually
[redacted]	2019	Kenworth	T880	[redacted]	Paccar	Mx 13	Tractor w th sem Tra er	13,588 Ga ons	87,948 m es
	2018	Kenworth	T880		Paccar	Mx 13	Tractor w th sem Tra er	4,082 Ga ons	27,500 m es
	2018	Kenworth	T880		Paccar	Mx 13	Tractor w th sem Tra er	3,370 Ga ons	27,262 m es
	2017	Kenworth	T880		Paccar	Mx 13	Tractor w th sem Tra er	9,496 Ga ons	57,912 m es
	2017	Kenworth	T880		Paccar	Mx 13	Tractor w th sem Tra er	14,969 Ga ons	92,643 m es
	2015	Kenworth	T880		Cumm ns	ISX 15	Tractor w th sem Tra er	6,123 Ga ons	37,016 m es
Location 2: [redacted]									
Truck #	Year	Make	Model	VIN #	Engine Make	Engine Model	Description of Truck/Use	Estimated Fuel Volume Annually	Estimated Mileage Annually
[redacted]	2018	Kenworth	T880	[redacted]	Paccar	Mx 13	Tractor w th sem Tra er	15,228 Ga ons	106,357 M es
	2018	Kenworth	T880		Paccar	Mx 13	Tractor w th sem Tra er	10,462 Ga ons	65,422 M es
	2017	Kenworth	T880		Paccar	Mx 13	Tractor w th sem Tra er	9,667 Ga ons	66,597 M es
	2017	Kenworth	T880		Paccar	Mx 13	Tractor w th sem Tra er	12,301 Ga ons	85,738 M es
	2015	Kenworth	T880		Cumm ns	ISX 15	Tractor w th sem Tra er	11,002 Ga ons	78,484 M es
	2014	Kenworth	T680		Paccar	Mx 13	Tractor w th sem Tra er	6,772 Ga ons	47,065 M es
	2013	Kenworth	T660		Paccar	Mx 13	Tractor w th sem Tra er	7,873 Ga ons	48,344 M es

ADF Submission

Appendix B



OPTIMUS

TECHNOLOGIES

Revised: 5.17.19

California Supplemental Regulatory Information – Optimus Developmental Fuel

Company Information

Fleet Company Name ("Fleet"):

[redacted]

Primary Fleet Contact:

[redacted]

Fleet Legal Address:

[redacted]

In conjunction with deployment of Optimus Proposal [redacted], Optimus is required to collect and submit supplemental information to various California regulatory entities regarding Fleet usage of high biodiesel blends and Fleet's acknowledgement of the risks associated with the use of Optimus' developmental fuel and emerging technology in California.

Fleet Information

Total number of vehicles/equipment within fleet:

[redacted]

Total number of vehicles/equipment participating in the Optimus pilot:

[redacted]

Refueling Information

Developmental fuels will be restricted to only the participating fleet vehicles by the means of a cardlock or an RFID-equipped nozzle. No other fleet vehicles or retail customers will have access to the alternative fuel. There will be two fueling locations for this project.

Location 1: [redacted]

Location 2: [redacted]

Fleet Certification

Fleet acknowledges and agrees that the above information provided to Optimus is true and correct. In the event that Fleet discovers any submitted information to be incorrect, Fleet will notify Optimus immediately and within 5 business days of discovery provide Optimus with a revised California Supplemental Regulatory Information form. Fleet acknowledges and agrees that the Optimus fuel system technology and products are unique, complex and will be interacting with and integrated into the Vehicles/Equipment specified above and will be utilized in conjunction with the developmental fuel. As such, even though Optimus has made every attempt to determine the impact that the technology and developmental fuel could potentially have on the Vehicles/Equipment specified above Fleet acknowledges and accepts the risks associated with utilizing the emerging technology and developmental fuel. Fleet authorizes Optimus to share provided information with necessary California regulatory entities.

Date:

Fleet:

By:

Name:

Title:

ADF Submission

Appendix C

OPTIMUS

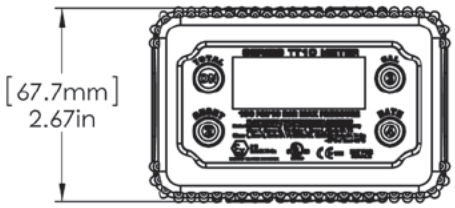
TECHNOLOGIES

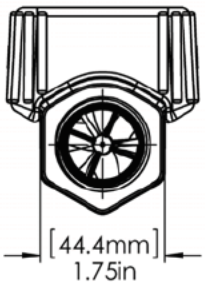
FILL-RITE®

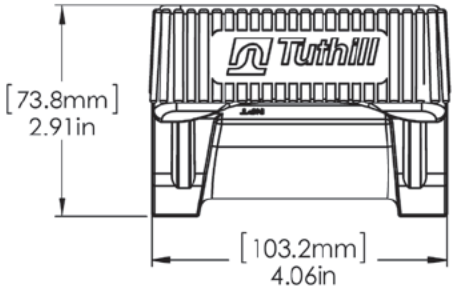
The Most Trusted Name in Pumps and Meters

TT10A / TT10ANC Series

In-Line Digital Turbine Meter Technical Specifications







Technical Information

Flow Ports	1" NPT or BSPP female inlet and outlet ports
Flow Range	2 to 35 U.S. GPM / 7.6 to 132.5 LPM
Working Pressure	50 PSI (3.4 Bar)MAX UL 300 PSI (20.7 Bar) Burst
Storage Temperature	-40°F to 176°F (-40°C to 60°C) *(No Liquids)*
Operating Temperature	-40°F to 176°F (-40°C to 60°C)
Measurement Accuracy	±1.0% (After field calibration)
Measurement Repeatability	±0.30% (Batch sizes ≥ 2 Gallons)
Measurement Units	Ounce, Pint, Quart, Liter, Gallon
Totalizer Range	0 - 90,000,000 Units

Batch Range	0.00 - 9999 Units *(Blinks when Batch exceeds 9999)*
Wetted Materials	304/316 Stainless Steel, Aluminum, Acetal, Gold
Display	-40°F to 176°F (-40°C to 60°C)
Power	2 approved alkaline batteries. See battery replacement section of the manual
Memory	Meter totals and calibration are preserved when replacing batteries
Safety	Intrinsically safe electronics for use in hazardous locations.

Tuthill
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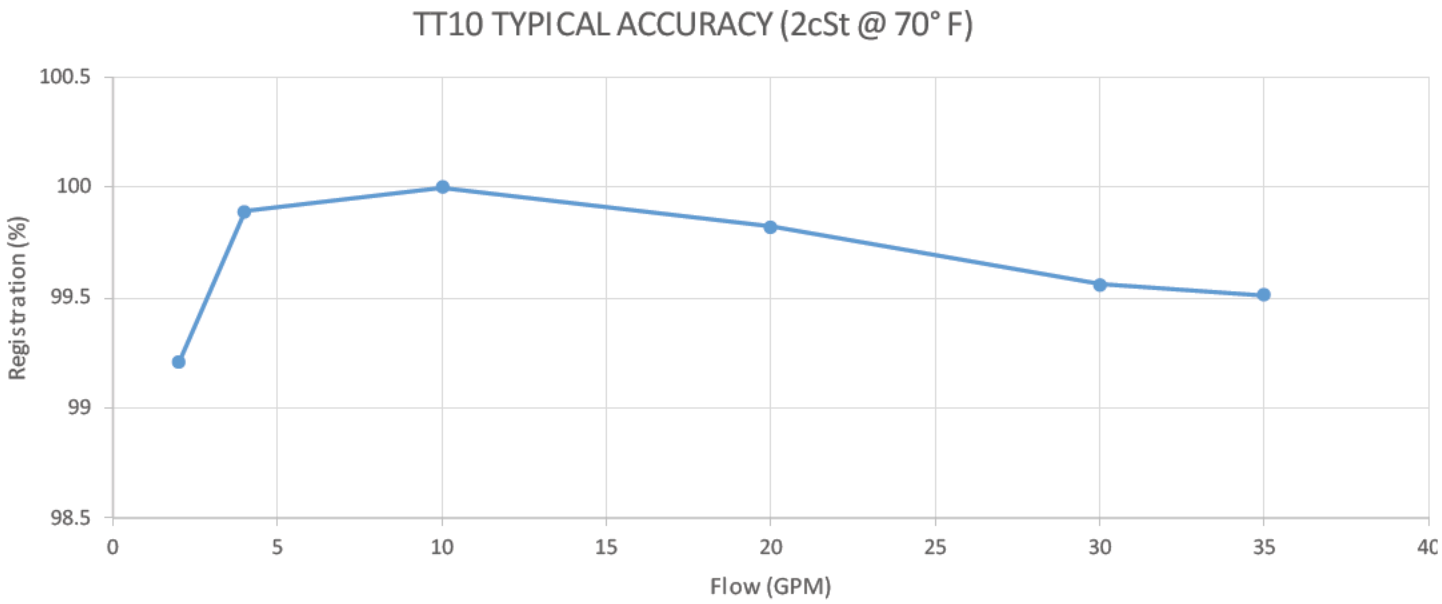

