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FINAL REPORT

Diesel Fuel Testing on an Isuzu 4JG1T engine with and without a Diesel Oxidation Catalyst

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Introduction:

The MSHA Approval and Certification Center's Diesel Laboratory has been conducting a series of tests on various diesel fuels with and without the use of a Diesel Oxidation Catalyst (DOC). These tests were conducted on an Isuzu 4JG1T 4 cylinder turbocharged diesel engine. The fuels examined in the study included low and ultralow sulfur petroleum based diesel fuels, biodiesel fuels and blends, and a fischer-tropsch coal derived synthetic fuel.

The tests were conducted to examine the changes in engine emissions and performance when changing diesel fuels from one type or manufacturer to another and to gage the emissions and performance of each fuel when used in combination with a DOC. The tests measured the Diesel Particulate Matter (DPM) gravimetric (mass) emissions and the DPM emissions analyzed for Total (TC), Organic (OC), and Elemental (EC) Carbon composition. The MSHA regulated gas emissions of Carbon Dioxide (CO2), Carbon Monoxide (CO), Nitric Oxide (NO), and Nitrogen Dioxide (NO2) of the engine were also analyzed for each fuel and DOC combination.

The primary goal of the tests was to determine if there were large emissions performance changes when changing from one fuel source to another, and if there were large variations in performance of a particular fuel type between manufacturers. Another goal was to analyze the changes in emissions behavior when a DOC is used in combination with the various fuels.

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The data generated from these series of tests were analyzed for the changes in the emissions performance of the engine under each test condition and predictions for the most effective combination for alternate mining equipment scenarios were made based on the data generated. Comparisons of the MSHA data to other available fuel tests from the open technical literature and other U.S. government research were conducted.

Background:

MSHA has promulgated two final rules for controlling miner's exposure to DPM in underground mines on January 19, 2001:

- 30 CFR Part 57 Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners
- 30 CFR Part 72 - Diesel Particulate Matter Exposure of Underground Coal Miners

Diesel Particulate Matter (DPM) is a component of diesel engine exhaust and is described in the "METAL AND NONMETAL DIESEL PARTICULATE MATTER (DPM) STANDARD Compliance Guide Q&As"[1] as follows:

> DPM is a component of diesel exhaust. DPM includes diesel soot and solid aerosols such as organic carbon compounds, ash, metallic abrasion particles, sulfates and silicates. The majority of diesel exhaust particles are less than 1.0 µm in size. Diesel soot particles have a solid core mainly consisting of elemental carbon, with a wide variety of other substances attached to the surface.
>
> Exposure to high concentrations of DPM can result in a variety of serious adverse health effects. These health effects have been found to include: (i) sensory irritations and respiratory symptoms serious enough to distract or disable miners; (ii) premature death from cardiovascular, cardiopulmonary, or respiratory causes; and (iii) lung cancer. The health effects are discussed in the January 2001 and the June 2005 preambles.

Whole DPM samples obtained for gravimetric analysis are the standard method of analyzing engine-out DPM emissions by MSHA for engine approvals and by the US EPA for compliance with their engine emissions regulations. MSHA's DPM standard for underground metal and nonmetal mines limits miners' exposure to DPM by regulating total carbon (TC) exposures. Total carbon was selected as a surrogate for DPM for compliance determination purposes because there is no practical sampling or analytical method for measuring personal exposure to whole DPM in the underground mine environment. Practical sampling and analytical methods do exist for measuring personal exposures to

[1] See http://www.msha.gov/REGS/COMPLIAN/Guides/MNMDPM/MNMdpmcompguide.pdf

TC in the underground mine environment, and as noted above, TC is consistently 80% to 85% of DPM. Thus, limiting TC exposure is a feasible means of controlling miners' exposure to DPM.

The rule for metal nonmetal mining allows the use of a wide variety of control technologies to reduce a miner's exposure to DPM. Compliance with the DPM limits in the final rule is based on in-mine testing of the miner's personal exposure. Some of the methods that may be used to meet the regulatory requirements include:

- Increased/Improved mine ventilation
- Newer technology diesel engines and mining machines which include enclosed cabs
- Diesel Oxidation Catalyst[2] (DOC) or similar technologies
- DPM Exhaust Filters
- Alternate Fuels

These are engineering controls that reduce a miner's exposure to DPM by reducing its concentration in the mine atmosphere. These and other engineering controls, as well as administrative control methods are discussed in detail in the Compliance Guide.

Two of these potential technologies are investigated in this report. One is the use of alternate fuels. Alternate fuels for diesel engines are usually grouped as Biodiesels and Synthetic Diesels. Biodiesels are fuels derived from plant or animal based sources, such as soybeans, vegetable oils, or animal fats. Synthetic diesel fuels are some form of non-petroleum based fuel manufactured in a catalytic process from a source such as coal, natural gas, or biomass[3]. For this research, petroleum-based diesel fuels were included in the tests both as a baseline to use for comparison and to test alternate formulations of diesel fuel such as low sulfur (LSD) and ultralow sulfur (ULSD) fuels.

The second technology examined in this work is a DOC. This catalytic technology has a proven record of reducing a diesel engine's emissions of CO, gaseous hydrocarbons, and some components of DPM. For each fuel tested, the engine's emissions were tested with and without the use of the DOC on the engine's exhaust. From this information, a matrix of several combinations of fuels with and without DOC can be compared to find the best combination for a mine's currently available machines and offers options for DPM control strategy.

For purposes of discussion in the appropriate section later in the report, it was imagined certain scenarios that a mine operator investigating these technologies might be faced with for his mine. These scenarios are based on what equipment they currently have and steps have already been taken to lower their DPM emissions. Of these scenarios, the data generated by these experiments were used to show steps they could take to further reduce DPM. The scenarios investigated are as follows:

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[2] A DOC is a device equivalent in operation, if not exact construction, to every automobile's catalytic converter.
[3] A Biomass source such as wood chips can be used.

1. Mining machinery all running petroleum diesel (D-2 LSD used as baseline) and none using DOC: what DPM reduction could be expected by only changing fuels?
2. Mining machinery is already using one of the test fuels (either petroleum or alternate): what DPM benefit is there to adding a DOC to this existing fuel choice?
3. Mining machinery already universally equipped with DOCs: what fuel choice would offer the best DPM reductions?
4. Mining machinery all running petroleum diesel (D-2 LSD used as baseline) and none using DOC: what combination of fuel and DOC will offer best reductions in DPM?

Fuels Used for Testing:

Several fuels were used for testing purposes. These are shown in Table 1, with some of their primary properties. Detailed data sheets on each fuel may be found in Appendix A.

Three petroleum based diesel fuels were tested. One was a 2005 specification low sulfur diesel (LSD). This fuel is a certified[4] version of the older EPA D-2 LSD. This is the fuel that has been used until recently as the only fuel for MSHA approval testing of engines[5]. D-2 LSD was also until recently the typical fuel available for on-highway vehicles. The second was 2007 specification certified ultralow sulfur diesel (ULSD). ULSD is the new EPA D-2 standard fuel and has been replacing LSD D-2 for on-highway use. ULSD D-2 has been accepted by MSHA as an alternate for LSD for approval testing. This fuel is also required by several (if not most) engine manufacturers for newer technology engines. The third diesel fuel is an on-highway D-2 ULSD purchased from a local distributor. This fuel is representative of a typical ULSD as would be purchased by a mine operator. It also meets the ULSD D-2 specification, but is somewhat different in properties and may contain additives not found in the certified ULSD.

The biodiesels used in the study were provided by multiple manufacturers. One fuel was provided by the Stepan Company. The product provided for testing was B100 Biodiesel SB-W, described as a soybean oil methyl ester and is part of several products produced by the company for various applications, including solvents[6]. Two biodiesel fuels were provided by Iowa Renewable Energy REG for testing[7]. The first formulation was B100 REG-9000-10 which is a pure soy-based biodiesel. The second formulation was B100 REG-9000-5 which was a blend of soy-based biodiesel and animal fat derived biodiesel. The mixture was 60% soy and 40% animal fat. The final biodiesel tested was a B50[8]

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[4] Certified in this case means blended and tested to meet the specifications for this type of diesel fuel. Certified fuel is used as the test fuel for EPA engine certifications (and MSHA engine approvals).
[5] See § 7.86 Test equipment and specifications, **http://www.msha.gov/30cfr/7.86.htm** .
[6] See www.stepan.com/en/products for more information.
[7] See http://www.regfuel.com/biodiesel.html for more information.
[8] B50 is 50% biodiesel and 50% petroleum diesel.

blend of Stepan SB-W and the on-highway ULSD D-2 discussed above. This mixture was a 50/50 blend (by volume).

The final fuel used for testing was a Fischer-Tropsch (F-T) synthetic diesel fuel. This fuel was manufactured using GTL technology in South Africa by PetroSA[9]. The test fuel is 100% Fischer-Tropsch[10] fuel, (note: it is usually blended with petroleum diesel fuel when sold in South Africa). While not generally available in commercial quantities in the United States, it is a fuel with a long history of development and some use around the world. This fuel was provided by Rentech Inc.[11] and representatives of the W.V. Mingo County Redevelopment Authority who are developing F-T processes and potential production facilities in W.V.

Table 1: Fuel Properties.

FUEL	API Gravity	S.G. @ 60F	Cetane No.	Cetane Index	Sulfur	Viscosity	Flash Point
	degAPI				ppm	cSt @ 40C	degF
Certified 2005 LSD	36.8	0.8370	45	47.3	322	2.5	158
Certified 2007 ULSD	35.2	0.8462	44	44.1	9	2.2	150
D-2 Highway (typ) ULSD	44.4	0.8088	57.06	n/a	8	2.15	137
Stepan SB-W BD	n/a	0.8858	49.2	n/a	5.1	n/a	280
IRE REG-900-10 BD	29.84	0.8794	59.4	n/a	7	4.379	262
IRE REG-9000-05 BD[12]	28.441 29.938	0.8781	50.9 59.4	n/a	1 5	4.088 4.379	246 295
B50 mix*	n/a	0.843	~53	n/a	~6.5	n/a	~208
PetroSA Fischer-Tropsch Synthetic	n/a	0.7657	n/a	n/a	<1	~1.6	147

* 50/50 (by volume) mix of Stepan SB-W and D-2 highway ULSD

Engine:

The engine used in testing all the diesel fuels listed above was an Isuzu 4JG1TMA[13]. This is a four cylinder turbocharged engine rated at 83 hp at 2500rpm and a peak torque speed of 1800 rpm. It was

[9] See http://www.petrosa.co.za/ under GTL technology for more information.

[10] See http://www.fischer-tropsch.org/ and http://www.afdc.energy.gov/afdc/pdfs/epa_fischer.pdf for more information on the development of the F-T process.

[11] See http://www.rentechinc.com/ for more information.

[12] This is a blend of two biodiesel batches, the data shows the test results from the two individual batches, data from the blended product was not provided.

approved by MSHA for use in non-permissible areas of coal mines as Approval Number 7E-B095. Under MSHA regulations, specified in §7.88 and §7.89[14], it requires a ventilation rate of 6000 CFM and a Particulate Index of 6500 CFM. The approval test engine had a weighted average gravimetric DPM emission of 11.05 g/hr (0.24 g/bhp-hr) based on the 8 mode steady state cycle shown in Table 2.

The Isuzu 4JG1TMA engine (serial # 8972496660) was donated to MSHA by Isuzu for experimental purposes after being used by MSHA and Isuzu for a quality control audit and altitude simulation experiments. It has been used in a number of test programs, including other synthetic diesel fuel tests. It has been found to provide a stable platform for testing alternate fuels and after treatment devices and has shown stable emissions after repeated baseline tests since 2005.

A comparison of previous engine baselines for the 4JG1T engine to data generated in this test series using LSD may be found in Appendix B. In this comparison it is shown that the engine as used in the current tests is not showing any significant deviations from past performance. In light of the fact that the comparison baselines from the past were run with various LSD fuels, some certified, some not and that test conditions were not always identical[15] the consistency of the engine's performance is more than adequate for alternative fuel testing.

It should be noted that no adjustments whatsoever were made to the engine during testing. There was no attempt to adjust timing to compensate for biodiesel's inherent changes in injection and ignition properties. Nor was there any attempt to adjust the engines fuel rate to try to match engine performance between all the test fuels. The differences in fuel (mass) consumption, shown in the results, would be primarily due to differences in fuel density.

The testing conducted here is therefore a reflection of a simple fuel change in a diesel powered mining machine, without any attempt to optimize the engine for the alternate fuel. Some research on changes in injection properties and engine optimization has been carried out by other researchers and this information may be found in the discussion section.

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[13] See http://www.isuzu.co.jp/world/product/industrial/j_spe01.html and http://www.isuzu.co.jp/world/product/industrial/pdf/j_draw03.pdf for more information.
[14] See http://www.msha.gov/30cfr/7.88.htm and http://www.msha.gov/30cfr/7.89.htm .
[15] The most significant difference between the historical baselines for the 4JG1T engine was exhaust restriction; some tests were completed using the manufacturer's maximum allowable backpressure, while some were run with minimal, or some other backpressure setting. The difference was due to what type of experiment was being performed at the time baseline data was needed.

Diesel Oxidation Catalyst:

The DOC[16] used for testing was manufactured by Engine Control Systems (ECS). It is their Purifier[17] model (Part No. A16-0119, Serial No B106844) and was manufactured on 3/24/08. It was supplied by ECS and sized for the Isuzu 4JG1T engine. The DOC was new when received, but was run on the Isuzu engine for several hours before actual testing began.

Laboratory Equipment and Method:

MSHA's Approval and Certification Center maintains a fully equipped diesel test laboratory capable of performing diesel engine and diesel power package approvals (Title 30 CFR, Part 7 subpart E and F regulations). In addition other technical assistance testing involving diesel engines, fuels and pre-or-after treatment technologies (filters, DOCs, alternate fuels, additives, etc) are undertaken in the interest of improving the mining environment. Figure 1 shows the engine coupled to a dynamometer and instrumented for testing. Figure 2 shows the dynamometer control room and associated laboratory instrumentation.

The laboratory maintains two General Electric eddy current dynamometers. The dynamometer used for this testing was a General Electric TH342, rated for 400 hp. The dynamometer is controlled using a SuperFlow ProATC control sensor box with XConsole interface[18]. The ProATC controls the engine's speed, torque and throttle settings and maintains desired set points with automatic PID[19] control. The ProATC system also records all data from its own bank of instrumentation, as well as other sensors and emissions system in the lab, creating one complete test file of all data to be analyzed.

Gaseous exhaust emissions sampling was performed using a Horiba laboratory sampling bench, which can measure the raw undiluted CO2, CO, NO, and NO2 content of the diesel engine exhaust. The Horiba bench contains an AIA-220 infrared analyzer for CO and CO2 measurements. It contains a CLA-220 chemiluminescence analyzer for NOX measurement[20]. Gas handling, drying and temperature control of the gas sample is controlled by systems embedded in the Horiba sampling bench.

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[16] More information on DOCs and their effect on engine emissions may be found at http://www.epa.gov/otaq/diesel/documents/420f07068.htm and http://www.epa.gov/otaq/diesel/documents/420f07068.htm .

[17] See http://www.enginecontrolsystems.com/images/products/doc/8.5x10%20AZ%20Purifiers%20and%20Purimufflers.pdf for more information.

[18] See http://www.superflow.com/data/index_269.cfm for more information.

[19] Proportion, Integral, Derivative, see http://en.wikipedia.org/wiki/PID_controller.

[20] The CLA-220 measures NO directly and uses a NOX converter to convert all oxides of nitrogen to NO. The NO2 measurement is made by a total NOX measurement (with sample flow through the converter) and an NO-only measurement (sample flow bypassing NOX converter). The difference between these to measurements is the NO2 emissions.

Fuel measurements were made using the Max Flow fuel consumption indicator system. Combustion air flow to the engine was measured using a Meriam Laminar Flow element. Intake air restriction, and exhaust backpressure, barometer, and other pressure measurements were made using various MKS pressure sensors and/or pressure sensors embedded in the Superflow control system. Various temperature measurements are read and recorded using the Superflow embedded thermocouple readers and J-type thermocouples.

DPM sampling was performed using a Sierra BG-2 micro-dilution test stand[21]. This instrument was used to collect DPM samples for gravimetric (dpm mass emission) analysis. Samples obtained from the BG-2 are weighed in a clean room using a Mettler Toledo micro balance. The BG-2 was also used to collect DPM samples that were analyzed by MSHA's Pittsburgh Safety and Health Technology Center (PSHTC), Dust Division, for NIOSH 5040 EC/OC analysis.