Fluid Compatibility

- Gasoline
- Diesel
- Kerosene
- Hexane
- E85*
- Jet Fuel*
- Heptane
- Non-Potable Fresh Water
- B100 Biodiesel*
- Lavatory Water*
- Mineral Spirits*

* TT10ANC Nickel plated models only

Safety Testing Approvals

The Fill-Rite TT10 Series meters have been tested for compliance to the standards set forth by Underwriters Laboratories (UL), UL Canada, ATEX, and other testing organizations. **To determine which specific compliances apply to your particular meter, refer to the faceplate for information and compliance logos.**

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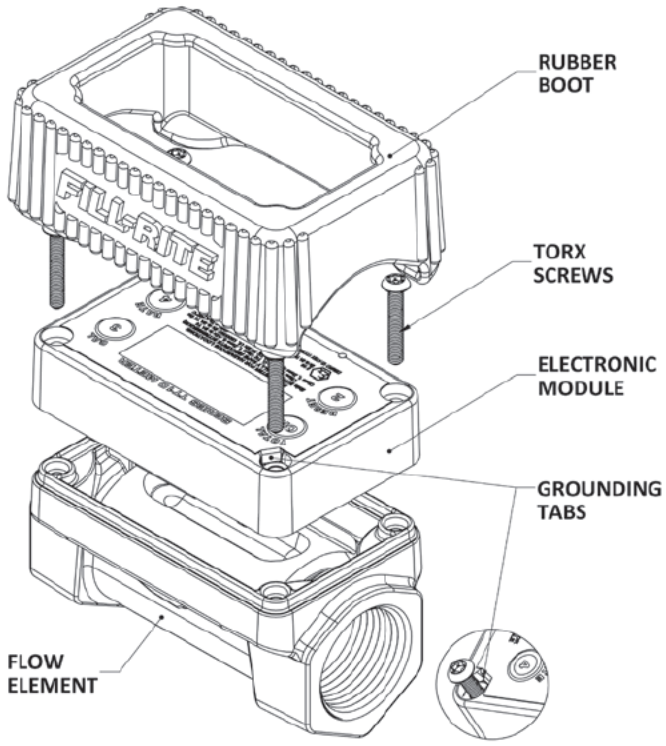
CE

Ex

Certifications are applicable to all meter components.

Meter Assembly



Tuthill PUMP YOUR HEART INTO IT

Tuthill Corporation
8825 Aviation Drive
Fort Wayne, IN 46809
800-634-2695

FILLRITE.COM

ADF Submission

Appendix D

OPTIMUS

TECHNOLOGIES

Safety Data Sheet (SDS)

ID: SDS 101-US

Section 1 – Identification

Product identifier	**Biodiesel (B99.9)**
Other means of identification	
Synonyms	Biodiesel, fatty acid methyl esters, B100, B99, B99.9, FAME
Recommended use	Fuel, solvent, cleaning agent, heating oil, blend stock
Restrictions on use	Not intended for direct human consumption
Supplier information	REG Marketing & Logistics Group, LLC 416 S. Bell Ave Ames, IA 50010 (888) 734-8686
Emergency phone number	**For Hazardous Materials [or Dangerous Goods] Incident, Spill, Leak, Fire, Exposure, or Accident** **Call CHEMTREC Day or Night:** **Domestic: 1-800-424-9300** **International: +1 703-741-5970**

Section 2 – Hazard(s) Identification

Classification (in accordance with 29 CFR 1910.1200)

Hazard Class	Hazard Category	Route of Exposure
Skin Irritation	Category 2	Absorption
Eye Irritation	Category 2B	Absorption
Carcinogenicity	Category 2	Contact

Signal word: **WARNING**

Pictograms:

Hazard Statements

H315 Causes skin irritation
H320 Causes eye irritation
H351 Suspected of causing cancer

Precautionary statements

Prevention: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves/protective clothing/eye protection/face protection. Wash hands thoroughly after handling.

Response: If exposed or concerned: Get medical advice/attention. If on skin, wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash it before reuse. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

Storage: Store locked up.

Disposal	Dispose of contents/container in accordance with local, state, and federal regulations.
Hazards not otherwise specified	None identified

Section 3 – Composition / Information on Ingredients

Chemical Name	Common Name & Synonyms	CAS number	% of product
Fatty acids, C14-18 and C16-18-unsatd., Me esters	Biodiesel, Fatty Acid Methyl Esters	67762-26-9	99-100%
Petroleum Fuel Oil	Diesel Fuel	68476-30-2	<1%

Section 4 – First-Aid Measures

First-aid measures for exposure

Inhalation	Move to fresh air. If feeling unwell, seek medical attention.
Skin	If on skin, wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash it before reuse.
Eyes	If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
Ingestion	Rinse mouth out with water. If feeling unwell, seek medical attention.

Most important symptoms / effects

Acute	Causes skin irritation. Causes eye irritation.
Delayed / Chronic	Suspected of causing cancer.

Indication of immediate medical attention	Treat symptomatically and supportively.
Special treatment needed, if necessary	No special treatment identified.

Section 5 – Fire-Fighting Measures

Suitable extinguishing media	Water mist, firefighting foam, dry chemical, carbon dioxide, or clean extinguishing agents (such as Halon or Halotron)
Unsuitable extinguishing media	Do not use a solid water stream, as it may scatter and spread the fire
Specific hazards arising from the chemical	May burn if heated, but does not readily ignite. Materials saturated with this product, such as oily rags, used oil dri, soaked insulation pads, etc., may spontaneously combust due to product decomposition in the presence of oxygen. Place all such

	materials into appropriate oily waste containers (such as metal cans with metal lids or oily waste dumpsters with lids), and dispose of according to local, state, and federal regulations.
Hazardous combustion products include	Carbon monoxide, carbon dioxide, nitrogen oxides, and hydrocarbons
Protective equipment and precautions for firefighters	Incipient stage fires may be controlled with a portable fire extinguisher. For fires beyond the incipient stage, evacuate all unnecessary personnel. Emergency responders in the immediate area should wear standard firefighting protective equipment, including self-contained breathing apparatus (SCBA) and full bunker gear. In case of external fires in proximity to storage containers, use water spray to keep containers cool, if it can be done safely. Prevent runoff from entering streams, sewers, storm drains, or drinking water supply.

Section 6 – Accidental Release Measures

Personal precautions, protective equipment, and emergency procedures	Keep all sources of ignition away from spill. Wear protective garments, impervious oil resistant boots, protective chemical-resistant gloves, and safety glasses. If product has been heated, wear appropriate thermal and chemical protective equipment. If splash is a risk, wear splash resistant goggles and face shield. Shut off source of spill, if safe to do so. Contain spill to the smallest area possible. Isolate immediate hazard area and remove all nonessential personnel. Prevent spilled product from entering streams, sewers, storm drains, unauthorized treatment drainage systems, and natural waterways. Place dikes far ahead of the spill for later recovery and disposal. Immediate cleanup of any spill is recommended. **If material spills into or upon any navigable waters and causes a film or sheen on the surface of the water, immediately notify the National Response Center at 1-800-424-8802.**
Methods for containment and clean-up	
Small spill / incidental release	Small spills can be cleaned up with a properly rated vacuum system, absorbent inert media (oil dri, sand, or earth), or absorbent pads. Use soapy water or degreaser to remove oily residue from the affected area, then rinse area with water. Place saturated materials in an appropriate oily waste container (metal can with a metal lid or an enclosed oily waste dumpster), and dispose of according to local, state, and federal regulations.
Large spill / release	A spill remediation contractor with oil booms and skimmers may be needed for larger spills or spills that come into contact with a waterway or sensitive wetland. Recover as much product as possible by pumping it into totes or similar intermediate containers. Remove any remaining product with a properly rated vacuum system, absorbent inert media (oil dri, sand, or earth), or absorbent pads. Use soapy water or degreaser to remove oily residue from the affected area, then rinse area with water. Place saturated materials in an appropriate oily waste container (metal can with a metal lid or an enclosed oily waste dumpster), and dispose of according to local, state, and federal regulations.
Other information	Materials saturated with this product, such as oily rags, used oil dri, soaked insulation pads, etc., may spontaneously combust due to product decomposition in the presence of oxygen. Place all such materials into appropriate oily waste containers (such as metal cans with metal lids or oily waste dumpsters with lids), and dispose of according to local, state, and federal regulations.

Section 7 – Handling and Storage

Precautions for safe handling	When transferring product, use pipes, hoses, and tanks that are electrically bonded and grounded to prevent the accumulation of static electricity.

Conditions for safe storage, including incompatibilities	Keep away from strong oxidizing agents, strong reducing agents, strong acids, and strong bases. Store the product in a cool dry place, in a tightly closed container. Storage tanks should have an appropriate ventilation and pressure relief system.

Section 8 – Exposure Controls / Personal Protection

Precautions for safe handling	When transferring product, use pipes, hoses, and tanks that are electrically bonded and grounded to prevent the accumulation of static electricity.
Component exposure limits	At this time, the constituents have no known exposure limits.
Appropriate engineering controls	Keep product enclosed in primary containment (hoses, pipes, tanks, etc.) to avoid contact with skin. Handle in accordance with good industrial hygiene and safety practices.
Individual Protection Measures	
Personal protective equipment	
Eyes / face	Wear safety glasses. If splash potential exists, use splash resistant goggles and a face shield.
Skin	Wear disposable nitrile or other similar chemical-resistant gloves for incidental contact. For more substantial contact, wear thicker nitrile or other similar chemical-resistant gloves. Wear protective garments, such as a chemical apron, chemical resistant coveralls, or chemical resistant coat and pants, along with impervious oil-resistant boots. Remove soaked protective equipment, decontaminate with soapy water, and rinse thoroughly before reuse. **Note**: product will cause natural rubbers to degrade at a very rapid rate. Such protective equipment will need to be carefully inspected after decontamination to see if it is still in serviceable condition. Any defective or worn out equipment should be immediately discarded.
Respiratory	No exposure limits are available, but appropriate organic vapor or supplied air respiratory protection may be worn if irritation or discomfort is experienced. Respiratory protection must be provided and used in accordance with all local, state, and federal regulations.

Section 9 – Physical and Chemical Properties

Appearance - Physical State:	Liquid	**Appearance - Color:**	Water white to pale yellow to brown if undyed
Odor:	Mild oily or animal fat odor	**Odor Threshold:**	*No information available*
pH:	Not applicable	**Melting/Freezing Point:**	-1°C to 20°C / 30°F to 68°F
Boiling Point/Range:	>280°C / 536°F (at 1 atm)	**Flash Point:**	>93°C / >200°F (ASTM D93)
Evaporation Rate:	*No information available*	**Flammability (solid/gas):**	*No information available*
LFL:	*No information available*	**UFL:**	*No information available*
Vapor Pressure:	*No information available*	**Vapor Density:**	*No information available*
Relative Density:	0.87-0.89 @ 25°C	**VOC:**	*No information available*
Solubility (H_20):	Negligible	**Solubility *(other)*:**	*No information available*
Auto Ignition Temp.:	*No information available*	**Decomposition Temp.:**	*No information available*
Viscosity @ 40°C:	3.8-5.0 cSt	**Partition coefficient** (n-octanol/water) **:**	*No information available*

Section 10 – Stability and Reactivity

Reactivity	When handled and stored appropriately, no dangerous reactions are known
Chemical stability	Stable in closed containers at room temperature under normal storage and handling conditions
Possibility of hazardous reactions	When handled and stored appropriately, no dangerous reactions are known See Sections 5 and 6 regarding spontaneous combustion of product-saturated absorbent materials.
Conditions to avoid	Ignition sources, accumulation of static electricity, heating product to its flash point, or allowing the product to cool below its melting point (otherwise it may solidify and not be transferable until it is reheated).
Incompatible materials	Keep away from strong oxidizing agents, strong reducing agents, strong acids, and strong bases.
Hazardous decomposition products	Carbon oxides, hydrogen sulfide, nitrogen oxides, and hydrocarbons

Section 11 – Toxicological Information

Likely routes of exposure	Absorption, ingestion, and inhalation
Symptoms	
Inhalation	Coughing or irritation
Ingestion	Nausea, vomiting, or feeling unwell
Skin contact	Redness or irritation
Eye contact	Redness or irritation and tearing
Acute toxicity	
Oral	LD50 >17,500mg/kg (rat) estimated
Dermal	LC50 >2000mg/kg (rat)
Inhalation	No information available
Skin corrosion / irritation	(rat) after 24 hr exposure, some irritation which subsided within 12 – 14 days (human) after 24 hr exposure, some minor irritation (less than that of a 4% soap & water solution)
Serious eye damage / eye irritation	Industrial experience has shown that product in the eyes can cause redness and irritation which subsides within 7 days.
Sensitization *(Respiratory or Skin)*	*No information available*
Germ cell mutagenicity	*No information available*
Carcinogenicity	This product is not listed as a carcinogen by IARC, NTP, or OSHA
Component carcinogenicity	ACGIH Group A3: Confirmed animal carcinogen with unknown relevance to humans

Fuels, Diesel (0.1% by vol.)	GHS / CLP: Carcinogenicity Category 2
Reproductive / developmental toxicity	*No information available*
Specific target organ toxicity	
Single exposure	*No information available*
Repeated exposure	*No information available*
Aspiration hazard	*No information available*

Section 12 – Ecological Information

Acute ecotoxicity - short-term exposure	
Fish	48hr LC50 (rainbow trout) 2.8-4.6 ug/L 96hr LC50 (bluegill) >1000mg/L
Invertebrates	LC-50 (Daphnia Manga) 23 ppm
Long Term Exposure (Fish & algae)	NOEL >100mg/L (fish, invertebrate, and algae)
Persistence and degradability	Product is biodegradable in aerobic conditions (90% biodegraded within 23 days)
Bioaccumulative potential	There is a potential for bioaccumulation of this product
Mobility in soil	*No information available*
Other adverse effects	See section 5 & 6 regarding spontaneous combustion of materials that are soaked in this product

Section 13 – Disposal Considerations

Disposal *(waste / unwanted product)*	This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate local, state, regional, or federal regulations for additional requirements.
Disposal *(containers with residue)*	Dispose of all containers with residue according to local, state, regional, and federal regulations.