All testing was done using the MSHA's part 7, subpart E test protocol[22]. This protocol is based on the ISO-8178 type C1 standard test protocol[23]. The MSHA test protocol is a steady state 8-mode test, and is used by MSHA[24] for mining engine approvals. The 8-mode test is also used by the EPA for certain classes of off-road engines. The 8-mode test measures the steady state performance and emissions at 8 points within the engine's operating envelope, as shown in Table 2 below. The weighting factors adjust emissions obtained at different test modes to give greater influence to higher load conditions at rated speed when calculating average gravimetric DPM emissions[25]. For the Isuzu 4JG1TMA engine, the rated speed for modes 1 through 4 is 2500rpm and the intermediate speed for modes 5 through 7 is 1800rpm.

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[21] See http://www.sierrainstruments.com/techsupport/manuals/im_bg1.pdf for a description of the system and its operation.

[22] See http://www.msha.gov/30cfr/7.0.htm .

[23] See http://www.dieselnet.com/standards/cycles/iso8178.html for more information on the 8-mode test protocol.

[24] http://www.msha.gov/30cfr/7.88.htm .

[25] The ISO-8178 method also applies the weighting factors when calculating the mass emissions of the gaseous components of the exhaust. This is not used by the MSHA Part 7 test protocol, as gaseous mass emissions at each of the 8 modes are calculated separately and used to compute a maximum ventilation rate for the engine. For the analysis of gaseous emissions, weighting factors were applied per the ISO test protocol to analyze average effects and to make the data comparable to EPA data. Ventilation rates and emissions were also compared modally per Part 7.

Table 2: MSHA §7.88 and §7.89 (ISO-8178 Type C1) 8-mode test points.

Mode	1	2	3	4	5	6	7	8
Engine Speed	Rated Speed				Intermediate Speed			Idle
Torque %	100	75	50	10	100	75	50	0
Weighting Factor	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15

The procedure used for all the fuel tests are outlined in Table 3 below. The main test variable was fuel (8 fuels). Each fuel was tested under two conditions; with and without the DOC in the exhaust system. Two tests were run per condition; a total of 32 tests were run to complete the series. The data generated from the tests on each fuel yielded four 8-mode tests for each fuel. Two tests were completed back to back without the DOC in the exhaust system, and two tests were completed back to back with the DOC in the exhaust system. The engine was run for an average of 3 hours before testing with each fuel on the bare engine and 3 hours before testing with each fuel for engine/DOC combination.

These tests yielded two sets of performance and gas emission data from each test condition, one set of gravimetric DPM samples per condition, and one set of 5040 EC/OC samples per condition[26]. This yielded whole DPM samples compatible with MSHA approval data and TC data relevant to the 30 CFR Part 57 regulations.

The DPM samples collected for NIOSH 5040 analysis[27] were used to determine the carbon components of the DPM in the exhaust. The analysis provides the Elemental Carbon (EC), the Organic Carbon (OC) and Total Carbon (TC) content of the engine's raw exhaust in micrograms per cubic meter of exhaust gas. While the concentration of the carbon in raw exhaust is much higher than an in-mine environment, it is these components that are diluted by mine air and are collected for compliance testing. Changes in engine-out emissions will directly affect changes in mine air quality, though the actual percent change in the mine is dependent on other variables, such as ventilation.

The DPM samples collected for 5040 analysis were sent to MSHA's PSHTC Dust Division for analysis using the same equipment used for processing in-mine personal and area samples. Data on EC, OC, and TC emissions of the engine were returned to the Diesel Lab for analysis. The gravimetric DPM

[26] One of the back-to-back 8-mode tests was used to collect gravimetric DPM samples, one was used to collect NIOSH 5040 samples, and gas emission and other data were collected for both.
[27] See http://www.cdc.gov/niosh/nmam/pdfs/5040f3.pdf for 5040 method and http://www.cdc.gov/niosh/mining/pubs/pdfs/ifdpm.pdf for information on in-mine sampling methods.

samples were weighed, after appropriate conditioning (per §7.89) and modal and weighted average DPM emissions were calculated.

The weighting factors that were applied to the modal gravimetric DPM data are provided in the ISO-8178 type C1 standard test protocol and are used by MSHA for Part 7, subpart E engine approvals (see Table 2). The DPM emission for each mode is multiplied by the weight factor for that mode in Table 2. These are then added together to calculate the weighted average DPM emission for the test[28]. There is no protocol in the MSHA or ISO test method for analyzing carbon (EC, OC, and TC) data, but the carbon samples were obtained and carbon analysis was performed in this test series because the MSHA MNM DPM regulation uses TC as the surrogate for DPM. For compatibility with the test method the same weighting factors were applied as gravimetric DPM samples when computing the averages for the carbon data[29].

As noted above, DPM samples used for gravimetric analysis are the standard method of analyzing engine-out DPM emissions by MSHA for engine approvals. These emissions include the carbon forms mentioned above, and other non-carbon solids that comprise DPM. Some of the "other" materials can include sulfates, nitrates, metal particles, ash, silicates, etc. Normally the carbon component of DPM is around 85% or more, but changes in fuel sulfur, fuel additives, and after treatment systems can alter the relative percentage of these components. The gravimetric test does not differentiate the components, but gives a total weight of particulate mass.

Gas emissions data and other test data for each 8-mode test were input into the standard 8-mode data sheet used by the Diesel Lab for documenting tests. The two sets of data for each test condition were then averaged together into a composite performance for that test condition, which is the data that will be discussed in the results section below.

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[28] Modes 1, 2, 3 and 8 are given a weight factor of 0.15, giving them a higher importance in the resulting average than the other modes. If all were given equal emphasis, then the weight factors would all be 0.125.

[29] The weight factors applied to the steady state 8 mode cycle are used to calculate an average emission based upon giving certain modes more effect on the resulting average than others. In effect, this models an assumed *duty cycle* for the engine. Calculations where alternate duty cycles could be modeled are discussed in the comments at the end of the report.

Table 3: General Procedure for Fuel Testing Experiment

STEP	Item
1	Drain Fuel System
2	Refill Fuel System with Test Fuel
3	Input Specific Gravity Data in Fuel Measurement System
4	Run Engine on Test Fuel at Various Speeds and Loads: Min Time 2.5 hrs Max Time 3.5 hrs (Ave 3 hours)
5	Run 8-mode test, collecting gas emission and gravimetric DPM Data
6	Re-Run 8-mode test, collecting gas emission data and collecting samples for NIOSH 5040 test
7	Analyze each 8-mode test: weigh gravimetric DPM samples, send 5040 samples to MSHA Dust Div. for analysis
8	Analyze tests run in Step 5 and 6: two test average of gas emission data, one test sample set for gravimetric DPM, on set of 5040 data
9	Add (or remove) DOC from Exhaust System
10	Repeat Steps 4 through 7
11	Next test fuel: go to step 1 and repeat

(a)

(b)

Figure 1 (a): Isuzu 4JG1T engine installed and instrumented for testing. (b) View of GE dynamometer and SuperFlow Control System.

Figure 2: Laboratory control room showing XConsole, Horiba Emissions Bench, Sierra BG-2 and miscellaneous other instrumentation.

Results:

The results of all the testing will be shown below. More detailed tabulations, data sheets and charts showing of the emissions data may be found in Appendix C. The discussion section to follow will delve into what impact this data might have on the decision making for DPM reduction strategies, and comparisons of these results to other available data.

DPM Emissions, Gravimetric:

The weighted average gravimetric DPM emissions data for the tests conducted are shown in Table 4. The data shows the bare engine DPM emission and the engine/DOC combination DPM emission for each fuel tested. Shown in the table are DPM percent change calculations between bare engine test and the LSD baseline, as well as percent changes between with and without DOC and overall change in fuel/DOC combinations compared to LSD bare engine baseline. A graphic representation of the data may be found in Figure 3.

Table 4: DPM gravimetric Weighted Average Data

Fuel No.	FUEL		Bare Engine DPM (g/hr)		Engine +DOC DPM (g/hr)	% change w/ DOC	% change from LSD-Bare
1	2005 spec LSD Certified		9.03		10.84	20.0	20.0
2	2007 spec ULSD Certified		9.02		7.5	-16.9	-16.9
	% change fromLSD		-0.1		-30.8		
3	Highway ULSD		7.31		8.74	19.6	-3.2
	% change fromLSD		-19.0		-19.4		
4	Stepan SB-W	biodiesel	8.47		4.38	-48.3	-51.5
	% change fromLSD		-6.2		-59.6		
5	IRE REG-9000-10	biodiesel	8.62		4.87	-43.5	-46.1
	% change fromLSD		-4.5		-55.1		
6	IRE REG-9000-5	biodiesel	8.21		4.73	-42.4	-47.6
	% change fromLSD		-9.1		-56.4		
7	B50 Mix*		7.78		5.69	-26.9	-37.0
	% change fromLSD		-13.8		-47.5		
8	PetroSA Fischer-Tropsch	synthetic	6.33		6.06	-4.3	-32.9
	% change fromLSD		-29.9		-44.1		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

For the bare engine tests, it is notable that none of the B100 biodiesels lowered gravimetric emissions significantly. The B50 blend did lower the DPM emissions nearly 14% compared to LSD, but the highway ULSD sample alone lower DPM 19% compared to LSD. This lower emission of the highway sample is probably due mostly to low density and high cetane number. Mixing it with SB-W biodiesel lowered cetane and raised density, causing higher DPM than the ULSD alone.

It is also notable that the highway ULSD had lower gravimetric DPM than the B100 fuels.

For the DOC tests, it was found that the addition of the DOC significantly lowered DPM emissions for all the fuels, except F-T which was only slightly lower and LSD and highway ULSD which went up. For the LSD adding a DOC increased DPM emissions by 20%; this is postulated to sulfate production in the DOC and has been observed in other tests at MSHA. For the highway ULSD, the increase in DPM is unexplained, but could be due to commercial fuel additives in this product.

For the B100 biodiesels adding a DOC significantly lowered DPM, whether you compared it to B100 on a bare engine, or compared it with LSD with or without a DOC. B100 emissions were lowered 42-48% with the addition of a DOC. B100 DPM emissions were lowered 55-59% compared to LSD with a DOC. B100 DPM emissions were lowered 46-51% compared to LSD on a bare engine.

For the F-T fuel, bare engine DPM emissions were lowered by 30% compared to LSD. The addition of the DOC did not significantly improve it performance, which will be discussed below. These results are consistent with the F-T fuel tests conducted previously by MSHA on Syntroleum S-2 and Synpar 200 synthetic fuels.

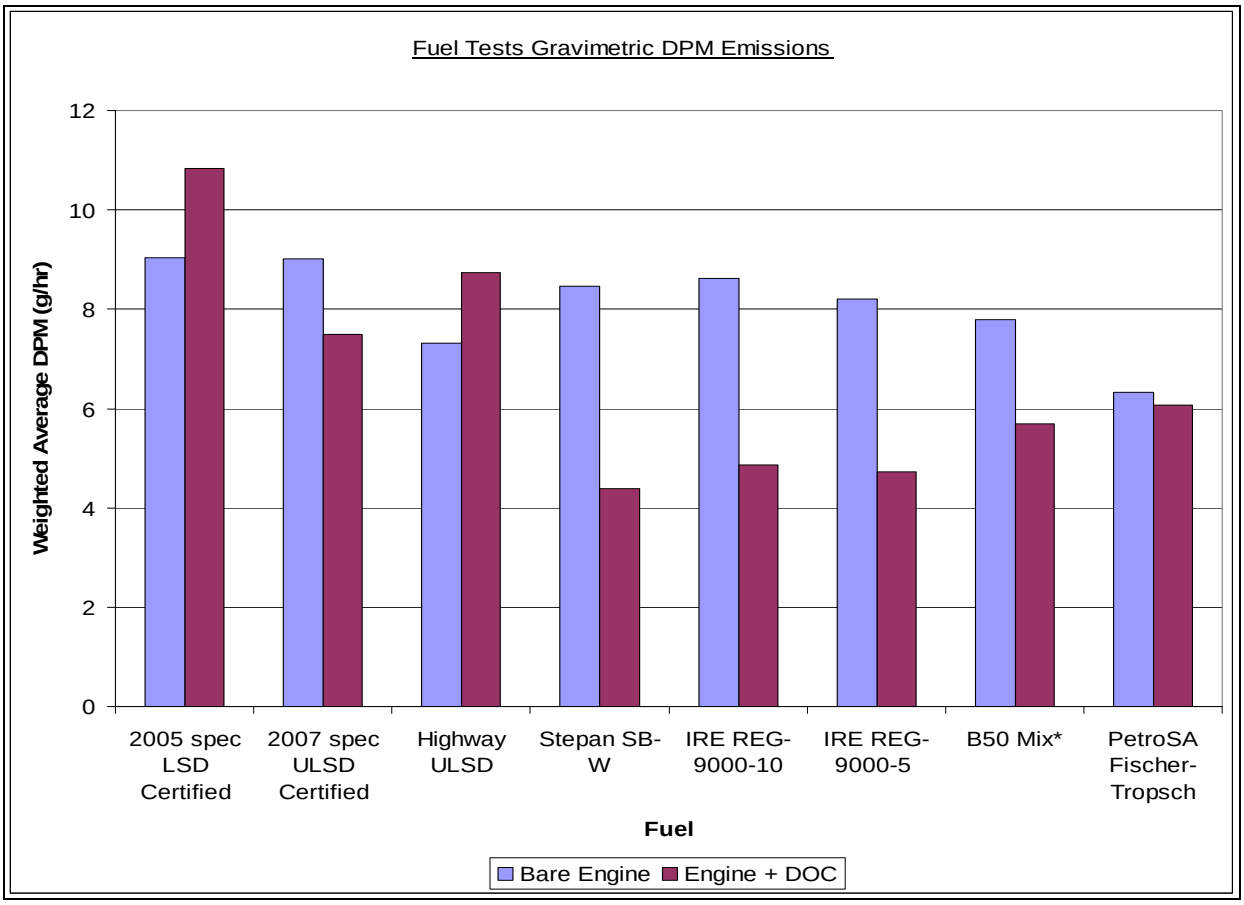

Figure 3: Weighted Average DPM Emission Data (from Table 4).

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Carbon Emissions, Bare Engine:

The carbon component of the DPM emission, as measured by the NIOSH 5040 samples, are shown in Table 5 for the bare engine tests. Data sheets and charts of the data may be found in Appendix C. The tables show the EC, OC and TC emissions for each fuel test for all 8 of the test modes. Changes in each of these emissions are compared to the baseline emissions for each test mode and an average percentage change[30] for the entire test is highlighted in the right hand column. These average changes are discussed below.

An interesting result from the *bare engine* tests include the relative lack of difference in carbon emissions in the three petroleum fuels, with the exception of 12.9% lower OC emissions from highway ULSD than LSD. This one significant change is again probably due to the high cetane and low density of the highway ULSD.

The B100 fuels all show significant *reductions* in EC emissions in comparison to the petroleum based diesel fuels. This EC reduction was from 52-61% depending B100 product, when compared to LSD. The B50 blend showed an EC reduction of 46%. The F-T fuel also had a significant EC reduction of 27.5%.

The B100 fuels all showed significant *increases* in OC emissions compared to petroleum diesel. This increase varied from 56 to 72% for the B100 fuels. The B50 fuel had a less significant OC increase of 27%. Only the F-T fuel showed both EC and OC reductions, the OC being 37% lower than the LSD baseline.

For the B100 fuels, these opposing trends of lowered EC and increased OC resulted in lower TC reductions than expected. This can be observed in the TC (TC=EC+OC) data. For the B100 fuels, the TC emissions were reduced compared to the LSD baseline, but only by 12-13%. For the B50 blend, the TC emissions were reduced 19% compared to LSD[31]. The most effective fuel for TC reductions on the bare engine was the F-T fuel, with a reduction of 31% compared to LSD.

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[30] As noted previously, this percent change uses the weighted average per the ISO weight factors. Percent changes by mode are also shown in the Table.

[31] It may be speculated that the blended fuel produced some of the EC reduction of B100, without more OC increase as B100, allowing moderately better TC performance than B100.

Table 5: Carbon Emission (EC/OC/TC) Results from NIOSH 5040 Analysis: Bare Engine Data.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
EC/OC Carbon DPM Data for Bare Engine

Fuel No.	Bare Engine Test FUEL		Test Mode 1 (ug/m3)	2 (ug/m3)	3 (ug/m3)	4 (ug/m3)	5 (ug/m3)	6 (ug/m3)	7 (ug/m3)	8 (ug/m3)	Weighted Average	Weighted Average %Difference
1	**2005 spec LSD Certified**	EC	22617	25554	18887	14111	32748	24076	16282	1106	18946.3	
		OC	11468	11104	10198	13718	13341	9673	9510	7616	10682.1	
		TC	34085	36659	29085	27829	46089	33750	25799	8722	29629.35	
	% OC in TC		33.6	30.3	35.1	49.3	28.9	28.7	36.9	87.3	41.3	Average
2	**2007 spec ULSD Certified**	EC	25116	30935	19728	13010	34517	23256	16370		20082.15	
		OC	10718	9786	9564	14488	10348	8618	10689	8403	10184.95	
		TC	36093	40713	29292	27498	44872	31874	27058	9002	30395.2	
	% OC in TC		29.7	24.0	32.7	52.7	23.1	27.0	39.5	93.3	40.3	Average
	EC % change from LSD		11.0	21.1	4.5	-7.8	5.4	-3.4	0.5	na		6.0
	OC % change from LSD		-6.5	-11.9	-6.2	5.6	-22.4	-10.9	12.4	10.3		-4.7
	TC % change from LSD		5.9	11.1	0.7	-1.2	-2.6	-5.6	4.9	3.2		2.6
3	**Highway ULSD**	EC	21974	27941	16546	17912	43091	24139	10254	1156	19682.15	
		OC	11284	8948	10225	12634	9819	7052	7969	6621	9309.1	
		TC	33250	36890	26770	30546	52910	31191	18223	7777	28990.05	
	% OC in TC		33.9	24.3	38.2	41.4	18.6	22.6	43.7	85.1	38.5	Average
	EC % change from LSD		-2.8	9.3	-12.4	26.9	31.6	0.3	-37.0	4.5		3.9
	OC % change from LSD		-1.6	-19.4	0.3	-7.9	-26.4	-27.1	-16.2	-13.1		-12.9
	TC % change from LSD		-2.4	0.6	-8.0	9.8	14.8	-7.6	-29.4	-10.8		-2.2
4	**Stepan SB-W**	EC	11039	14446	8586	5776	18845	9164	6920		9181.15	
	biodiesel	OC	14971	18924	20382	17186	14225	16967	18635	12244	16679.45	
		TC	26009	33370	28968	22962	33070	26132	25556	12564	25908.65	
	% OC in TC		57.6	56.7	70.4	74.8	43.0	64.9	72.9	97.5	67.2	Average
	EC % change from LSD		-51.2	-43.5	-54.5	-59.1	-42.5	-61.9	-57.5	na		-51.5
	OC % change from LSD		30.5	70.4	99.9	25.3	6.6	75.4	96.0	60.8		56.1
	TC % change from LSD		-23.7	-9.0	-0.4	-17.5	-28.2	-22.6	-0.9	44.0		-12.6
5	**IRE REG-9000-10**	EC	9131	11127	7260	4080	17239	6968	5059		7462.3	
	biodiesel	OC	17269	21786	19500	19116	14717	20843	20049	13562	18290.05	
		TC	26400	**32913**	26760	23195	31956	27819	25107	14260	25857.65	
	% OC in TC		65.4	66.2	72.9	82.4	46.1	74.9	79.9	95.1	72.9	Average
	EC % change from LSD		-59.6	-56.5	-61.6	-71.1	-47.4	-71.1	-68.9	na		-60.6
	OC % change from LSD		50.6	96.2	91.2	39.3	10.3	115.5	110.8	78.1		71.2
	TC % change from LSD		-22.5	-10.2	-8.0	-16.7	-30.7	-17.6	-2.7	63.5		-12.7
6	**IRE REG-9000-5**	EC	10012	**11820**	6667	4619	14017	6727	5055		7316.65	
	biodiesel	OC	17185	23246	19896	19683	14530	18524	20301	13352	18355.65	
		TC	27204	35066	26563	24302	28546	25259	25355	13866	25751.05	
	% OC in TC		63.2	66.3	74.9	81.0	50.9	73.3	80.1	96.3	73.2	Average
	EC % change from LSD		-55.7	-53.7	-64.7	-67.3	-57.2	-72.1	-69.0	na		-61.4
	OC % change from LSD		49.9	109.3	95.1	43.5	8.9	91.5	113.5	75.3		71.8
	TC % change from LSD		-20.2	-4.3	-8.7	-12.7	-38.1	-25.2	-1.7	59.0		-13.1
7	**B50 Mix***	EC	14096	14681	8603	8452	17302	14494	6396		10271.4	
		OC	12374	14089	14668	14807	13744	13724	15885	10437	13551.2	
		TC	26470	28770	23271	23259	31045	28225	22281	11163	23932.1	
	% OC in TC		46.7	49.0	63.0	63.7	44.3	48.6	71.3	93.5	60.0	Average
	EC % change from LSD		-37.7	-42.5	-54.5	-40.1	-47.2	-39.8	-60.7	na		-45.8
	OC % change from LSD		7.9	26.9	43.8	7.9	3.0	41.9	67.0	37.0		26.9
	TC % change from LSD		-22.3	-21.5	-20.0	-16.4	-32.6	-16.4	-13.6	28.0		-19.2
8	**PetroSA Fischer-Tropsch**	EC	24423	18580	9290	8775	24354	16964	8871		13740.35	
	synthetic	OC	8359	8650	7853	7144	6948	4935	5203	4213	6784.25	
		TC	32783	27222	17136	15926	31302	21900	14081	4437	20557.6	
	% OC in TC		25.5	31.8	45.8	44.9	22.2	22.5	37.0	95.0	40.6	Average
	EC % change from LSD		8.0	-27.3	-50.8	-37.8	-25.6	-29.5	-45.5	na		-27.5
	OC % change from LSD		-27.1	-22.1	-23.0	-47.9	-47.9	-49.0	-45.3	-44.7		-36.5
	TC % change from LSD		-3.8	-25.7	-41.1	-42.8	-32.1	-35.1	-45.4	-49.1		-30.6
			Weight Factors: 0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

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Carbon Emissions, Engine with DOC:

The carbon component of the DPM emission, as measured by the NIOSH 5040 samples, are shown in Table 6 for tests with the DOC. Data sheets and charts of the data may be found in Appendix C. The tables show the EC, OC and TC emissions for each fuel test for all 8 of the test modes. Changes in each of these emissions are compared to the baseline emissions for each test mode and an average percentage change for the entire test is highlighted in the right hand column. The baselines for comparison are the fuel's data from its bare engine test and the LSD with DOC test (LSD/DOC).

The petroleum diesels all showed reduced OC emissions due to the DOC reacting with the organic carbon. OC was reduced 42-51% compared to each fuel's bare engine data. EC emissions appear to be nearly unaffected by the addition of a DOC to the engine. The TC reductions for the petroleum diesels, due to the addition of a DOC, were from 12-15%.

The B100's all showed significant reductions in OC emissions with the addition of a DOC, 63-65%. Interestingly OC emissions of the B100's were still higher than the LSD/DOC combination by 5-10%. B50 showed a 60% reduction in OC over its bare engine data, while F-T showed a 31% OC reduction over its bare engine data.

Changes in EC emissions for B100's with a DOC varied between an 8% reduction and a 15% increase, depending on fuel. This minor variation in EC emission did not affect the B100's overall EC improvement over LSD/DOC, which equated to reductions of 58-63%. EC emissions of B50 with DOC were 44% better than LSD/DOC and F-T EC was reduced 26% from LSD/DOC.

All these relative changes in EC and OC translate to a B100 reduction in TC emissions of around 43% with the addition of a DOC. This reduction makes B100's TC emissions around 44% lower than a LSD/DOC combination. B50's TC was lowered 29% with the addition of a DOC and is 35% better than LSD/DOC. The F-T fuel's TC was only marginally lower by 4% by use of the DOC, but still has TC 25% lower than the LSD/DOC combination.

Table 6: **Carbon Emission (EC/OC/TC) Results from NIOSH 5040 Analysis: Engine with DOC Data.**

FUEL TESTING on Isuzu 4JG1T Diesel Engine
EC/OC Carbon DPM Data for Engine+DOC Combination
Engine + DOC Test

Fuel No.	FUEL		Test Mode 1 (ug/m3)	2 (ug/m3)	3 (ug/m3)	4 (ug/m3)	5 (ug/m3)	6 (ug/m3)	7 (ug/m3)	8 (ug/m3)	Weighted Average	Weighted Average %Difference
1	**2005 spec LSD Certified**	EC	23274	28299	20332	14895	33431	27289	15217	906	20004.85	
		OC	8756	8078	6988	7329	6427	4867	4387	1878	6156	
		TC	32037	36377	27320	22224	39857	32156	19604	2791	26162.85	
	% OC in TC		27.3	22.2	25.6	33.0	16.1	15.1	22.4	67.3	28.6	Average
	EC % change from bare engine		2.9	10.7	7.7	5.6	2.1	13.3	-6.5	-18.1		5.6
	OC % change from bare engine		-23.6	-27.3	-31.5	-46.6	-51.8	-49.7	-53.9	-75.3		-42.4
	TC % change from bare engine		-6.0	-0.8	-6.1	-20.1	-13.5	-4.7	-24.0	-68.0		-11.7
2	**2007 spec ULSD Certified**	EC	23341	28821	20707	12638	41127	28157	16690		20791.55	
		OC	5637	5764	6048	5926	5472	3935	4622	2422	4976.15	
		TC	28978	34585	26754	18563	46600	32099	21312	3147	25877	
	% OC in TC		19.5	16.7	22.6	31.9	11.7	12.3	21.7	77.0	26.7	Average
	EC % change from bare engine		-7.1	-6.8	5.0	-2.9	19.1	21.1	2.0	na		3.5
	OC % change from bare engine		-47.4	-41.1	-36.8	-59.1	-47.1	-54.3	-56.8	-71.2		-51.1
	TC % change from bare engine		-19.7	-15.1	-8.7	-32.5	3.9	0.7	-21.2	-65.0		-14.9
	EC % change from LSD w/ DOC		0.3	1.8	1.8	-15.2	23.0	3.2	9.7	na		3.9
	OC % change from LSD w/ DOC		-35.6	-28.6	-13.5	-19.1	-14.9	-19.1	5.4	29.0		-19.2
	TC % change from LSD w/ DOC		-9.5	-4.9	-2.1	-16.5	16.9	-0.2	8.7	12.8		-1.1
3	**Highway ULSD**	EC	27260	27093	16735	15755	41303	22586	13569	1059	20143.35	
		OC	5591	5416	9079	4998	4464	4179	4976	2693	5278.55	
		TC	32851	32501	25814	20752	45774	26764	18544	3752	25421.1	
	% OC in TC		17.0	16.7	35.2	24.1	9.8	15.6	26.8	71.8	27.1	Average
	EC % change from bare engine		24.1	-3.0	1.1	-12.0	-4.1	-6.4	32.3	-8.4		2.3
	OC % change from bare engine		-50.5	-39.5	-11.2	-60.4	-54.5	-40.7	-37.6	-59.3		-43.3
	TC % change from bare engine		-1.2	-11.9	-3.6	-32.1	-13.5	-14.2	1.8	-51.8		-12.3
	EC % change from LSD w/ DOC		17.1	-4.3	-17.7	5.8	23.5	-17.2	-10.8	16.9		0.7
	OC % change from LSD w/ DOC		-36.1	-33.0	29.9	-31.8	-30.5	-14.1	13.4	43.4		-14.3
	TC % change from LSD w/ DOC		2.5	-10.7	-5.5	-6.6	14.8	-16.8	-5.4	34.4		-2.8
4	**Stepan SB-W**	EC	10149	12256	7379	4425	20853	9469	6261		8568.4	
	biodiesel	OC	5278	6291	7180	7084	4812	7429	6845	3986	6027.25	
		TC	15427	18546	14559	11509	25657	16898	13098	4244	14632.6	
	% OC in TC		34.2	33.9	49.3	61.6	18.8	44.0	52.3	93.9	48.5	Average
	EC % change from bare engine		-8.1	-15.2	-14.1	-23.4	10.7	3.3	-9.5	na		-6.7
	OC % change from bare engine		-64.7	-66.8	-64.8	-58.8	-66.2	-56.2	-63.3	-67.4		-63.9
	TC % change from bare engine		-40.7	-44.4	-49.7	-49.9	-22.4	-35.3	-48.7	-66.2		-43.5
	EC % change from LSD w/ DOC		-56.4	-56.7	-63.7	-70.3	-37.6	-65.3	-58.9	na		-57.2
	OC % change from LSD w/ DOC		-39.7	-22.1	2.7	-3.3	-25.1	52.6	56.0	112.2		-2.1
	TC % change from LSD w/ DOC		-51.8	-49.0	-46.7	-48.2	-35.6	-47.4	-33.2	52.1		-44.1
5	**IRE REG-9000-10**	EC	9692	11151	6277	3789	16583	9371	5647		7607	
	biodiesel	OC	7563	9439	7790	7124	6057	6510	5781	3474	6787.1	
		TC	17255	20590	14074	10906	22640	15881	11428	4107	14489.4	
	% OC in TC		43.8	45.8	55.4	65.3	26.8	41.0	50.6	84.6	51.7	Average
	EC % change from bare engine		6.1	0.2	-13.5	-7.1	-3.8	34.5	11.6	na		1.9
	OC % change from bare engine		-56.2	-56.7	-60.1	-62.7	-58.8	-68.8	-71.2	-74.4		-62.9
	TC % change from bare engine		-34.6	-37.4	-47.4	-53.0	-29.2	-42.9	-54.5	-71.2		-44.0
	EC % change from LSD w/ DOC		-58.4	-60.6	-69.1	-74.6	-50.4	-65.7	-62.9	na		-62.0
	OC % change from LSD w/ DOC		-13.6	16.8	11.5	-2.8	-5.8	33.8	31.8	85.0		10.3
	TC % change from LSD w/ DOC		-46.1	-43.4	-48.5	-50.9	-43.2	-50.6	-41.7	47.2		-44.6
6	**IRE REG-9000-5**	EC	10428	11594	7550	4770	18110	8876	6223		8233.7	
	biodiesel	OC	6333	7799	8021	7614	6255	6017	6140	3603	6466	
		TC	16762	19392	15571	12384	24365	14892	12363	4179	14786	
	% OC in TC		37.8	40.2	51.5	61.5	25.7	40.4	49.7	86.2	49.1	Average
	EC % change from bare engine		4.2	-1.9	13.2	3.3	29.2	31.9	23.1	na		12.5
	OC % change from bare engine		-63.1	-66.5	-59.7	-61.3	-57.0	-67.5	-69.8	-73.0		-64.8
	TC % change from bare engine		-38.4	-44.7	-41.4	-49.0	-14.6	-41.0	-51.2	-69.9		-42.6
	EC % change from LSD w/ DOC		-55.2	-59.0	-62.9	-68.0	-45.8	-67.5	-59.1	na		-58.8
	OC % change from LSD w/ DOC		-27.7	-3.5	14.8	3.9	-2.7	23.6	40.0	91.9		5.0
	TC % change from LSD w/ DOC		-47.7	-46.7	-43.0	-44.3	-38.9	-53.7	-36.9	49.7		-43.5
7	**B50 Mix***	EC	14940	18215	9723	7617	21289	14161	6910		11429.4	
		OC	5977	6915	6415	5973	5657	5084	4577	2605	5415.9	
		TC	20910	25130	16138	13583	26947	19245	11487	3298	16947.6	
	% OC in TC		28.6	27.5	39.8	44.0	21.0	26.4	39.8	79.0	38.3	Average
	EC % change from bare engine		6.0	24.1	13.0	-9.9	23.0	-2.3	8.0	na		11.3
	OC % change from bare engine		-51.7	-50.9	-56.3	-59.7	-58.8	-63.0	-71.2	-75.0		-60.0
	TC % change from bare engine		-21.0	-12.7	-30.7	-41.6	-13.2	-31.8	-48.4	-70.5		-29.2
	EC % change from LSD w/ DOC		-35.8	-35.6	-52.2	-48.9	-36.3	-48.1	-54.6	na		-42.9
	OC % change from LSD w/ DOC		-31.7	-14.4	-8.2	-18.5	-12.0	4.5	4.3	38.7		-12.0
	TC % change from LSD w/ DOC		-34.7	-30.9	-40.9	-38.9	-32.4	-40.2	-41.4	18.2		-35.2
8	**PetroSA Fischer-Tropsch**	EC	24669	20418	10726	11380	27878	18509	9195		15068.15	
	synthetic	OC	6425	5501	4653	4643	4895	4497	3598	2450	4617.65	
		TC	31094	25919	15380	16023	32773	23006	12785	2776	19734.05	
	% OC in TC		20.7	21.2	30.3	29.0	14.9	19.5	28.1	88.3	31.5	Average
	EC % change from bare engine		1.0	9.9	15.5	29.7	14.5	9.1	3.7	na		9.7
	OC % change from bare engine		-23.1	-36.4	-40.7	-35.0	-29.5	-8.9	-30.8	-41.8		-31.9
	TC % change from bare engine		-5.2	-4.8	-10.2	0.6	4.7	5.1	-9.2	-37.4		-4.0
	EC % change from LSD w/ DOC		6.0	-27.8	-47.2	-23.6	-16.6	-32.2	-39.6	na		-24.7
	OC % change from LSD w/ DOC		-26.6	-31.9	-33.4	-36.6	-23.8	-7.6	-18.0	30.5		-25.0
	TC % change from LSD w/ DOC		-2.9	-28.7	-43.7	-27.9	-17.8	-28.5	-34.8	-0.5		-24.6
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD Weight Factors:			0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

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Gas Emissions, NO:

Table 7 shows the nitric oxide (NO) emissions for the fuel tests with and without the DOC. The table shows the raw NO emissions (in g/hr) and the ventilation rate calculations; i.e., the CFM of ventilation air required to keep NO ambient levels below the MSHA limits in the mine environment. The table also compares the changes in NO emissions for all the tests to the LSD baseline for the bare engine tests and compares a fuel's emissions with a DOC to its bare engine test. The weighted averages for each test are calculated and percent differences are calculated.