Section 14 – Transport Information

DOT

ID Number	Not Regulated as a hazardous material
UN Proper Shipping Name	Not Regulated as a hazardous material
Transport Hazard Class(es)	Not Regulated as a hazardous material
Packing Group	Not Regulated as a hazardous material
Placard	Not Regulated as a hazardous material
Marine Pollutant	No
Transport in Bulk Requirements	Not Regulated as a hazardous material
Special Transportation Precautions	Not Regulated as a hazardous material
Special Note	Not Regulated as a hazardous material

Shipping Label None

Placard None
(Shipment by truck or rail in bulk)

Section 15 – Regulatory Information

Inventory Listings

DSL ☒ Listed ☐ Exempt
TSCA ☒ Listed ☐ Exempt

U.S. Federal Regulations

CERCLA: This material, as supplied, contains the following chemical(s) regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

None

Clean Water Act: This product contains the following chemical(s) regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42):

None

SARA 311/312 Hazard Categories:

Hazard Class	Hazard Category
Skin Irritation	Category 2
Eye Irritation	Category 2B
Carcinogenicity	Category 2

SARA 313: Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains the following chemical(s) subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372:

None

U.S. State Regulations

California Proposition 65:

☒ This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations:

New Jersey	US New Jersey Worker and Community Right-to-know Act (New Jersey Statute Annotated Section 34:5A-5)
Component	*CAS Number*
Fuels, diesel, No 2	68476-34-8

Pennsylvania	US Pennsylvania Worker and Community Right-to-know Law (34 PA. Code Chap. 301-323)
Component	*CAS Number*
Fuels, diesel, No 2	68476-34-8

Section 16 – Other Information

Issuing Date: Aug 28, 2007

Revision Date: March 9, 2020

Version #: 20200309

NFPA 704 Ratings	
Health Hazard:	1
Flammability:	1
Instability:	0
Other:	-

Revision Note: Modified the CAS number for methyl esters in Section 3.

WARNING: POTENTIALLY HAZARDOUS MATERIAL. IMPROPER USE OR MISHANDLING CAN RESULT IN SERIOUS INJURY OR DEATH. THIS PRODUCT CONTAINS SUBSTANCES WHICH, IF MODIFIED, MAY BE FLAMABLE AND MAY BURN OR EXPLODE IF HEATED OR EXPOSED TO FLAME OR OTHER IGNITION SOURCE OR WATER, OXIDIZING AGENTS, ACIDS OR OTHER CHEMICALS. AVOID INGESTION, INHALATION AND CONTACT WITH SKIN AND EYES.

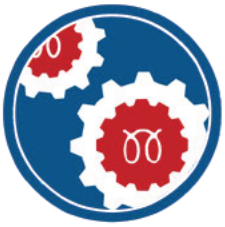
Disclaimer

The information provided on this SDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

ADF Submission

Appendix G



OPTIMUS

TECHNOLOGIES

cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
Karen Ross, Secretary

April 14, 2020

Kevin Smyth
Senior Mechanical Engineer
Optimus Technologies, Inc.
6901 Lynn Way
Pittsburgh, PA 15208

Dear Mr Smyth:

Re: Developmental Engine Fuel Variance

Your request of April 2, 2020 for a developmental engine fuel variance from California's fuel quality specifications for the use of a B99 fuel as developmental compression ignition fuel has been reviewed by the Division of Measurement Standards (DMS).

A variance is granted to Optimus Technologies for the use of a B99 Biodiesel Blend in the project with the [redacted] and will be valid for for two years with option of being renewned apon request from Optimus Technologies Inc.

The Business and Professions Code (BPC), Division 5, Chapter 14, Section 13405 authorizes the California Department of Food and Agriculture (CDFA) to grant variances for developmental engine fuels as a means to allow testing of developmental fuel technology under controlled conditions, which assists in the creation of a consensus standard for that type of engine fuel.

The variance is granted on the understanding that Optimus Technologies will be supplying a B99 fuel to [redacted] to conduct an evaluation of the B99 fuel's performance and vehicle emissions for the purpose of developing an ASTM fuel quality specification and to support the collection of data to fulfill the requirements of California Alternative Diesel Fuel Regulations. The fuel will consist of 99% Biodiesel meeting ASTM D6751 and 1% CARB Diesel meeting ASTM D975. This project will initially be conducted on [redacted] vehicles within [redacted] Fleet of company owned fleet.

The terms of this variance are specific to the distribution of your fuel to [redacted] for the purpose of conducting a demonstration pilot project.

This variance does not permit sales to the public, nor does it waive compliance with any other California statute or regulation pertaining to engine fuels.

To maintain this variance, you must adhere to the following reporting requirements:

- CDFA shall be notified at the onset and completion of the project. This variance is for two years with option of it being renewned apon request from Optimus Technologies.

- Compliance with the experimental designed as specified in your developmental engine fuel variance application letter. CDFA shall be notified if the the vehicle fleet size changes over the project.

- Optimus Technologies shall submit quarterly reports to CDFA constisting of total gallons of B99 fuel used and information concerning negative impact to vehicle performance or reliability. This submission may be by emailed letter. The quarters end on March31, June30, September 30, and December 31.

- Timely notification shall be given to CDFA of any vehicle and equipment damage and/or failure, when such damage/failure is directly related to the use of B99 fuel.

BPC Section 13405 and California Code of Regulations, Division 9, Chapter 6, Section 4144, authorizes the CDFA to revoke any variance if the variance holder has violated any terms and conditions of the waiver, has abandoned efforts to develop fuel standards through a recognized consensus organization or standards writing organization, or if a high probability exists that continued use of the fuel will result in equipment harm or a threat to public safety

If you have any questions regarding this variance please feel free to contact me either by phone at 916- 229-3046, or email allan.morrison@cdfa.ca.gov

Sincerely,

R. Allan Morrison, Jr.
Senior Environmental Scientist (Supervisior)
Division of Measurement Standards
California Department of Food and Agriculture

ADF Submission

Appendix H

OPTIMUS

TECHNOLOGIES

TO: Allan Morrison, CDFA

FROM: Kevin Smyth, Optimus Technologies Inc.

DATE: 4/2/2020

SUBJECT: Fuel Variance Application

Please find below the submission for a fuel variance for the private fleet use of B99 (1% CARB Diesel, 99% Biodiesel).

Increased use of B99 would provide several benefits to the people of California. B99 has an incredibly low carbon intensity score, and reduces GHG emissions by an average of 80%. Other benefits of B99 include the reduction of particulate matter and total hydrocarbon tailpipe emissions. Additionally, it is produced domestically and reduces our dependence on foreign oil. It is the safest alternative fuel to store and handle. CARB produced a multimedia evaluation in 2015 that stated:

> *"In general, studies have found environmental benefits associated with biodiesel use as compared to use of CARB diesel fuel. Biodiesel is considered a low carbon fuel and supports GHG emission reductions. Biodiesel emits less CO, PM, THC, and air toxics than CARB diesel." -2015 CARB – Multimedia Report*

The fuel will be consumed exclusively by NTDE Medium and Heavy Duty vehicles in [redacted] fleet, for the purposes of evaluating the fuel through the ADF regulation, and for evaluating Optimus Technologies' Vector System through ARB's aftermarket parts EO submission process. Please find the attached document [redacted] for additional fleet information.

Throughout the duration of the fuel variance, information regarding fuel quality, cost, and availability will be collected, in addition to the amount of fuel consumed. Also, data pertaining to vehicle fuel economy, reliability, and tailpipe emissions will be used for the evaluation of the fuel for the ADF regulation, in addition to the Aftermarket Parts evaluation.

For reporting purposes, Optimus Technologies proposes that quarterly reports including total gallons of the developmental used and any information concerning impact to vehicle performance or reliability will be submitted to CDFA. As required by the ARB Stage 1 ADF, the total gallons consumed over the first year of the variance are not to exceed the energy equivalent of 1 million gallons of CARB diesel. Optimus Technologies agrees to abide by any request made by the Department pertaining to the Developmental Engine Fuel Variance Program.