For the bare engine tests, the only significant variation in the petroleum diesels was a 13% lower NO emission from the highway ULSD compared to LSD. The B100 fuels did not show any significant changes in NO, varying from a 1% reduction to a 7.7% increase. The B50 NO emission did not vary significantly from LSD. The F-T fuel did lower NO significantly by 27%.

For the tests with the DOC, the emissions of NO did vary somewhat from the bare engine values. Generally, the DOC tests produced a reduction in NO emissions on all the fuels tested when compared to its bare engine counterpart. This reduction varied from 11% to a more significant 20% for one of the B100 formulas. These reductions in NO correlate directly to NO2 changes as discussed below[32].

Gas Emissions, NO2:

Table 8 shows the nitrogen dioxide (NO2) emissions for the fuel tests with and without the DOC. The table shows the raw NO2 emissions (in g/hr) and the ventilation rate calculations of the CFM of required to keep NO2 ambient levels below the MSHA required limits in the mine environment. The table also compares the changes in NO2 emissions for all the tests to the LSD baseline for the bare engine tests and compares a fuel's emissions with a DOC to its bare engine test. The weighted averages for each test are calculated and percent differences are calculated.

For the bare engine tests, NO2 emissions from all fuels were lower than the data from LSD. The petroleum based ULSD fuels were 7-10% lower than LSD. For the B100's, NO2 was 8-21% lower than LSD. B50 reduced NO2 by 9%, while the F-T reduced NO2 by 15%.

The DOC tests produced some significant NO2 increases in all fuels due to the DOCs oxidation of NO to NO2. For the petroleum diesels, the average increase varied from 90 to 146%. For the B100 fuels, increases in NO2 due to the use of the DOC varied from 184% to 209% depending on fuel. B50 fuel increased NO2 147%, while the F-T had an increase in NO2 of 99%.

[32] The reduction in NO is due to the conversion of NO to NO2 by the DOC.

These increases in NO2 emissions with the use of a DOC has been noted in other MSHA tests and in research conducted by other laboratories. The effects of this NO2 on the mine environment will be covered in the discussion section.

Table 7: NO Emission and Ventilation Rate Calculation for Fuel Tests.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
NO Emissions Data, gr/hr
with ventillation rates

Bare Engine Test

Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average % Diff
1	2005 spec LSD Certified	g/hr	266.19	181.75	113.60	30.09	240.84	171.80	110.14	14.72	141.7	
		CFM Vent	4938	3371	2107	558	4468	3187	2043	273		
2	2007 spec ULSD Certified	g/hr	272.52	183.40	115.27	30.21	246.15	179.24	112.04	12.57	144.3	
		CFM Vent	5055	3402	2138	560	4566	3325	2078	233		1.8
	% change from LSD		2.4	0.9	1.5	0.4	2.2	4.3	1.7	-14.6		
3	Highway ULSD	g/hr	235.47	152.95	95.16	25.83	209.60	152.62	95.69	13.25	122.9	
		CFM Vent	4368	2837	1765	479	3888	2831	1775	246		-13.3
	% change from LSD		-11.5	-15.8	-16.2	-14.1	-13.0	-11.2	-13.1	-10.0		
4	Stepan SB-W biodiesel	g/hr	288.52	194.50	121.47	34.08	255.29	186.30	121.57	14.93	152.6	
		CFM Vent	5352	3608	2253	632	4736	3456	2255	277		7.7
	% change from LSD		8.4	7.0	6.9	13.3	6.0	8.4	10.4	1.4		
5	IRE REG-9000-10 biodiesel	g/hr	259.27	173.66	111.74	30.25	240.79	177.17	108.20	15.55	139.7	
		CFM Vent	4809	3221	2073	561	4467	3286	2007	288		-1.4
	% change from LSD		-2.6	-4.5	-1.6	0.5	0.0	3.1	-1.8	5.6		
6	IRE REG-9000-5 biodiesel	g/hr	273.66	184.34	118.89	30.54	259.38	191.16	119.34	17.52	149.2	
		CFM Vent	5076	3419	2205	566	4811	3546	2214	325		5.3
	% change from LSD		2.8	1.4	4.7	1.5	7.7	11.3	8.4	19.0		
7	B50 Mix*	g/hr	260.03	175.05	109.68	28.93	237.75	168.69	111.20	15.27	138.7	
		CFM Vent	4823	3247	2035	537	4410	3129	2063	283		-2.2
	% change from LSD		-2.3	-3.7	-3.4	-3.8	-1.3	-1.8	1.0	3.7		
8	PetroSA Fischer-Tropsch Syn.	g/hr	189.28	128.80	81.90	22.50	184.05	129.58	83.41	13.66	104.0	
		CFM Vent	3511	2389	1519	417	3414	2404	1547	253		-26.6
	% change from LSD		-28.9	-29.1	-27.9	-25.2	-23.6	-24.6	-24.3	-7.2		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

Engine +DOC Test

Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average % Diff
1	2005 spec LSD Certified	g/hr	237.80	153.69	110.25	36.66	211.93	135.22	99.45	17.76	126.2	
		CFM Vent	4411	2851	2045	680	3931	2508	1845	329		-10.9
	% change from bare engine		-10.7	-15.4	-3.0	21.8	-12.0	-21.3	-9.7	20.6		
2	2007 spec ULSD Certified	g/hr	251.93	154.86	106.47	36.21	214.79	139.21	91.88	18.28	127.9	
		CFM Vent	4673	2873	1975	672	3984	2582	1704	339		-11.4
	% change from bare engine		-7.6	-15.6	-7.6	19.8	-12.7	-22.3	-18.0	45.4		
3	Highway ULSD	g/hr	202.25	124.14	91.33	30.41	178.94	110.44	81.45	15.78	105.1	
		CFM Vent	3752	2303	1694	564	3319	2049	1511	293		-14.4
	% change from bare engine		-14.1	-18.8	-4.0	17.7	-14.6	-27.6	-14.9	19.1		
4	Stepan SB-W biodiesel	g/hr	235.08	149.81	106.88	37.74	210.06	131.91	95.39	17.32	123.9	
		CFM Vent	4361	2779	1983	700	3897	2447	1769	321		-18.8
	% change from bare engine		-18.5	-23.0	-12.0	10.7	-17.7	-29.2	-21.5	16.0		
5	IRE REG-9000-10 biodiesel	g/hr	218.32	135.63	98.32	32.91	184.01	119.93	84.85	17.56	112.6	
		CFM Vent	4050	2516	1824	610	3413	2225	1574	326		-19.4
	% change from bare engine		-15.8	-21.9	-12.0	8.8	-23.6	-32.3	-21.6	12.9		
6	IRE REG-9000-5 biodiesel	g/hr	224.45	144.90	103.52	35.20	199.28	131.39	95.71	19.61	120.0	
		CFM Vent	4163	2688	1920	653	3697	2437	1775	364		-19.6
	% change from bare engine		-18.0	-21.4	-12.9	15.3	-23.2	-31.3	-19.8	11.9		
7	B50 Mix*	g/hr	225.48	138.45	95.32	32.74	192.65	119.76	87.48	18.23	114.9	
		CFM Vent	4183	2568	1768	607	3574	2222	1623	338		-17.1
	% change from bare engine		-13.3	-20.9	-13.1	13.2	-19.0	-29.0	-21.3	19.4		
8	PetroSA Fischer-Tropsch Syn.	g/hr	172.19	112.50	83.57	26.97	153.10	98.08	74.08	15.49	92.8	
		CFM Vent	3194	2087	1550	500	2840	1819	1374	287		-10.8
	% change from bare engine		-9.0	-12.7	2.0	19.9	-16.8	-24.3	-11.2	13.3		
		Weight Factors:	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

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Table 8: NO2 Emission and Ventilation Rate Calculation for Fuel Tests.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
NO2 Emissions Data, gr/hr
with ventillation rates

Bare Engine Test — Test Mode

Fuel No.	FUEL		1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	18.75	16.60	13.36	7.68	15.45	14.21	8.78	3.49	12.4	
		CFM Vent	1134	1004	808	465	935	860	531	211		
2	2007 spec ULSD Certified	g/hr	23.67	10.21	12.37	8.10	7.43	11.27	8.96	3.93	11.1	
		CFM Vent	1432	617	748	490	449	682	542	238		-10.8
	% change from LSD		26.3	-38.5	-7.4	5.5	-51.9	-20.7	2.1	12.5		
3	Highway ULSD	g/hr	20.35	15.77	12.71	8.09	6.77	11.30	11.32	3.44	11.6	
		CFM Vent	1231	954	769	489	410	683	685	208		-6.9
	% change from LSD		8.6	-5.0	-4.8	5.3	-56.2	-20.5	28.9	-1.5		
4	Stepan SB-W biodiesel	g/hr	15.31	12.80	8.59	6.33	11.56	12.07	6.91	4.03	9.8	
		CFM Vent	926	774	520	383	699	730	418	244		-21.3
	% change from LSD		-18.3	-22.9	-35.7	-17.6	-25.2	-15.1	-21.3	15.3		
5	IRE REG-9000-10 biodiesel	g/hr	17.62	10.71	10.52	6.90	8.46	13.52	9.09	3.63	10.2	
		CFM Vent	1066	648	636	418	512	818	550	219		-18.3
	% change from LSD		-6.0	-35.5	-21.3	-10.1	-45.2	-4.9	3.6	3.9		
6	IRE REG-9000-5 biodiesel	g/hr	20.78	14.09	11.70	6.06	10.09	13.14	9.55	3.71	11.4	
		CFM Vent	1257	852	708	366	611	795	578	225		-8.2
	% change from LSD		10.8	-15.1	-12.4	-21.2	-34.7	-7.5	8.9	6.4		
7	B50 Mix*	g/hr	19.74	13.18	11.79	6.29	13.76	11.39	9.28	3.46	11.3	
		CFM Vent	1194	797	713	380	833	689	561	209		-9.2
	% change from LSD		5.3	-20.6	-11.8	-18.2	-10.9	-19.9	5.7	-1.0		
8	PetroSA Fischer-Tropsch Syn.	g/hr	16.61	12.92	10.78	8.38	11.92	9.70	10.06	3.53	10.6	
		CFM Vent	1005	782	652	507	721	587	609	214		-14.9
	% change from LSD		-11.4	-22.1	-19.3	9.1	-22.9	-31.8	14.7	1.2		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

Engine +DOC Test — Test Mode

Fuel No.	FUEL		1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	43.92	36.58	12.95	0.00	31.95	43.58	21.14	0.09	23.7	
		CFM Vent	2657	2213	783	0	1933	2636	1279	5		90.5
	% change from bare engine		134.3	120.4	-3.1	-100.0	106.8	206.6	140.9	-97.5		
2	2007 spec ULSD Certified	g/hr	40.88	40.62	18.84	0.00	36.86	48.36	28.18	0.37	26.4	
		CFM Vent	2473	2457	1140	0	2229	2925	1705	22		138.2
	% change from bare engine		72.7	298.0	52.3	-100.0	396.3	329.1	214.5	-90.6		
3	Highway ULSD	g/hr	51.19	41.52	16.56	0.77	41.93	52.37	25.78	0.30	28.5	
		CFM Vent	3096	2512	1002	47	2536	3168	1560	18		146.1
	% change from bare engine		151.5	163.2	30.3	-90.5	519.3	363.6	127.8	-91.2		
4	Stepan SB-W biodiesel	g/hr	55.14	42.17	21.55	0.00	45.51	52.01	26.33	0.33	30.3	
		CFM Vent	3336	2551	1303	0	2753	3146	1593	20		208.9
	% change from bare engine		260.1	229.5	150.8	-100.0	293.7	330.7	281.0	-91.9		
5	IRE REG-9000-10 biodiesel	g/hr	57.19	45.76	21.30	0.32	50.92	57.24	25.24	0.30	32.1	
		CFM Vent	3460	2768	1288	20	3080	3463	1527	18		215.2
	% change from bare engine		224.6	327.2	102.5	-95.3	501.6	323.3	177.5	-91.8		
6	IRE REG-9000-5 biodiesel	g/hr	60.89	39.93	20.78	0.57	57.17	58.90	25.65	0.25	32.5	
		CFM Vent	3684	2415	1257	34	3458	3563	1552	15		184.5
	% change from bare engine		193.1	183.5	77.6	-90.6	466.3	348.1	168.5	-93.3		
7	B50 Mix*	g/hr	45.32	41.18	19.22	0.00	43.69	53.29	24.26	0.09	28.0	
		CFM Vent	2742	2491	1163	0	2643	3224	1468	6		147.9
	% change from bare engine		129.6	212.5	63.1	-100.0	217.4	368.1	161.4	-97.3		
8	PetroSA Fischer-Tropsch Syn.	g/hr	40.48	28.04	9.90	0.16	37.67	37.85	17.24	0.00	21.1	
		CFM Vent	2449	1696	599	10	2278	2289	1043	0		99.0
	% change from bare engine		143.7	117.0	-8.1	-98.1	216.0	290.2	71.3	-99.9		
		Weight Factors:	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

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Gas Emissions, CO:

Table 9 shows the carbon monoxide (CO) emissions for the fuel tests with and without the DOC. The table shows the raw CO emissions (in g/hr) and the ventilation rate calculations of the CFM of required to keep CO ambient levels below the MSHA required limits in the mine environment. The table also compares the changes in CO emissions for all the tests to the LSD baseline for the bare engine tests and compares a fuel's emissions with a DOC to its bare engine test. The weighted averages for each test are calculated and percent differences are calculated.

For the bare engine tests, the petroleum diesel's CO emissions remained within 10% of each other. For B100 fuels CO emissions were reduced by 18-25% compared to LSD. B50 CO emissions were 19% lower than LSD, while F-T CO emissions were also lower than LSD by 13%.

For the DOC tests, all fuels showed almost all CO emissions were eliminated by the use of a DOC. In fact, CO emissions were all but eliminated for all modes, with the exception of test modes 4 and 8. In these modes, the exhaust temperature was generally not high enough for the DOC to oxidize all CO to CO2. In these modes some CO emissions were observed, though much lower than the bare engine emissions.

Average drop in CO emissions for petroleum diesels was 85-100% with the use of a DOC. B100 emissions were lower by 93-98% with the use of a DOC. B50 CO emissions were lower by 97%, while F-T CO emissions were lower by 98%.

Gas Emissions, CO2:

Table 10 shows the carbon dioxide (CO2) emissions for the fuel tests with and without the DOC. The table shows the raw CO2 emissions (in g/hr) and the ventilation rate calculations of the CFM of required to keep CO2 ambient levels below the MSHA required limits in the mine environment. The table also compares the changes in CO2 emissions for all the tests to the LSD baseline for the bare engine tests and compares a fuel's emissions with a DOC to its bare engine test. The weighted averages for each test are calculated and percent differences are calculated.

CO2 emissions did not significantly vary with fuel on the bare engine tests, with the exception of the F-T fuel. Its CO2 emissions were 10% lower than LSD. CO2 emissions were also unaffected by the addition of a DOC, for any of the fuels tested.

Table 9: CO Emission and Ventilation Rate Calculation for Fuel Tests.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
CO Emissions Data, gr/hr
with ventillation rates

Bare Engine Test — Test Mode

Fuel No.	FUEL		1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	54.29	35.72	25.04	61.23	30.81	16.39	14.18	12.03	31.3	
		CFM Vent	539	355	249	609	306	163	141	120		
2	2007 spec ULSD Certified	g/hr	55.40	36.63	25.31	63.34	32.60	15.55	14.22	14.19	32.3	
		CFM Vent	551	364	252	630	324	155	141	141		3.1
	% change from LSD		2.0	2.6	1.1	3.4	5.8	-5.1	0.2	17.9		
3	Highway ULSD	g/hr	53.29	33.82	26.66	36.42	36.72	15.39	13.06	6.95	28.3	
		CFM Vent	530	336	265	362	365	153	130	69		-9.8
	% change from LSD		-1.8	-5.3	6.5	-40.5	19.2	-6.1	-7.9	-42.2		
4	Stepan SB-W biodiesel	g/hr	41.65	31.54	20.28	42.86	21.96	11.67	11.93	16.06	25.3	
		CFM Vent	414	313	202	426	218	116	119	160		-19.3
	% change from LSD		-23.3	-11.7	-19.0	-30.0	-28.7	-28.8	-15.9	33.5		
5	IRE REG-9000-10 biodiesel	g/hr	48.84	34.97	23.31	32.04	20.25	13.09	13.46	12.01	25.8	
		CFM Vent	485	348	232	318	201	130	134	119		-17.8
	% change from LSD		-10.0	-2.1	-6.9	-47.7	-34.3	-20.2	-5.1	-0.2		
6	IRE REG-9000-5 biodiesel	g/hr	43.97	32.24	19.95	32.22	20.05	11.20	12.17	10.98	23.6	
		CFM Vent	437	320	198	320	199	111	121	109		-24.5
	% change from LSD		-19.0	-9.7	-20.3	-47.4	-34.9	-31.6	-14.2	-8.8		
7	B50 Mix*	g/hr	48.38	31.65	22.53	35.53	21.32	14.35	12.20	10.14	25.2	
		CFM Vent	481	315	224	353	212	143	121	101		-19.4
	% change from LSD		-10.9	-11.4	-10.0	-42.0	-30.8	-12.5	-14.0	-15.7		
8	PetroSA Fischer-Tropsch Syn.	g/hr	46.46	31.13	27.31	50.54	20.80	16.10	16.26	8.67	27.4	
		CFM Vent	462	309	271	502	207	160	162	86		-12.5
	% change from LSD		-14.4	-12.8	9.1	-17.5	-32.5	-1.8	14.6	-27.9		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

Engine +DOC Test — Test Mode

Fuel No.	FUEL		1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	1.22	0.00	0.00	29.56	0.00	0.00	0.00	7.40	4.2	
		CFM Vent	12	0	0	294	0	0	0	74		-86.4
	% change from bare engine		-97.8	-100.0	-100.0	-51.7	-100.0	-100.0	-100.0	-38.5		
2	2007 spec ULSD Certified	g/hr	1.44	0.00	0.00	31.41	0.00	0.00	0.00	9.69	4.8	
		CFM Vent	14	0	0	312	0	0	0	96		-85.1
	% change from bare engine		-97.4	-100.0	-100.0	-50.4	-100.0	-100.0	-100.0	-31.7		
3	Highway ULSD	g/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
		CFM Vent	0	0	0	0	0	0	0	0		-100.0
	% change from bare engine		-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0		
4	Stepan SB-W biodiesel	g/hr	0.80	0.00	0.00	4.20	0.23	0.00	0.00	8.59	1.9	
		CFM Vent	8	0	0	42	2	0	0	85		-92.7
	% change from bare engine		-98.1	-100.0	-100.0	-90.2	-98.9	-100.0	-100.0	-46.5		
5	IRE REG-9000-10 biodiesel	g/hr	1.01	0.00	0.00	0.00	0.00	0.00	0.00	2.10	0.5	
		CFM Vent	10	0	0	0	0	0	0	21		-98.2
	% change from bare engine		-97.9	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-82.5		
6	IRE REG-9000-5 biodiesel	g/hr	0.00	0.00	0.00	1.19	0.00	0.00	0.00	6.72	1.1	
		CFM Vent	0	0	0	12	0	0	0	67		-95.2
	% change from bare engine		-100.0	-100.0	-100.0	-96.3	-100.0	-100.0	-100.0	-38.8		
7	B50 Mix*	g/hr	1.23	0.00	0.00	1.58	0.00	0.00	0.00	2.26	0.7	
		CFM Vent	12	0	0	16	0	0	0	22		-97.3
	% change from bare engine		-97.5	-100.0	-100.0	-95.6	-100.0	-100.0	-100.0	-77.7		
8	PetroSA Fischer-Tropsch Syn.	g/hr	0.41	0.00	0.00	0.53	0.36	0.00	0.00	3.57	0.7	
		CFM Vent	4	0	0	5	4	0	0	35		-97.5
	% change from bare engine		-99.1	-100.0	-100.0	-98.9	-98.3	-100.0	-100.0	-58.9		
		Weight Factors:	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

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Table 10: CO2 Emission and Ventilation Rate Calculation for Fuel Tests.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
CO2 Emissions Data, gr/hr
with ventillation rates

Bare Engine Test — Test Mode

Fuel No.	FUEL		1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	49561.67	37960.34	26179.77	11112.84	37466.47	27730.09	18918.68	2393.43	26937.1	
		CFM Vent	3122	2392	1649	700	2360	1747	1192	151		
2	2007 spec ULSD Certified	g/hr	50682.10	38116.28	26611.30	11348.76	38054.78	28444.86	19246.04	2188.60	27349.2	
		CFM Vent	3193	2401	1677	715	2397	1792	1213	138		1.5
	% change from LSD		2.3	0.4	1.6	2.1	1.6	2.6	1.7	-8.6		
3	Highway ULSD	g/hr	46572.34	34455.05	23842.35	10470.32	34330.64	24874.17	17012.15	2306.15	24745.1	
		CFM Vent	2934	2171	1502	660	2163	1567	1072	145		-8.1
	% change from LSD		-6.0	-9.2	-8.9	-5.8	-8.4	-10.3	-10.1	-3.6		
4	Stepan SB-W biodiesel	g/hr	48871.44	37659.48	26619.19	11359.65	36894.17	27162.13	19241.14	2406.26	26799.2	
		CFM Vent	3079	2373	1677	716	2324	1711	1212	152		-0.5
	% change from LSD		-1.4	-0.8	1.7	2.2	-1.5	-2.0	1.7	0.5		
5	IRE REG-9000-10 biodiesel	g/hr	48449.12	36452.19	26498.33	11261.61	36824.16	27484.58	18892.16	2638.30	26551.9	
		CFM Vent	3052	2296	1669	709	2320	1732	1190	166		-1.4
	% change from LSD		-2.2	-4.0	1.2	1.3	-1.7	-0.9	-0.1	10.2		
6	IRE REG-9000-5 biodiesel	g/hr	49406.47	37287.40	26836.36	11328.75	37799.52	28038.41	19721.28	2817.31	27140.9	
		CFM Vent	3113	2349	1691	714	2381	1766	1242	177		0.8
	% change from LSD		-0.3	-1.8	2.5	1.9	0.9	1.1	4.2	17.7		
7	B50 Mix*	g/hr	48341.96	36168.07	25755.45	10842.00	36426.12	26809.15	18645.03	2454.28	26180.2	
		CFM Vent	3046	2279	1623	683	2295	1689	1175	155		-2.8
	% change from LSD		-2.5	-4.7	-1.6	-2.4	-2.8	-3.3	-1.4	2.5		
8	PetroSA Fischer-Tropsch Syn.	g/hr	44068.42	33373.94	23250.68	10758.95	33257.19	24930.60	17291.59	2488.12	24101.0	
		CFM Vent	2776	2103	1465	678	2095	1571	1089	157		-10.5
	% change from LSD		-11.1	-12.1	-11.2	-3.2	-11.2	-10.1	-8.6	4.0		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

Engine +DOC Test — Test Mode

Fuel No.	FUEL		1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	49730.22	37583.96	26545.83	11275.04	37690.64	27711.02	19128.31	2445.84	27026.4	
		CFM Vent	3133	2368	1672	710	2375	1746	1205	154		0.3
	% change from bare engine		0.3	-1.0	1.4	1.5	0.6	-0.1	1.1	2.2		
2	2007 spec ULSD Certified	g/hr	51105.09	38565.46	26600.15	11195.67	38569.78	28451.18	19203.65	2567.94	27567.8	
		CFM Vent	3220	2430	1676	705	2430	1792	1210	162		0.8
	% change from bare engine		0.8	1.2	0.0	-1.3	1.4	0.0	-0.2	17.3		
3	Highway ULSD	g/hr	46524.75	34872.78	24552.80	10927.97	35197.91	25525.75	17690.55	2383.74	25184.3	
		CFM Vent	2931	2197	1547	688	2217	1608	1115	150		1.8
	% change from bare engine		-0.1	1.2	3.0	4.4	2.5	2.6	4.0	3.4		
4	Stepan SB-W biodiesel	g/hr	48882.10	36478.06	26482.98	11210.56	36078.39	26545.49	18642.61	2280.63	26366.3	
		CFM Vent	3080	2298	1668	706	2273	1672	1174	144		-1.6
	% change from bare engine		0.0	-3.1	-0.5	-1.3	-2.2	-2.3	-3.1	-5.2		
5	IRE REG-9000-10 biodiesel	g/hr	48483.31	36089.99	26109.38	11106.74	35535.06	26124.89	17192.09	2389.28	25956.7	
		CFM Vent	3054	2274	1645	700	2239	1646	1083	151		-2.2
	% change from bare engine		0.1	-1.0	-1.5	-1.4	-3.5	-4.9	-9.0	-9.4		
6	IRE REG-9000-5 biodiesel	g/hr	48692.86	36084.91	26084.04	11236.53	36815.50	27501.26	19056.74	2661.05	26489.4	
		CFM Vent	3068	2273	1643	708	2319	1733	1201	168		-2.4
	% change from bare engine		-1.4	-3.2	-2.8	-0.8	-2.6	-1.9	-3.4	-5.5		
7	B50 Mix*	g/hr	48871.32	36386.24	25703.02	11161.90	36512.10	26976.25	18435.94	2598.84	26342.5	
		CFM Vent	3079	2292	1619	703	2300	1700	1161	164		0.6
	% change from bare engine		1.1	0.6	-0.2	3.0	0.2	0.6	-1.1	5.9		
8	PetroSA Fischer-Tropsch Syn.	g/hr	44826.11	33702.06	23906.04	10777.67	33257.31	24822.01	17274.02	2420.38	24341.3	
		CFM Vent	2824	2123	1506	679	2095	1564	1088	152		1.0
	% change from bare engine		1.7	1.0	2.8	0.2	0.0	-0.4	-0.1	-2.7		
		Weight Factors:	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

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Engine Performance:

Table 11 shows the engine performance data (HP) for all the fuels tested. As can be seen there was little change in engine performance with most of the fuels tested. The performance of biodiesel fuels was negligibly different than that of petroleum diesels. The only fuel having a significant change in engine performance was the F-T fuel. It has and average performance loss (HP) of 8.7% when compared to LSD. This is consistent with past tests on synthetic diesels and is due to the somewhat lower energy content of the fuel.

The performance of the engine with a DOC on the exhaust was also not significantly different from that of a bare engine. This is consistent with past engine tests using DOCs, as the increase in exhaust backpressure due to the DOC is minimal and does not alter the engine performance.

Table 11: Engine Performance (HP) data.

Fuel No.	Bare Engine Test / FUEL	Test Mode 1	2	3	4	5	6	7	8		
1	2005 spec LSD Certified	84.16	64.31	42.88	9.48	71.96	53.98	35.95	1.52	HP	
2	2007 spec ULSD Certified	85.15	64.31	42.83	9.44	72.34	54.86	36.03	0.81	HP	
	% change from LSD	1.2	0.0	-0.1	-0.4	0.5	1.6	0.2	-46.3	0.4	AVE CHANGE**
3	Highway ULSD	81.89	60.79	40.43	9.40	69.11	51.38	34.26	1.82	HP	
	% change from LSD	-2.7	-5.5	-5.7	-0.8	-4.0	-4.8	-4.7	20.0	-4.0	AVE CHANGE
4	Stepan SB-W biodiesel	84.18	64.15	42.87	9.53	71.11	53.12	36.02	1.05	HP	
	% change from LSD	0.0	-0.2	0.0	0.5	-1.2	-1.6	0.2	-30.8	-0.3	AVE CHANGE
5	IRE REG-9000-10 biodiesel	82.77	61.80	42.83	9.55	69.67	52.22	34.29	1.35	HP	
	% change from LSD	-1.7	-3.9	-0.1	0.8	-3.2	-3.3	-4.6	-11.0	-2.3	AVE CHANGE
6	IRE REG-9000-5 biodiesel	83.98	63.04	42.73	9.40	70.90	53.12	35.98	1.84	HP	
	% change from LSD	-0.2	-2.0	-0.3	-0.9	-1.5	-1.6	0.1	21.3	-0.9	AVE CHANGE
7	B50 Mix*	83.82	62.94	42.74	9.53	71.22	53.10	35.97	1.90	HP	
	% change from LSD	-0.4	-2.1	-0.3	0.5	-1.0	-1.6	0.1	25.2	-0.7	AVE CHANGE
8	PetroSA Fischer-Tropsch Syn.	75.37	57.17	38.12	9.53	65.01	48.81	32.62	1.78	HP	
	% change from LSD	-10.4	-11.1	-11.1	0.5	-9.7	-9.6	-9.3	17.4	-8.7	AVE CHANGE

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD ** mode 8 discounted in average change

	Engine +DOC Test / FUEL	Test Mode 1	2	3	4	5	6	7	8		
1	2005 spec LSD Certified	83.68	63.06	42.88	9.51	71.28	53.16	36.03	1.48	HP	
	% change from bare engine	-0.6	-1.9	0.0	0.3	-0.9	-1.5	0.2	-2.5	-0.6	AVE CHANGE**
2	2007 spec ULSD Certified	85.66	64.20	42.74	9.49	72.02	54.85	36.01	1.63	HP	
	% change from bare engine	0.60	-0.17	-0.21	0.47	-0.44	-0.02	-0.07	100.76	0.0	AVE CHANGE
3	Highway ULSD	80.22	59.62	40.55	9.56	68.80	50.56	34.34	1.67	HP	
	% change from bare engine	-2.04	-1.92	0.30	1.65	-0.45	-1.61	0.23	-8.11	-0.5	AVE CHANGE
4	Stepan SB-W biodiesel	83.39	61.86	42.72	9.60	70.67	53.17	35.99	1.52	HP	
	% change from bare engine	-0.94	-3.57	-0.34	0.75	-0.62	0.08	-0.09	44.79	-0.7	AVE CHANGE
5	IRE REG-9000-10 biodiesel	83.07	61.82	42.80	9.48	69.35	52.23	34.27	1.79	HP	
	% change from bare engine	0.37	0.03	-0.06	-0.72	-0.46	0.01	-0.05	32.49	-0.1	AVE CHANGE
6	IRE REG-9000-5 biodiesel	83.93	61.89	42.77	9.42	71.09	53.11	36.00	1.84	HP	
	% change from bare engine	-0.07	-1.82	0.08	0.20	0.27	-0.02	0.06	0.03	-0.2	AVE CHANGE
8	B50 Mix*	83.24	61.88	41.65	9.51	70.81	53.05	35.17	1.91	HP	
	% change from bare engine	-0.69	-1.68	-2.55	-0.18	-0.57	-0.10	-2.23	0.50	-1.1	AVE CHANGE
8	PetroSA Fischer-Tropsch Syn.	77.41	58.29	39.31	9.52	66.11	49.73	33.41	1.74	HP	
	% change from bare engine	2.71	1.97	3.13	-0.08	1.70	1.89	2.41	-2.40	2.0	AVE CHANGE

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD ** mode 8 discounted in average change

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Discussion:

The discussion of the results of the test series completed at MSHA is divided into three parts. First is a discussion of the TC data as it relates to compliance with the 30 CFR Part 57 DPM regulation. The second part is a discussion of the increased NO2 emissions with the DOC. The third discusses some test results found in other research on alternative fuels in diesel engines and compares those to the data generated in this test series.

Discussion Part 1: TC reductions in the Mine Environment:

The primary impetus for conducting the tests detailed above was to investigate the variations in emissions performance using various fuel formulations and how their emissions performance changes with the addition of DOC after treatment.

The data generated from laboratory tests cannot be used to directly compute emissions reductions in a mine environment. The data can be used to imply the likely changes when alternate fuels are used, and compare the merits of fuel and after treatment combinations. Actual reductions in a mine environment depend on several other variables[33].

Within the specified limits of the data above, these tests can be used to compare the potential capability of lowering a mine's DPM (TC) emissions to comply with the requirements of the 30 CFR Part 57 regulation for Metal/Non-metal mines. TC is the portion of DPM sampled in the mine atmosphere to determine compliance with the regulation, so a focus on changes in exhaust TC is used describe changes in DPM in the mine atmosphere.

To aid the discussion, four scenarios may be envisioned to discuss how fuel choices may be used to improve a mine's TC levels. These are shown below:

Scenario S-1: Mining machinery all running petroleum diesel (D-2 LSD used as baseline) and none using DOC: what benefit would changing fuels only have on DPM emissions?

Scenario S-2: Mining machinery is already using one of the test fuels (either petroleum or alternate): what DPM benefit is there to adding a DOC to this existing fuel choice?

Scenario S-3: Mining machinery already universally equipped with DOCs: what fuel choice would offer the best DPM reductions?

Scenario S-4: Mining machinery all running petroleum diesel (D-2 LSD used as baseline) and none using DOC: what combination of fuel and DOC will offer best reductions in DPM?

[33] Some of these variables will be outlines in the Conclusions and Comments Section.

The TC emission data is used to discuss these scenarios, and the relative changes in TC emissions based on these may be found in tabular form in Table 12. These will be discussed and plotted below.