Future activities to support the development of a fuel standard include dynamometer testing for tailpipe emissions of high blends of biodiesel in NTDE engines. Furthermore, this fleet-use project will serve as a case study for any impacts on vehicle performance or reliability during on-road use, as well as verifying the economics and logistics of using B99 as an on-road fuel.

6901 Lynn Way
Pittsburgh, PA 15208

412.727.8228
www.optimustec.com

Additional testing and data collection may be conducted or recorded as requested by CDFA or CARB, for the fuel variance, ADF Stage 1, or Aftermarket Parts EO submission.

I appreciate you taking the time to evaluate this submission. Please don't hesitate to reach out with any questions or concerns.

Best,

Kevin Smyth

6901 Lynn Way
Pittsburgh, PA 15208

412.727.8228
www.optimustec.com

ADF Submission

Appendix I

OPTIMUS

TECHNOLOGIES

SOUTHWEST RESEARCH INSTITUTE®

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POWERTRAIN ENGINEERING DIVISION
Fax (210) 522-3950

ISO 9001 Certified
ISO 14001 Certified

January 6, 2021

Colin Huwyler
Chief Executive Officer
Optimus Technologies
6901 Lynn Way
Pittsburg, PA 15208

Via email: c.huwyler@optimustec.com
k.smyth@optimustec.com

Subject: Test Plan for Section 27156 of the California Vehicle Code for Optimus Technologies

1.0 INTRODUCTION

The Department of Diesel Engine and Emissions Research & Development (DEERD) at Southwest Research Institute (SwRI®) is pleased to provide this test plan to Optimus Technologies. The proposed test plan is submitted for a device evaluation using a protocol specified by the California Air Resources Board (CARB). The protocol is based on transient emission measurement procedures developed by the EPA for emissions regulatory purposes. The CARB protocol allows a 2019 Cummins X15 engine (engine family - KCEXH0912XAW) to be used as the "test bench". The CARB protocol requires the Federal Test Procedure (FTP), Ramped Mode Cycle (RMC) Supplemental Emissions Testing (SET), and the "Not-to-Exceed" (NTE) test according to guidelines specified in the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" adopted December 12, 2002 and last amended on April 18, 2019.

2.0 SwRI QUALIFICATIONS

As part of this test plan, SwRI has extensive experience with CARB certification testing, the testing of biofuel blends, and fuel registration testing for the Environmental Protection Agency (EPA). Some of our experience is listed below. A more comprehensive list is available upon request.

- EPA fuel registration of B20 and B100 for the National Biodiesel Board in 1998
- Over twenty years of EPA fuel and fuel additive registration of many different types of fuels including:

  - alternative diesel
  - Fischer Tropsch
  - ethanol diesel blends
  - water/fuel emulsions
  - vegetable oil
  - renewable diesel
  - fuel additives
- More than twenty years of CARB certification testing
- Almost 40 years of sampling, characterizing, and measuring toxic air pollutants such as 1,3-butadiene, formaldehyde, acrolein, acetaldehyde, BTEX (benzene, toluene, ethyl benzene, and xylene), and polycyclic aromatic hydrocarbons (PAH)
- Texas Commission for Environmental Quality (TCEQ) Alternative Diesel Fuel Certification testing

SwRI has a 2019 Cummins X15 engine that was used with other testing for CARB. This engine is available for use in this program and meets the following guidelines:

- Test engine certified for use in California (engine family – KCEXH0912XAW)
- Test engine accumulated more than 125 hours of normal operation
- Test engine tuned to manufacturer specifications
- Test engine in good operating condition and baseline emissions typical for the model year and engine model
- System installed according to Optimus Technologies installation instructions
- System must be emission tested with a blend containing 20 percent or less of biodiesel using a CARB diesel and biodiesel (B100) to make the blend
- Test engine under the control of SwRI throughout the testing
- No maintenance will be performed without prior approval of CARB

3.0 STATEMENT OF WORK

SwRI proposes to test the Optimus Technologies Vector System according to the appropriate CARB test protocol as indicated in a letter from Ms. Kimberly Pryor, Chief, Aftermarket Parts Certification and Audit Branch dated December 22, 2020 (Reference No. A-2020-502). The test cycles will include the FTP, RMC SET, and NTE. The Vector System will be installed in the test cell according to written instructions from Optimus Technologies. The Vector System allows for the diesel engine to operate initially with unheated CARB diesel fuel; and after certain criteria are met, the engine switches over to the heated biodiesel fuel. Regulated exhaust emissions (total hydrocarbons - THC, non-methane hydrocarbons – NMHC which includes the measurement of methane – CH_4, carbon monoxide - CO, oxides of nitrogen - NO_X, and particulate matter - PM), and carbon dioxide - CO_2 will be evaluated for all tests conducted. Tests will be performed according to U.S. Code of Federal Regulations (CFR) Title 40 Part 1065 requirements. Table 1 presents the proposed test plan for the heavy-duty engine test work.

TABLE 1. PROPOSED TEST PLAN FOR HEAVY-DUTY TESTING

STEP	DESCRIPTION
1	Perform emission instrument calibrations as required. Calibrate torque meter and check signal conditioning systems. Validate CVS gaseous and particulate sampling systems using propane recovery techniques.
2	Install engine in transient-capable test cell, and check engine condition. Bring engine oil level to "full" using oil specified by the manufacturer.
3	Perform fuel change procedure to CARB reference fuel. Change fuel filters, purge fuel supply, etc. Install the Vector System according to written instructions. Prepare the fuel handling system to operate by bypassing the Vector System or with the Vector System in-use.
4	Repeat Step 1 as necessary. With the Vector System in bypass mode, operate the engine at rated speed and full load for approximately 10-minutes, then power validate engine.
5	Conduct transient "full-throttle" torque map from low- to high-idle and save resulting transient command cycle. (Note: This initial transient command cycle with the CARB reference fuel will be used for all subsequent emission tests in this test plan.) Change the Vector System to the operating position.
6	Run at least one 20-minute practice EPA transient cycle and adjust dynamometer controls to meet statistical requirements for transient cycle operation. Soak the engine overnight for a cold-start test.
7	Run a cold-start and a hot-start transient cycle with a 20 minute soak between each. Collect samples for THC, NMHC, CO, NO_X, PM, and CO_2 during each cycle.
8	Run an RMC SET as a "prep", and run an RMC SET with emissions. Collect samples for THC, NMHC, CO, NO_X, PM, and CO_2 during the second cycle.
9	Run an NTE cycle at the three designated speed/load points. Collect samples for THC, NMHC, CO, NO_X, PM, and CO_2 during each point.

3.1 FTP

The heavy-duty FTP is described by means of percent of maximum torque and percent of rated speed for each one-second interval over a test cycle of 1199 seconds duration. To generate a transient cycle, an engine's full power curve is obtained from an engine speed below curb idle speed to maximum no-load engine speed. Data from this "power curve," or engine map, are used with the specified speed and load percentages to form a transient cycle. A graphic presentation of the speed and torque commands which constitute a transient cycle is given in Figure 1 for illustration purposes.