S-1: Changing Fuels on a Bare Engine:

If a mine has been running their mining equipment using standard petroleum diesel (for a baseline for comparison LSD data is used) and does not have engines equipped with a DOC, then what reductions in TC emissions could be expected by changing fuels? Using the data generated in the MSHA test, this scenario is plotted in Figure 4.

It is clear that for these tests, changing fuels on a bare engine provides a modest reduction in TC emissions for the B100 fuels of around 13%. The B50 mixture had a somewhat higher 19% reduction and the F-T fuel's 33% reduction was significant.

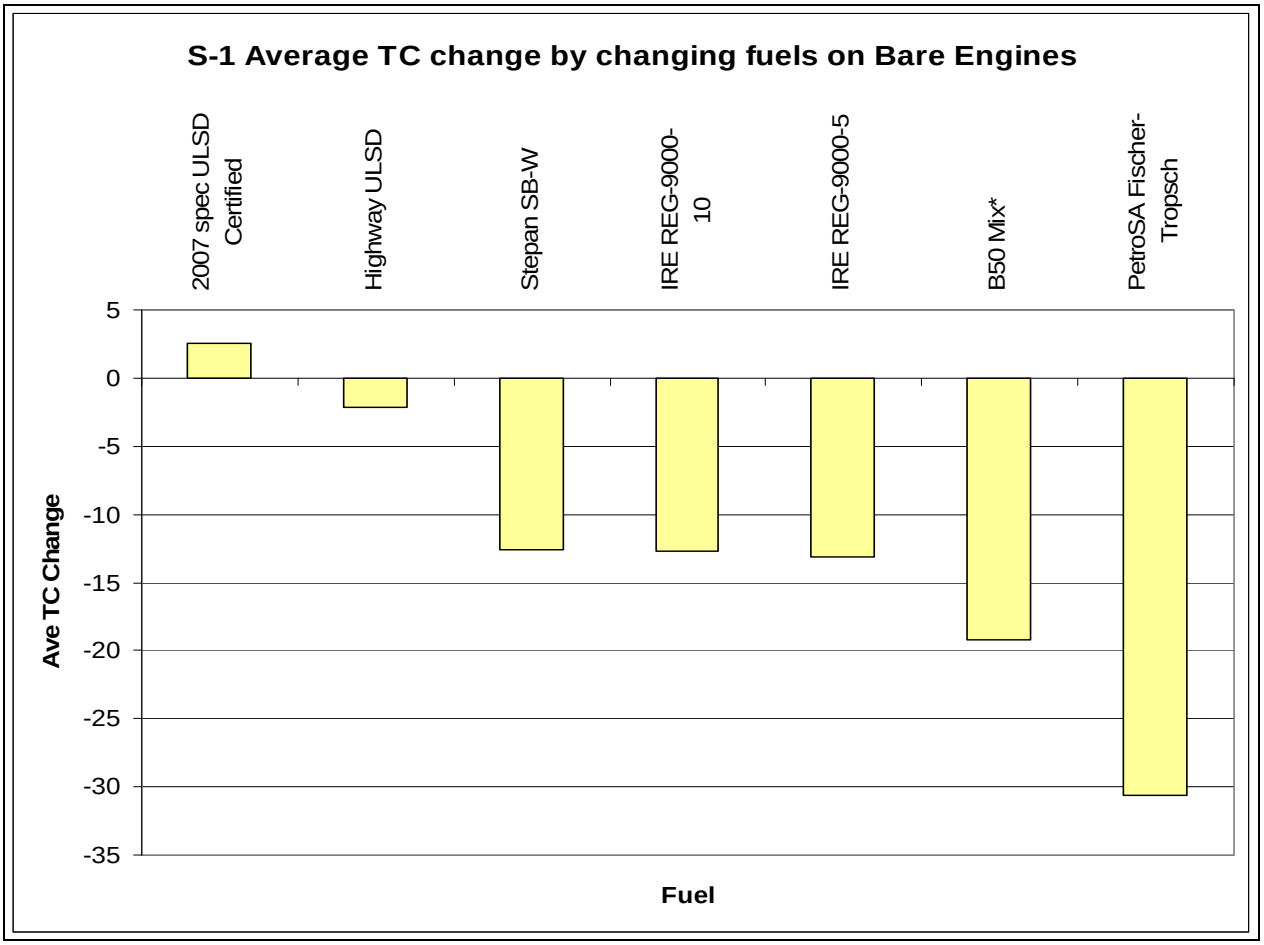

Figure 4: TC emissions changes on a bare engine.

S-2: Adding a DOC to any fuel:

If a mine has been using either petroleum or alternative fuels and have not equipped their engines with DOCs, then what reductions in TC emissions could be expected by adding DOCs to their engines? Using the data generated in the MSHA test, this scenario is plotted in Figure 5.

Clearly, the DOC is beneficial in all cases. For engines running petroleum diesels, adding a DOC reduces TC emissions by 12-15%. For B100 fuels, adding a DOC lowered TC emissions by 43-44%. B50 TC was lowered by 29%. F-T TC emissions were lowered only 4% by the addition of a DOC.

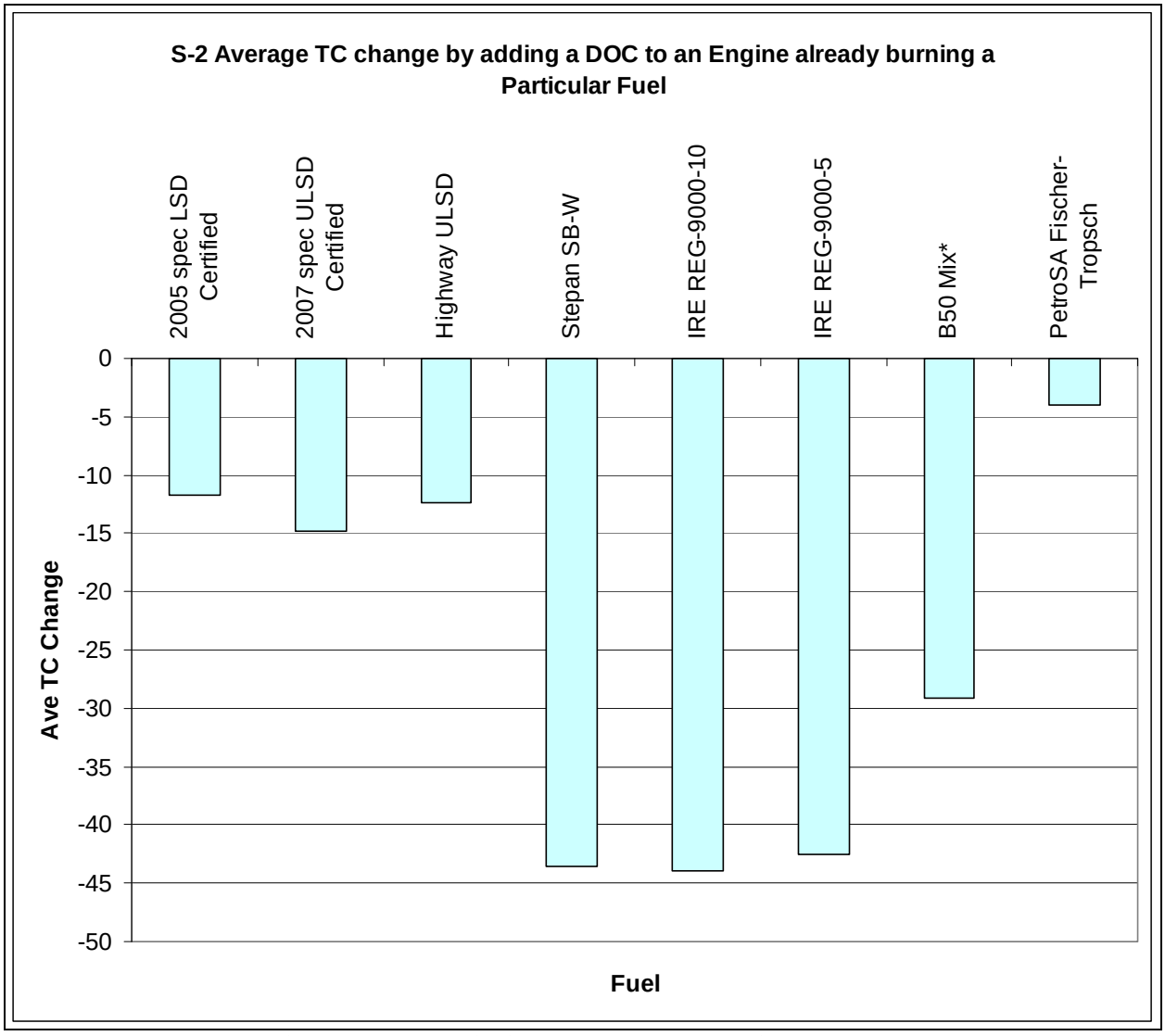

Figure 5: TC emissions changes by adding a DOC.

S-3: Changing Fuels on DOC equipped engines:

If a mine has been running their mining equipment using standard petroleum diesel (for a baseline for comparison LSD data is used) and with engines equipped with DOCs, then what reductions in TC emissions could be expected by changing fuels? Using the data generated in the MSHA test, this scenario is plotted in Figure 6.

There is no real change in TC emissions between petroleum diesels on DOC equipped engines. B100 will lower TC emissions around 44% compared to the same DOC equipped engine running LSD. B50 will lower TC by 35% and F-T will be 24% lower than LSD and a DOC.

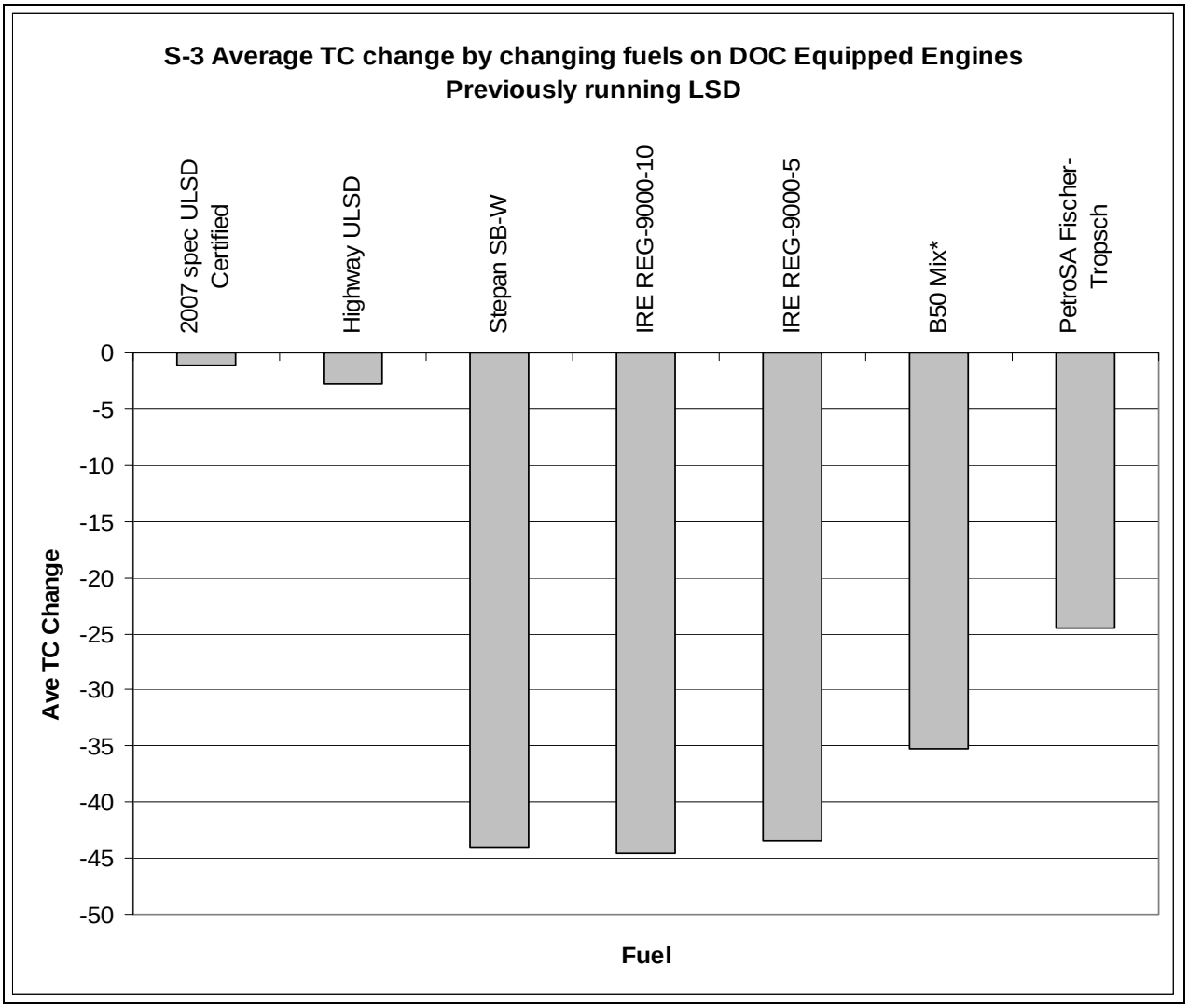

Figure 6: TC emissions changes by changing fuels on DOC equipped engines.

S-4: Changing Fuels and adding a DOC:

If a mine has been running their mining equipment using standard petroleum diesel (for a baseline for comparison LSD data is used) and does not have engines equipped with a DOC, then what reductions in TC emissions could be expected by a combination of adding a DOC *and* changing fuels? Using the data generated in the MSHA test, this scenario is plotted in Figure 7.

The change in petroleum based diesels with a ULSD/DOC is primarily due to the DOC part of the combination, as petroleum diesel's TC emissions are pretty consistent, and the approximately 15% indicated in the chart is the benefit of using the DOC. The B100/DOC combinations all showed ~51% lower TC than a bare engine burning LSD. B50/DOC was nearly as good, with a TC reduction of 43%. The F-T/DOC combination had a TC emission 33% lower than a bare engine burning LSD.

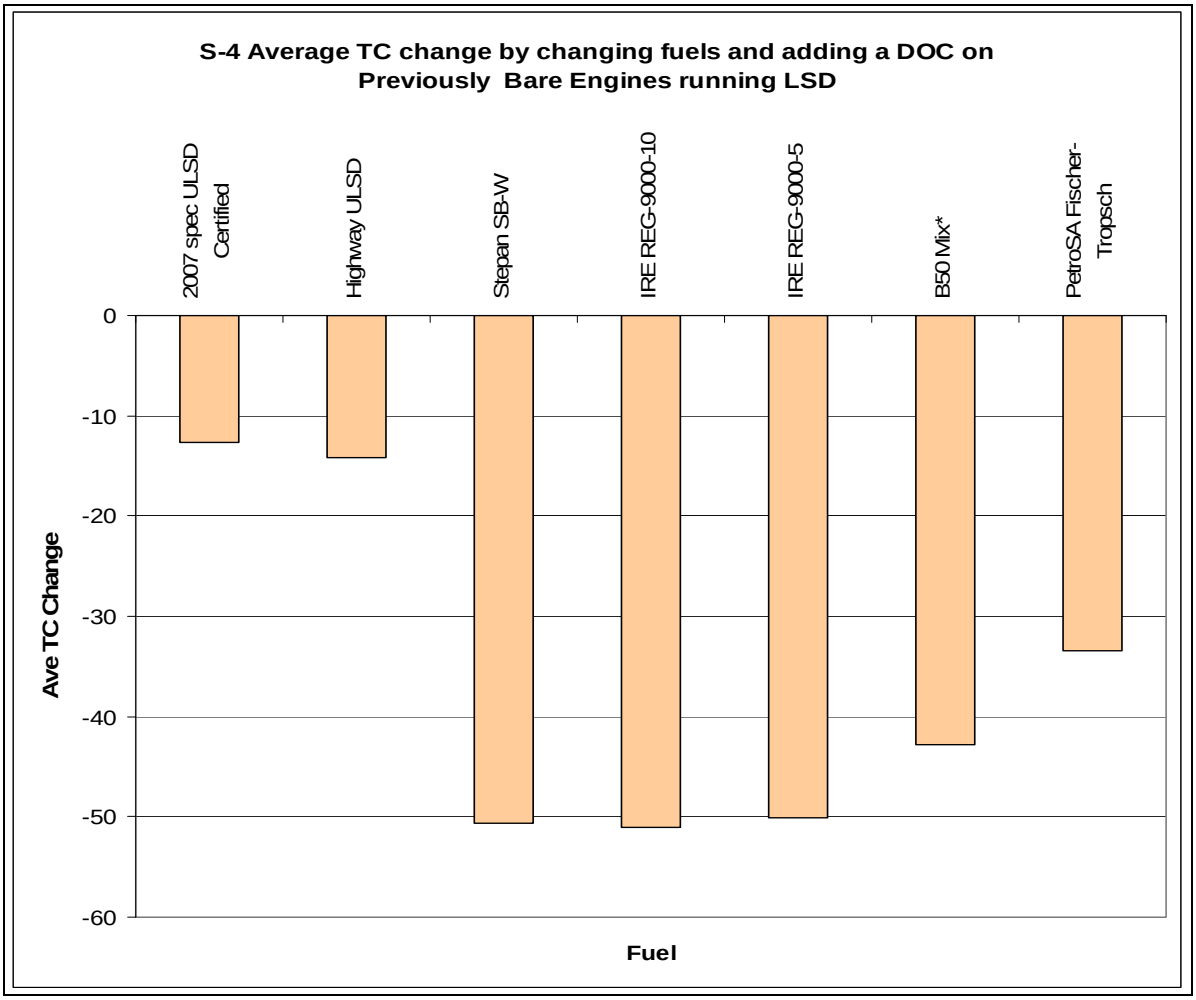

Figure 7: TC emissions changes by changing fuels *and* adding a DOC.

Table 12: TC Emission Scenarios with Alternate Fuels and DOC.

Summary of Changes in Total Carbon Emissions of Engines using Various Fuels With and Without a DOC

Base Fuel for Comparison 2005 spec Certified Low Sulfer Diesel (LSD) fuel

Fuels		Test Mode TC Data (TC (ug/m3)) 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
2005 spec LSD Certified	Bare	34085	36659	29085	27829	46089	33750	25799	8722	**29629.35**	
	with DOC	32037	36377	27320	22224	39857	32156	19604	2791	**26162.85**	
	% change in fuel with DOC	-6.0	-0.8	-6.1	-20.1	-13.5	-4.7	-24.0	-68.0		**-11.7**
2007 spec ULSD Certified	Bare	36093	40713	29292	27498	44872	31874	27058	9002	**30395.2**	
	%change from LSD	5.9	11.1	0.7	-1.2	-2.6	-5.6	4.9	3.2		**2.6**
	with DOC	28978	34585	26754	18563	46600	32099	21312	3147	**25877**	`
	% change in fuel with DOC	-19.7	-15.1	-8.7	-32.5	3.9	0.7	-21.2	-65.0		**-14.9**
	% change from LSD-DOC	-9.5	-4.9	-2.1	-16.5	16.9	-0.2	8.7	12.8		**-1.1**
	% change from LSD-BARE	-15.0	-5.7	-8.0	-33.3	1.1	-4.9	-17.4	-63.9		**-12.7**
Highway ULSD	Bare	33250	36890	26770	30546	52910	31191	18223	7777	**28990.05**	
	%change from LSD	-2.4	0.6	-8.0	9.8	14.8	-7.6	-29.4	-10.8		**-2.2**
	with DOC	32851	32501	25814	20752	45774	26764	18544	3752	**25421.1**	
	% change in fuel with DOC	-1.2	-11.9	-3.6	-32.1	-13.5	-14.2	1.8	-51.8		**-12.3**
	% change from LSD-DOC	2.5	-10.7	-5.5	-6.6	14.8	-16.8	-5.4	34.4		**-2.8**
	% change from LSD-BARE	-3.6	-11.3	-11.2	-25.4	-0.7	-20.7	-28.1	-57.0		**-14.2**
Stepan SB-W	Bare	26009	33370	28968	22962	33070	26132	25556	12564	**25908.65**	
biodiesel	%change from LSD	-23.7	-9.0	-0.4	-17.5	-28.2	-22.6	-0.9	44.0		**-12.6**
	with DOC	15427	18546	14559	11509	25657	16898	13098	4244	**14632.6**	
	% change in fuel with DOC	-40.7	-44.4	-49.7	-49.9	-22.4	-35.3	-48.7	-66.2		**-43.5**
	% change from LSD-DOC	-51.8	-49.0	-46.7	-48.2	-35.6	-47.4	-33.2	52.1		**-44.1**
	% change from LSD-BARE	-54.7	-49.4	-49.9	-58.6	-44.3	-49.9	-49.2	-51.3		**-50.6**
IRE REG-9000-10	Bare	26400	32913	26760	23195	31956	27819	25107	14260	**25857.65**	
biodiesel	%change from LSD	-22.5	-10.2	-8.0	-16.7	-30.7	-17.6	-2.7	63.5		**-12.7**
	with DOC	17255	20590	14074	10906	22640	15881	11428	4107	**14489.4**	
	% change in fuel with DOC	-34.6	-37.4	-47.4	-53.0	-29.2	-42.9	-54.5	-71.2		**-44.0**
	% change from LSD-DOC	-46.1	-43.4	-48.5	-50.9	-43.2	-50.6	-41.7	47.2		**-44.6**
	% change from LSD-BARE	-49.4	-43.8	-51.6	-60.8	-50.9	-52.9	-55.7	-52.9		**-51.1**
IRE REG-9000-5	Bare	27204	35066	26563	24302	28546	25259	25355	13866	**25751.05**	
biodiesel	%change from LSD	-20.2	-4.3	-8.7	-12.7	-38.1	-25.2	-1.7	59.0		**-13.1**
	with DOC	16762	19392	15571	12384	24365	14892	12363	4179	**14786**	
	% change in fuel with DOC	-38.4	-44.7	-41.4	-49.0	-14.6	-41.0	-51.2	-69.9		**-42.6**
	% change from LSD-DOC	-47.7	-46.7	-43.0	-44.3	-38.9	-53.7	-36.9	49.7		**-43.5**
	% change from LSD-BARE	-50.8	-47.1	-46.5	-55.5	-47.1	-55.9	-52.1	-52.1		**-50.1**
B50 Mix*	Bare	26470	28770	23271	23259	31045	28225	22281	11163	**23932.1**	
	%change from LSD	-22.3	-21.5	-20.0	-16.4	-32.6	-16.4	-13.6	28.0		**-19.2**
	with DOC	20910	25130	16138	13583	26947	19245	11487	3298	**16947.6**	
	% change in fuel with DOC	-21.0	-12.7	-30.7	-41.6	-13.2	-31.8	-48.4	-70.5		**-29.2**
	% change from LSD-DOC	-34.7	-30.9	-40.9	-38.9	-32.4	-40.2	-41.4	18.2		**-35.2**
	% change from LSD-BARE	-38.7	-31.4	-44.5	-51.2	-41.5	-43.0	-55.5	-62.2		**-42.8**
PetroSA Fischer-Tropsch	Bare	32783	27222	17136	15926	31302	21900	14081	4437	**20557.6**	
synthetic	%change from LSD	-3.8	-25.7	-41.1	-42.8	-32.1	-35.1	-45.4	-49.1		**-30.6**
	with DOC	31094	25919	15380	16023	32773	23006	12785	2776	**19734.05**	
	% change in fuel with DOC	-5.2	-4.8	-10.2	0.6	4.7	5.1	-9.2	-37.4		**-4.0**
	% change from LSD-DOC	-2.9	-28.7	-43.7	-27.9	-17.8	-28.5	-34.8	-0.5		**-24.6**
	% change from LSD-BARE	-8.8	-29.3	-47.1	-42.4	-28.9	-31.8	-50.4	-68.2		**-33.4**

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

Gravimetric or TC DPM Emission Change Scenarios

S-1	Bare Engine, changing fuels only
S-2	Adding DOC to an Engine Already Burning a Particular Fuel
S-3	Changing Fuels on DOC Equipped Engines previously running LSD
S-4	Changing Fuels and Adding DOC to Bare engines previously running LSD

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Discussion Part 2: NO2 Increase due to use of a DOC:

The increase in NO2 emissions with the use of catalyzed aftertreatment systems (DOCs and Diesel Particulate Filters (DPF)) has been noted in previous MSHA testing and has been documented by other research, both during laboratory testing and tests in the mine environment[34]. MSHA's previous tests[35] on DOCs and catalyzed diesel particulate filters (DPF) has shown quite variable NO2 emissions, from in some cases a reduction in NO2 compared to a bare engine, to dramatic increases in NO2 emissions. In general, there is some moderate NO2 increase due to the platinum catalyst in the DOC oxidizing NO to NO2.

MSHA's past policy on this effect, at least in terms of coal mines, is that this increase in NO2 emissions due to DOC (or DPF) use is tolerable as long as the engine's approved ventilation rate is not violated. In other words, if the NO2 ventilation rate is not higher than that listed on the engine approval, the after treatment technology in question should not degrade the mine environment significantly. For some DPFs, testing has shown a level of NO2 emissions that far exceeded the ventilation requirements for the engine, and these problem systems were reported and prohibited for mine use. Due to the NO2 issue in the mine environment, and to a much greater extent CARB[36] interest in NO2 in California; manufacturers of DOCs and DPFs have worked to reformulate these devices to the extent possible to minimize NO2 production.

For engines approved for coal mine use, the MSHA 8-mode test is used to check the NO, NO2, CO and CO2 emissions at the 8 test modes. Using this data, gaseous ventilation rates are calculated for all four gases at all 8 modes and the highest ventilation rate from this matrix is used (rounded up per §7.88(b)(1) and (2)) as the approved gaseous ventilation rate for the engine. For example, for the Isuzu 4JG1T engine used in these tests, the approved ventilation rate is 6000 CFM, based on the NO emissions at mode 1.

The NO2 ventilation requirements from the fuel tests on the bare engine and engine/DOC combination are shown in Figure 8. The vertical scale is set to 6000 CFM, the ventilation requirement for the engine. It is clearly noted the increase in NO2 emissions between the bare engine and the DOC equipped engine. This increase, while large, does not approach the ventilation requirement of the engine. With adequate ventilation in the mine area where the engine is operating (6000 CFM and above) it does not seems likely for NO2 emissions to rise above a miner's TLV levels for NO2 exposure.

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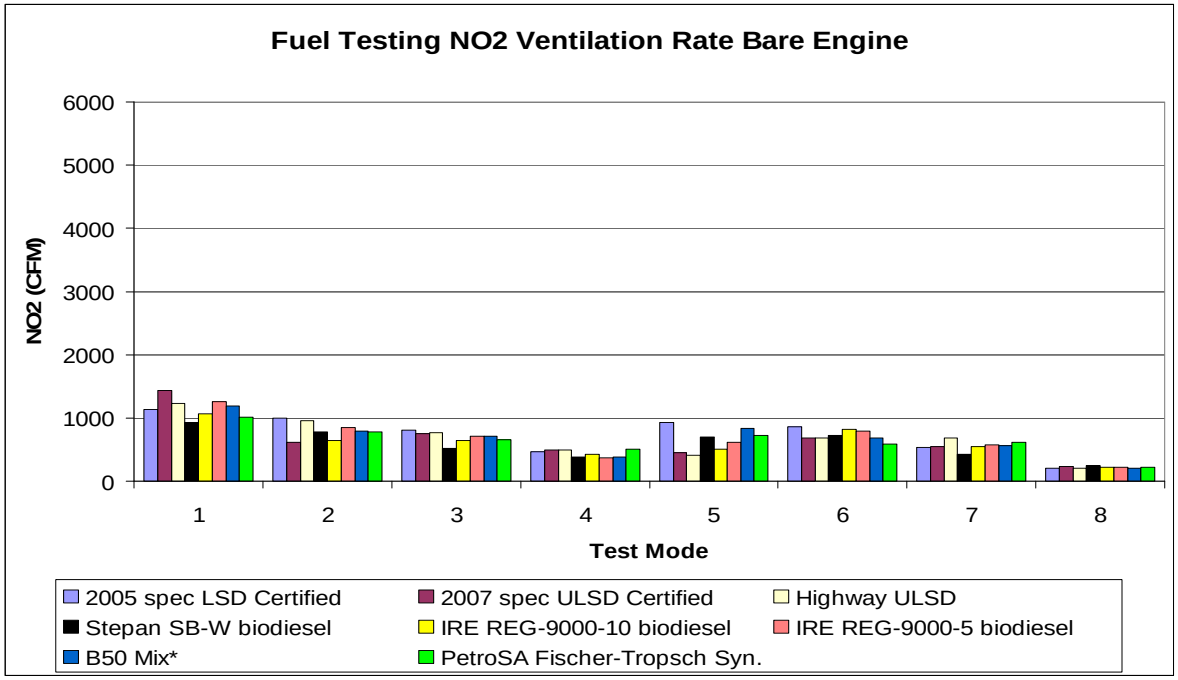
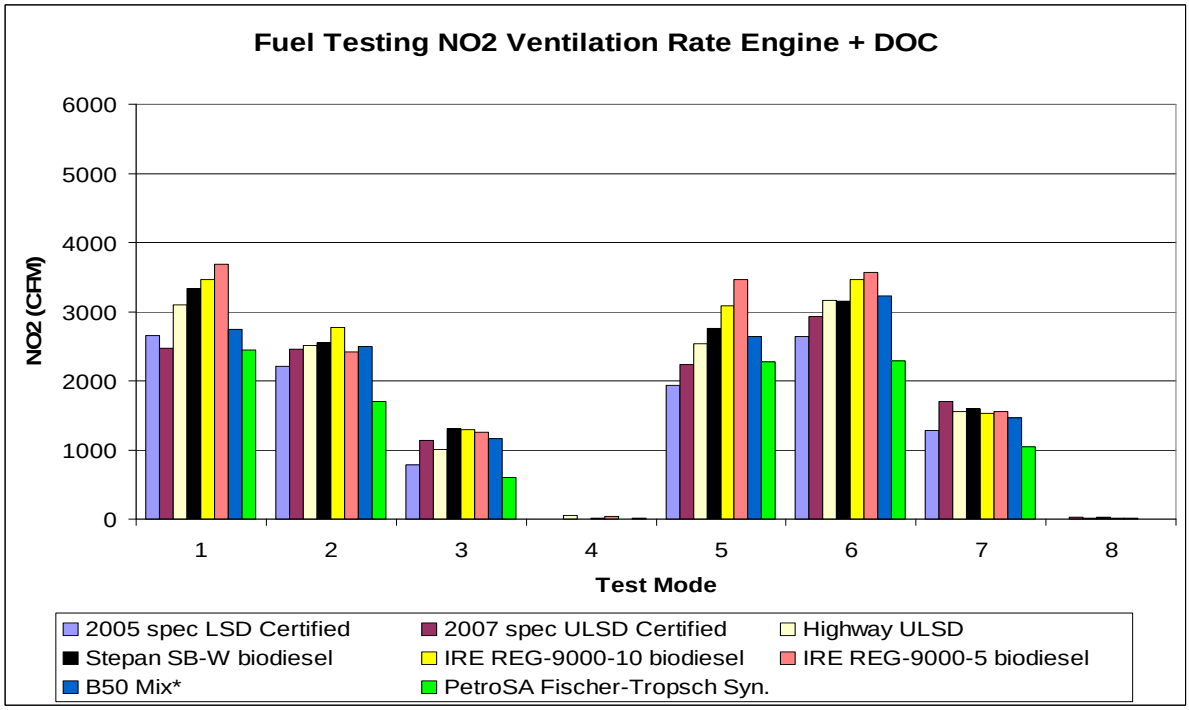
[34] See http://www.msha.gov/regs/complian/PIB/2002/pib02-04.htm , http://www.cdc.gov/niosh/blog/nsb020209_no2.html and http://www.cdc.gov/niosh/mining/pubs/pubreference/outputid2604.htm and http://www.cdc.gov/niosh/mining/pubs/pubreference/outputid2094.htm for more discussion of this effect.
[35] Contact stackpole.russell@dol.gov for information on MSHA diesel lab testing.
[36] CARB: California Air Resources Board.

In mine environments with inadequate ventilation, where local "dead spots" exist in work areas, or other reasons for poor air mixing, it would be possible for NO2 levels to rise to problematic levels faster with use of a DOC than without. But if this event would occur, then other regulated gas levels would also be increasing and most likely exceeding their individual TLV limits as well. For example, say ventilation around this Isuzu 4JG1T engine with the DOC is 3000 CFM. For some of the fuels tested with a DOC, this is not adequate ventilation to keep NO2 below 5ppm. But NO at that point would be twice as high as the 25ppm limit and CO2 would also have exceeded its 5000ppm limit. It is also noted that such low ventilation would cause the miner's personal exposure to exceed the TC limits, even with the 50% TC reduction provided by a DOC and B100 fuel.

Therefore, while the increase in NO2 is one undesirable side effect of the use of a DOC, the increase in NO2 generally should not affect a well managed mine environment. MSHA has made mine operators aware of these potential increases in NO_2 with the use of these technologies and should be monitoring and testing for NO2 exposure in localized areas where circumstance might limit ventilation or where there was a concentration several mining machines.



(a)



(b)

Figure 8: NO2 Ventilation Rates for (a) Bare engine and (b) Engine with DOC.