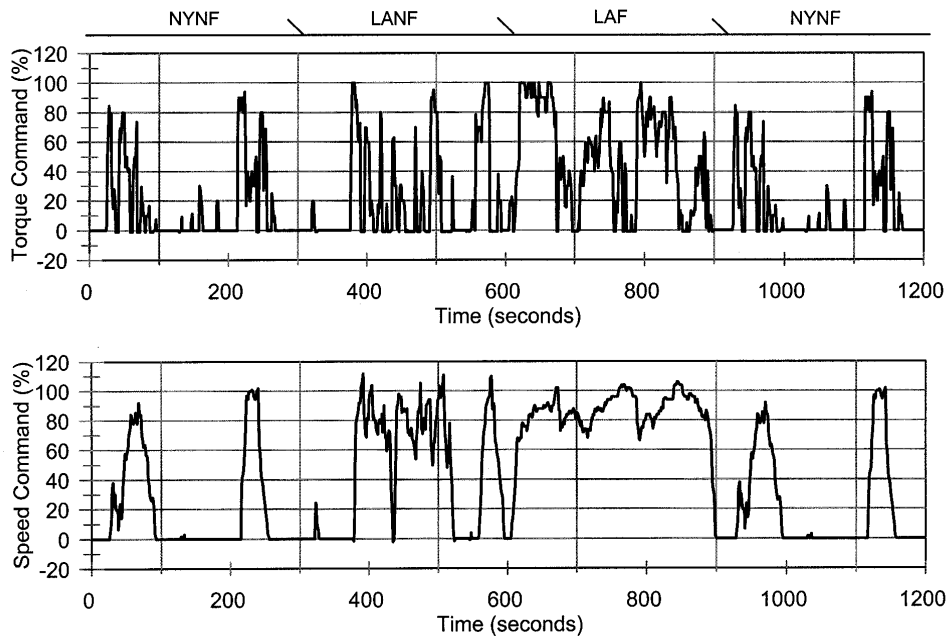

FIGURE 1. GRAPHIC REPRESENTATION OF TORQUE AND SPEED COMMANDS FOR THE TRANSIENT CYCLE FOR HEAVY-DUTY ENGINES

In general, a transient test consists of a cold-start transient cycle and a hot-start transient cycle. The same engine command cycle is used in both cases. For the cold-start, the diesel engine is operated over a "prep" cycle, and then allowed to stand overnight in an ambient soak at a temperature between 68°F and 86°F. The cold-start transient cycle begins when the engine is cranked for cold start-up. Upon completion of the cold-start transient cycle, the engine is stopped and allowed to stand for 20 minutes. After this hot-soak period, a hot-start cycle begins with engine cranking. In order to determine how well the engine follows the transient command cycle, engine performance is compared to engine command, and several statistics are computed. These computed statistics must be within tolerances specified in the CFR. In addition to statistical parameters, the cycle work actually produced should be between 5 percent above and 15 percent below the work requested by the command cycle.

3.2 RMC SET

The RMC SET is a 13-mode steady-state engine dynamometer test with linear transitions between modes. This cycle is similar to the European Stationary Cycle (ESC), and it was first introduced by the Environmental Protection Agency (EPA) as part of the 1998 consent decrees with United States heavy-duty engine manufacturers and later included in the 2007 emission standards for heavy-duty engines. The 2007 ramped mode cycle SET is applicable to 2007-2009 heavy-duty engines. While it contains the same operating modes and weightings as the ESC, the order is different and the transition between modes is defined. For 2007-2009 model year engines, manufacturers can use either the 2007 RMC SET or the ESC. For 2010 and later model year

heavy-duty engines, manufacturers must use the 2010 RMC SET. This cycle is similar to the 2007 RMC SET with the exception that the order in which the modes are run is the same as the ESC. For the 2010 model year only, manufacturers can continue to use the 2007 RMC SET as long as it does not adversely affect the ability to demonstrate compliance with emission standards. Table 2 summarizes two versions of the RMC SET cycles. In 2016, the EPA introduced an additional set of weighting factors for the RMC SET test. The two sets of weighting factors are shown in Table 3. Weighting Factor A represents the original weighting factors (identical to those of the ESC), while Weighting Factor B represents an additional set of weighting factors. Weighting factor B were developed to account for the downspeeding trend in heavy-duty engines and are used for testing of engine CO_2 emissions for the purpose of EPA Phase 2 greenhouse gas (GHG) emission standards. Weighting factor A continues to be used for the purpose of pollutant (CO, HC, NOx, and PM) emission testing. The engine speeds (A, B, and C) used during the test will be calculated from the following formulas:

$$A = n_{lo} + 0.25(n_{hi} - n_{lo})$$

$$B = n_{lo} + 0.50(n_{hi} - n_{lo})$$

$$C = n_{lo} + 0.75(n_{hi} - n_{lo})$$

3.3 NTE

The NTE should be conducted within the NTE control area. Exhaust emission sampling will be conducted using each of the three test points:

- 50 percent torque at 90 percent rpm
- 85 percent torque at 80 percent rpm
- 65 percent torque at 70 percent rpm

4.0 SUMMARY

A test plan has been outlined for conducting a test program to obtain transient emissions data from a 2019 Cummins X15 engine using a California reference fuel and with the Vector System using a B20 blend. The emissions data are to be accumulated using the procedure outlined in Table 1 to conduct the emission tests and fuel changes.

It has been a pleasure to prepare this test plan. We hope the items and approach discussed will meet your needs. The DEERD at SwRI looks forward to beginning this project as soon as possible. If you have any questions of a technical nature, please contact E. Robert Fanick by telephone at (210) 522-2653, by FAX at (210) 522-3950, or by e-mail at rfanick@swri.edu.

TABLE 2. RAMPED MODE CYCLE SET

RMC MODE		2007-2009			2010 & LATER		
		TIME, SEC.	SPEED	TORQUE, %	TIME, SEC.	SPEED	TORQUE, %
1a	Steady-state	170	Warm idle	0	170	Warm idle	0
1b	Transition	20	Linear transition	Linear transition	20	Linear transition	Linear transition
2a	Steady-state	170	A	100	173	A	100
2b	Transition	20	A	Linear transition	20	Linear transition	Linear transition
3a	Steady-state	102	A	25	219	B	50
3b	Transition	20	A	Linear transition	20	B	Linear transition
4a	Steady-state	100	A	75	217	B	75
4b	Transition	20	A	Linear transition	20	Linear transition	Linear transition
5a	Steady-state	103	A	50	103	A	50
5b	Transition	20	Linear transition	Linear transition	20	A	Linear transition
6a	Steady-state	194	B	100	100	A	75
6b	Transition	20	B	Linear transition	20	A	Linear transition
7a	Steady-state	219	B	25	103	A	25
7b	Transition	20	B	Linear transition	20	Linear transition	Linear transition
8a	Steady-state	220	B	75	194	B	100
8b	Transition	20	B	Linear transition	20	B	Linear transition
9a	Steady-state	219	B	50	218	B	25
9b	Transition	20	Linear transition	Linear transition	20	Linear transition	Linear transition
10a	Steady-state	171	C	100	171	C	100
10b	Transition	20	C	Linear transition	20	C	Linear transition
11a	Steady-state	102	C	25	102	C	25
11b	Transition	20	C	Linear transition	20	C	Linear transition
12a	Steady-state	100	C	75	100	C	75
12b	Transition	20	C	Linear transition	20	C	Linear transition
13a	Steady-state	102	C	50	102	C	50
13b	Transition	20	Linear transition	Linear transition	20	Linear transition	Linear transition
14	Steady-state	168	Warm idle	0	168	Warm idle	0

TABLE 3. RMC SET WEIGHTING FACTORS

Mode	Engine Speed	Load, %	Weighting Factor A	Weighting Factor B
1	Low idle	0	15	12
2	A	100	8	9
3	B	50	10	10
4	B	75	10	10
5	A	50	5	12
6	A	75	5	12
7	A	25	5	12
8	B	100	9	9
9	B	25	10	9
10	C	100	8	2
11	C	25	5	1
12	C	75	5	1
13	C	50	5	1
		Total	100	100
		Total A speed	23	45
		Total B speed	39	38
		Total C speed	23	5

Prepared by:

E. Robert Fanick, Principal Scientist
Emission Chemistry
Diesel Engine & Emissions R&D Department

Approved by:

Nolan T. Wright, Manager
Emissions Chemistry
Diesel Engine & Emissions R&D Department

ADF Submission

Appendix J

OPTIMUS

TECHNOLOGIES

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REDUCE FUEL COSTS. REDUCE EMISSIONS. EASILY.

Optimus Technologies Stage 1 ADF Application

Supplemental Submission 3.12.21

Section (M) Emissions testing completed on criteria pollutants

This document contains trade secret information of Optimus Technologies, Inc.

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Section (M) Emissions testing completed on criteria pollutants

According to the State of California Environmental Protection Agency Multimedia Evaluation of Biodiesel Staff Report, Section 3. Secondary Air Pollutants (page 12):

"Engines that meet the latest emission standards through the use of Selective Catalytic Reduction (SCR) systems have been shown to have no significant difference in NOx emissions based on the fuel used. A study conducted by the National Renewable Energy Laboratory looked at two Cummins ISL engines equipped with SCR systems.[25] Results showed that the use of SCR was effective at reducing NOx to near the detection limit on all duty cycles and fuels, including B100.[26]

Light-duty and medium-duty vehicles have similarly been found not to experience increases in NOx due to the use of biodiesel. For example, a study performed on three light-duty vehicles using different biodiesel blends found no significant and consistent pattern in NOx emissions based on blend levels across the different engines, blends, and cycles.[27]"

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[25] Lammert et al., *Effect of B20 and Low Aromatic Diesel on transit Bus NOx emissions Over Driving Cycles with a Range of Kinetic Intensity*, SAE Int. J Fuels Lubr., 5(3):2012
[26] Air Resources Board. *Proposed Regulation on the Commercialization of New Alternative Diesel Fuels Staff Report: Initial Statement of Reasons.* January 2, 2015. Page 44.
[27] Air Resources Board. *Proposed Regulation on the Commercialization of New Alternative Diesel Fuels Staff Report: Initial Statement of Reasons.* January 2, 2015. Page 45.

In addition to the findings cited by the State of California above, Optimus is submitting a confidential internal report that was based on independent testing utilizing a portable emissions measurement system (PEMS) conducted by the West Virginia University Center for Alternative Fuels, Engines and Emissions (WVU CAFEE). The report can be found on the following pages.

Optimus Vector System Biodiesel Emissions Test Report

Overview

Optimus Technologies designs and manufactures EPA compliant biodiesel fuel systems for medium and heavy-duty diesel engines to operate on up to 100% biodiesel (B100). The Optimus Vector system is available as a retrofit that seamlessly integrates with existing engines or as a ship-through option on new commercial vehicle purchases. The Optimus system is a bolt-on technology that requires no permanent modifications to the engine.

Today, most diesel engines can operate on a blend of biodiesel (up to 20% biodiesel mixed with diesel); the Vector system overcomes limitations and allows the engine to operate on 100% biodiesel. The technology never inhibits the engine from using regular diesel if necessary, which enables fleets to have the flexibility to deploy 100% biodiesel while also mitigating risks associated with new fuels and technology. The Vector system is completely automated; there is no change to vehicle operation or driver behavior with the Optimus system deployed and the Optimus software optimizes use of the renewable fuels for the dynamic operating conditions of the vehicle. The Vector system enables proper operation of high biodiesel blends without compromising the performance, emissions, or fuel economy of the engine.

The Vector system is comprised of a few primary components (both mechanical and electronic) and the system is completely automated ensuring no driver engagement is required for operation. The primary components are identified in *Figure 1: Vector System Overview* below, and consist of:

- Vector Manifold
  - This is the primary fuel conditioning module which includes a dedicated fuel pump, filter, heat exchanger, recirculation valve, and sensors for the on-board conditioning of biodiesel fuel.
- Vector Fuel Tank
  - FMCSA and DOT compliant aluminum fuel tank with an integrated in-tank heat exchanger and heated fuel pickup.

- Electronic Control Unit
  - The Optimus system is fully automatic and controlled by the Electronic Control Unit (ECU). The ECU integrates with the engine control unit and telematics data reporting device to enable real time analytics.
- Fuel Selector Valves (Not Pictured)
  - The fuel selector valves are controlled by the ECU and switch the fuel supply system between the diesel fuel system and biodiesel fuel system.
- User Interface
  - The User Interface provides the driver with information on the Vector system such as biodiesel fuel tank level, current operating mode of the engine, and will illuminate a service indicator in the event that the Vector system is experiencing a fault condition or requires maintenance.
- Remote User Applications
  - The Optimus ECU and OEM engine controller are integrated to an embedded telematics device which allows for real-time data reporting of the system's operation and biodiesel utilization.

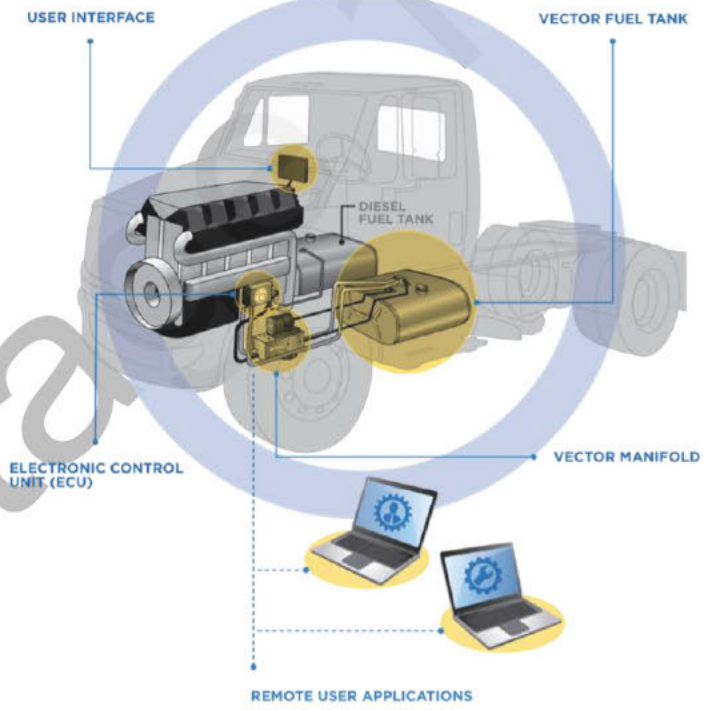


Figure 1: Vector System Overview

Test Summary

[redacted]

[redacted]

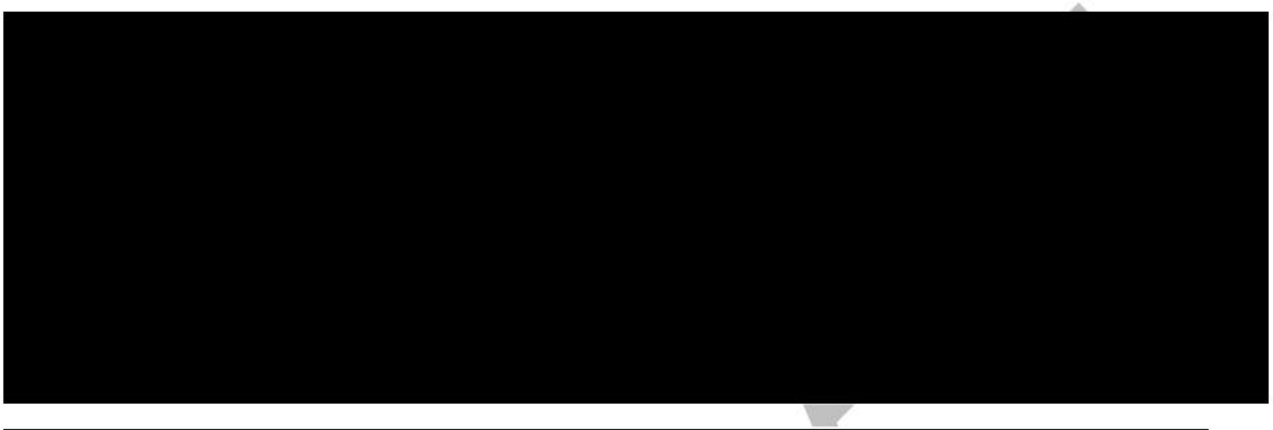
Test Routes

[redacted]

[redacted]

Test Results

[redacted]



[redacted]

[redacted]

Appendix

Location and Contact:

West Virginia University Center for Alternative Fuels, Engines, and Emissions (CAFEE)
359 Evansdale Dr.
Ag. Sci. Annex Bldg.
Morgantown, WV 26506

Main Contact: Joshua Israel
Telephone: 304.629.0128
Email: Joshua.israel@mail.wvu.edu

Optimus Technologies:
6901 Lynn Way
Pittsburgh, PA 15208

Main Contact: Colin Huwyler
Telephone: 412.727.8228
Email: c.huwyler@optimustec.com

Test Vehicle Information:

Engine Type: DT 466 D260 (see Figure 5 for engine control plate)
OEM Engine Fuel: Diesel
Engine Manufacturer: International
Test Weight: 29,640 pounds (see Figure 6 for weight slip)
Model Year: 2004
Vehicle Mileage: 310,088 (see Figure 7 mileage slip)
Combustion Cycle: Homogeneous Charge Compression Ignition
Horsepower: 260
Cooling Mechanism: Water Cooled
Number of Cylinders: 6
Valves per cylinder: 4
Engine Displacement: 7.6 L
Emissions Control Device(s): TC, CAC, EGR, ECM, OC, DI
Aspiration: Electronic Variable Response Turbocharger with Air-to-Air Intercooler

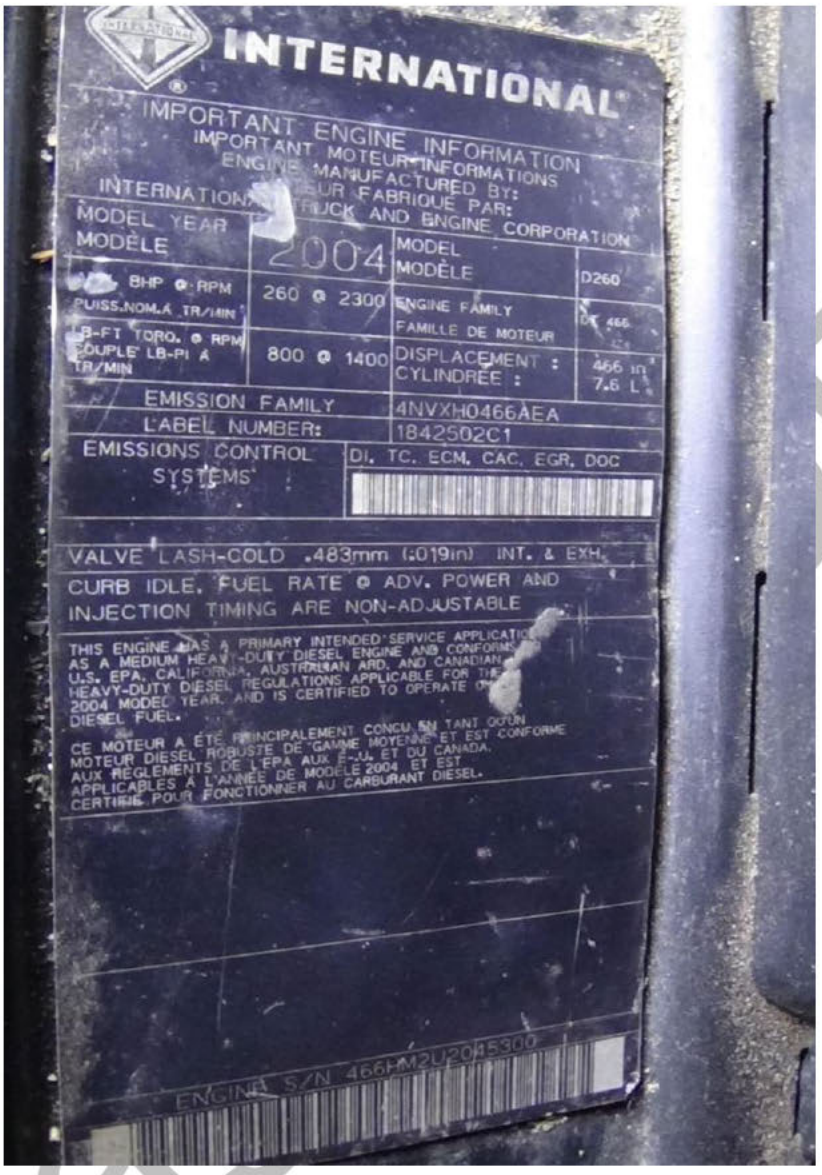
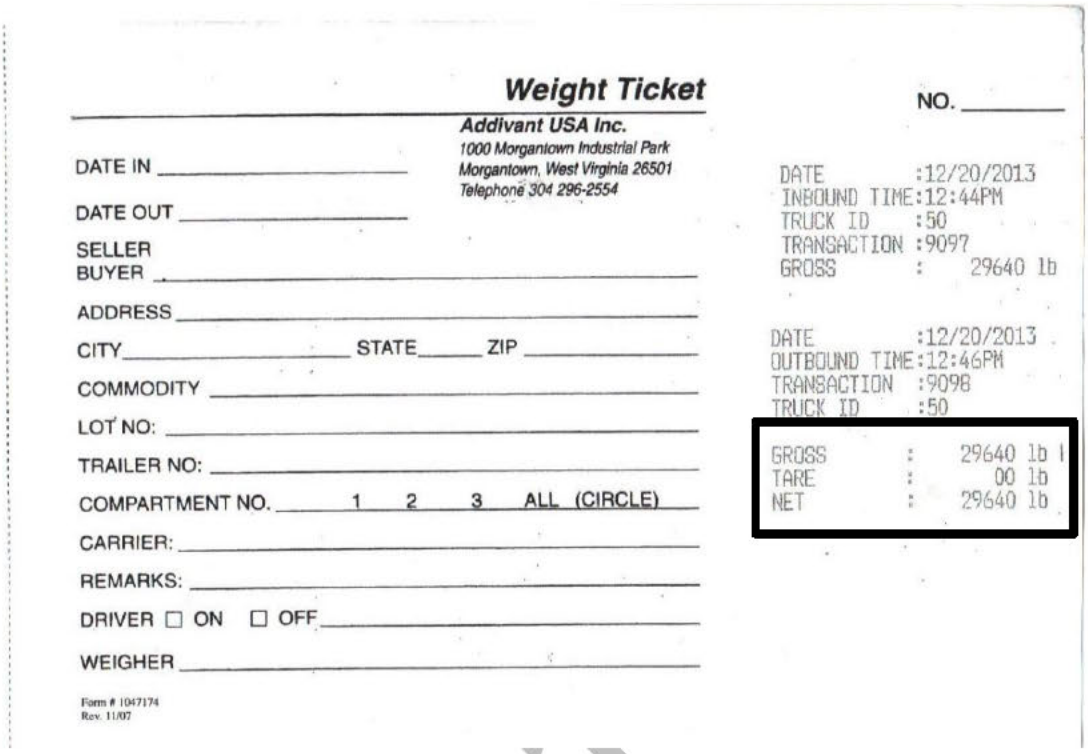


Figure 5: Test Engine Emissions Control System Plate



Weight Ticket

NO. _____

Addivant USA Inc.
1000 Morgantown Industrial Park
Morgantown, West Virginia 26501
Telephone 304 296-2554

DATE IN _____
DATE OUT _____
SELLER
BUYER _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
COMMODITY _____
LOT NO: _____
TRAILER NO: _____
COMPARTMENT NO. 1 2 3 ALL (CIRCLE)
CARRIER: _____
REMARKS: _____
DRIVER ☐ ON ☐ OFF _____
WEIGHER _____

Form # 1047174
Rev. 11/07

DATE :12/20/2013
INBOUND TIME:12:44PM
TRUCK ID :50
TRANSACTION :9097
GROSS : 29640 lb

DATE :12/20/2013
OUTBOUND TIME:12:46PM
TRANSACTION :9098
TRUCK ID :50

GROSS : 29640 lb
TARE : 00 lb
NET : 29640 lb

Figure 6: Test Vehicle Weight Slip

[redacted]