Discussion Part 3: Other Testing on Alternative Fuels:

There is a wealth of other data on alternative fuels in the technical literature and in other government publications. Some of this dates back literally decades, especially in the F-T fuel case. Locating and correlating the details of the testing and results is a large and never ending task in a field of continuing research. However, for our purposes, the data generated by this test series should be compared to some of the available data from other sources to attempt to discern its relevance to the goals of understanding alternative fuel emissions and their potential for improving the a mine environment. Some *initial research* into the literature produced the citations discussed below. Further research and comparisons may be available in future reports or publications.

Part 3 A: EPA Analysis:

One attempt to gather the available data on biodiesel exhaust emissions was the EPA report "A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions" published in 2002[37]. This report analyzed pre-existing test data on engines, and vehicles on engines, 98% of which were model year 1997 and earlier. The report collected at large data set from the literature on biodiesel emission effects and used statistical regression techniques to analysis the effect of biodiesel blends (from 0 to 100% biodiesel) on the resulting emissions performance of the engine.

The data collection concentrated on actual production engines and diesel vehicles and purposely left out data from research (single cylinder) engines, prototype engine technology, and data from test cycles that were too far removed from a standard test protocol. The vast majority of engines represented by the data collected were heavy duty on-highway (HDOH) diesel engines, although there were relatively small data samples of heavy duty non-road (HDNR) engines and light duty on-highway (LDOH) engines. The vast majority of tests were conducted on engines in a laboratory environment, though a small data set from diesel vehicles tests were included. The vast majority of test cycles used on these engines were the transient FTP protocol, although some data used the R49 13-mode cycle (HDOH engines) and 8-mode cycle (HDNR).

Some important information about the data used in the study includes the following:

- Engines: 50% from '91-93, 19% from '94-97, 2% from '98 and newer, remainder '90 and older
- Diesel machine type: 80%HDOH engines, 17% HDOH vehicles, 2% HDNR, 1% LDOH
- Base Fuels: #1 or #2 diesel
- Biodiesel Fuels: transesterfied from misc plant and animal sources (+ few virgin oil samples)
- Biodiesel blends: 40+ samples of B20, 40 samples of B100, <10 samples of B50, plus a few other blends
- Test Cycle : 80% Federal FTP transient cycle, 7% EEC R49 13-mode, 2% non-road 8-mode

[37] See http://www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf for PDF copy of the report.

Although it is not specifically stated, the test protocols used would indicate that DPM measurements were all gravimetric, and that none of the research collected or used PM data for specific components such as EC or OC measurements. This will be verified by researching a selection of the reference documents. Assuming the measurements reported are gravimetric, they can be compared to the gravimetric results of the MSHA tests.

It is noted specifically in the report that the vast majority of engines were pre-1998 specifications, so that newer technologies such as EGR and DPF are not represented. However in no place is there any mention of catalyzed DOCs. It would seem that technology would deserve some mention, as it was already being applied (at least in a limited fashion) in the time period represented by the test data. So it cannot be determined from the report whether the data represents only raw engine data or there is some representation of biodiesel emissions that include a DOC on the engine[38].

After initially analyzing the available data and potential variables that effect emissions performance, the statistical correlations were made using only the HDOH engine data, using the FTP transient cycle. Then these correlations were analyzed for second order relationships to detailed information from the tests such as fuel source, test cycles, engine groups (based on model years), etc. Then the predictions from the correlations were then compared to the data sets excluded from the initial correlation calculations; HDHW diesel vehicle test data, HDNR data, LDOH.

The correlations between biodiesel and emissions changes in NOx, PM, HC and CO are reproduced here as Figure 9 (Figure IV.A.1-1, page 37 in EPA report). Figure 10 shows only the PM correlation plotted with the data used to generate the correlation (Figure IV.A.1-3 from page 39 of EPA report). Visually, the data in Figure 10 shows significant scatter in the test results; for example, note the variation in PM data at 100% biodiesel. Note again, this is all HWHD data run on FTP cycles, so different engine types and test cycles are already excluded.

Some "clustering" of data can be seen in the data as plotted in Figure 10, in that some data is sometimes found in semi-distinct groups along the vertical axis of % biodiesel. No attempt was made using the raw data to see if there were distinct relationships in the raw data, but only analyzed the relationships in the data relative to the correlation. There is no way to know from the report if the "clusters" noted can be linked to any of second order effects such as biodiesel type differences, engine groups (model year), base fuels, duplication of experiments, etc.

The report's analysis of second order relationships in the correlation showed:

- R49 13-mode data compared to FTP correlation: appears to be a difference in PM and CO result between FTP and R49 – R49 data excluded from final correlations.

[38] This is being researched by obtaining representative SAE reports used as references by the EPA.

- Fuel Effects: plant and animal bio differing PM results, soybean and rapeseed types produce a 3-7% difference at the B100 level.
- Engine Groups: '91-'93 engine group ~23% better PM emission than other groups at B100 level.
- Base Fuels: "clean fuels" (high cetane, low density, low aromatics) produce a different % change to biodiesel blends due to better initial (0% blend) performance, but will cause higher NOX increases than blends using average diesels.

The report's comparisons of the correlation to the data excluded from the correlation calculations:

- HDOH *Vehicle* Tests: PM and HC reductions from vehicle data **less** than predicted by the correlation, NOx data from vehicles shows **reduction**, not increase in NOx with biodiesel, CO reduction from vehicle tests higher than predicted by correlation.
- Virgin Oils: correlation should not be used to prediction virgin oil behavior
- HDNR Engine Tests: correlations do a poor job representing test data from non-road engines by over-predicting NOX increase, over-predicting PM reduction, over-predicting CO reduction, over-predicting HC reduction.
- LDHW Engines: correlation deviated significantly from LDHW engine data

The deviation of the limited non-road 8-mode engine data was investigated further by comparing it to a correlation generated using the HDHW R-49 13-mode data. The results of this analysis showed that clearly the effects from biodiesel deviate between HDHW and HDNR engines. The difference between the R49 correlation and the HDNR engines were:

- Correlation over-predicted NOx increase compared to NR data.
- Correlation did not match NR PM, CO or HC data – data from NR deviated significantly.

The conclusion from the FTP and R49 correlations when compared to the non-road test data was that there appears to be a difference in response between on-highway and non-road when using biodiesel, even though technology of the two engine types is quite similar, if not essentially the same. The limited non-road data restricted the ability to make detailed comparisons, but it was concluded that the HDHW correlations would not predict HDNR behavior reliably[39].

For comparison, the MSHA data was superimposed on the EPA emission correlations, as shown in Figure 11. The MSHA data used bare engine data, and gravimetric DPM data based on the assumption the EPA correlations are representative of the same. It is clearly noted the correlations to not appear to correspond to the results of the MSHA non-road tests.

[39] LDNR engine data was not available; nothing can be said for this engine type.

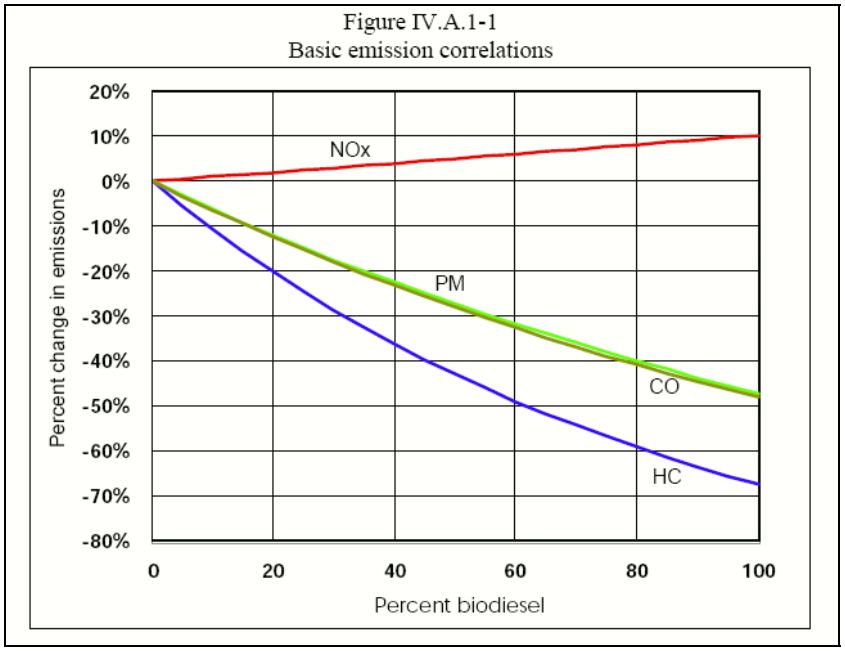


Figure 9: EPA Correlations between HDOH FTP test data and percent biodiesel (Figure IV.A.1-1, page 37 in EPA report).

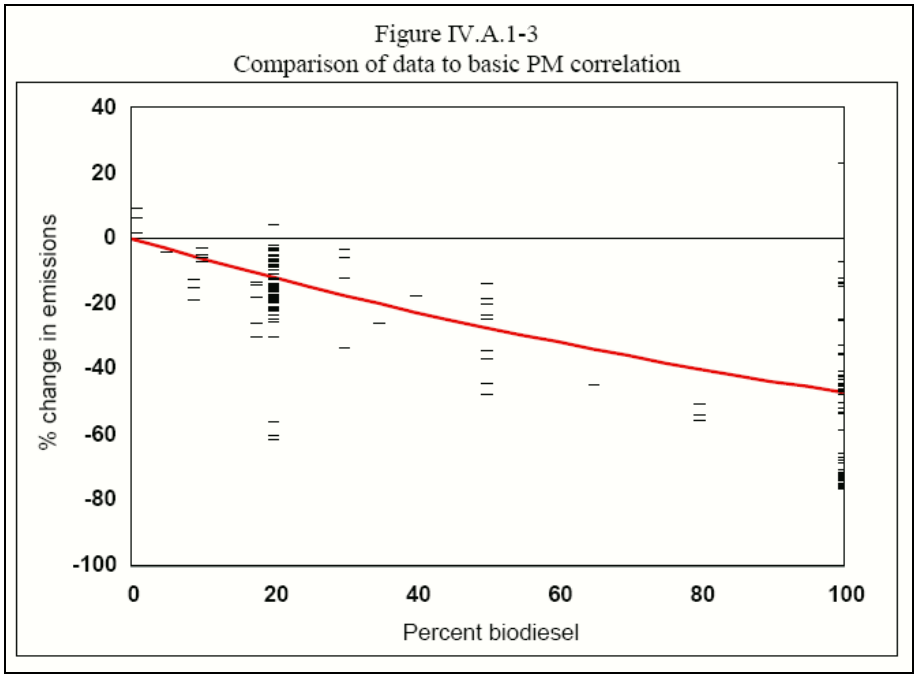


Figure 10: EPA PM Correlation between HDOH FTP test data and percent biodiesel with test data overlaid (Figure IV.A.1-3 from page 39 of EPA report).

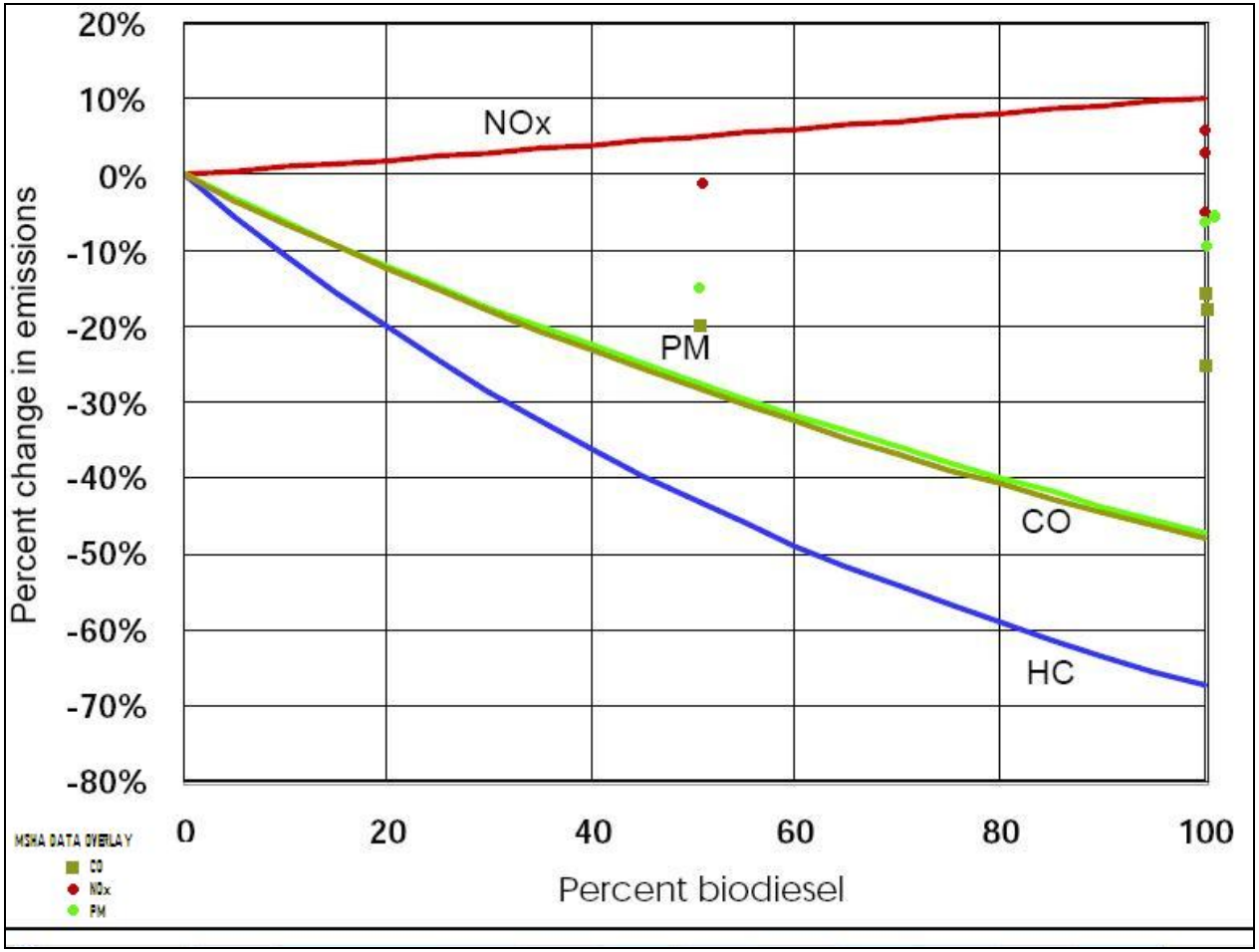


Figure 11: EPA Emission Correlations for Biodiesel with superimposed MSHA data (MSHA data points color coded to correlation curves).

Signature: Russell P. Stackpole II

Part 3B: University of Minnesota Evaluation (DEEP):

Another citation, in this case particularly applicable to mining, is a study conducted by the University of Minnesota of in-mine emissions measurements and comparisons of petroleum and biodiesel emissions on mining machines using DOCs. This study was published in 1998 in connection with the Canadian Diesel Emission Evaluation Program (DEEP)[40]. Participants included NIOSH, and several other organizations listed in the report.

A description of the work from the executive summary says:

> "The study characterized the concentration of diesel particulate matter (DPM) and exhaust gas emissions in a non-producing test section. During the first week of the evaluation a diesel powered scoop was operated on low sulfur, number 2 diesel fuel (D2). During the second week the scoop was operated on a 58 % (by mass) blend of soy methyl ester (SME) biodiesel fuel and a low sulfur D2. During both weeks the scoop was equipped with a pair of identical, advanced design diesel oxidation catalysts (DOC). The objective of the evaluation was to determine changes in exhaust emissions and to estimate operating costs of a test vehicle fueled with blended biodiesel."[41]

The machine used in the study was a Wagner ST-8a scooptram powered by a Deutz F12L413FW engine. The fuels used in the study were low sulfur D-2 and soy biodiesel from NOPEC Corporation. The evaluation tested pure D-2 compared to a blend of biodiesel/D-2 (approximately 56% biodiesel).

The DOCs used were provided by the Manufacturers of Emissions Controls Association. The machine was operated daily for approximately 5 hours while emissions samples were collected. The test method used upstream, downstream and on machine sampling for emissions, as well as daily torque stall measurements of engine performance and consistency. Measurements included gas measurements, DPM size selective sampling (SS), respirable combustible dust (RCD) and NIOSH 5040 carbon analysis. Sampling was normally conducted for 4 days per test condition.

The results of the mine sampling study for the carbon emissions showed that the blended fuel DOC combination lowered TC emissions by approximately 21% compared to D-2 DOC combination. This drop incorporated an EC reduction of 28.6% and an OC reduction of 6%. There was no data collected for the bare engine (without DOC) for either fuel tested, so there is not way to characterize the changes in EC and OC emissions found between fuel effects and DOC effects.

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[40] See http://www.deep.org/, http://www.canadianbioenergy.com/resources/Mining_DEEP_report.pdf , and http://www.deep.org/reports/inco_bio.pdf.

[41] Page 4, http://www.deep.org/reports/inco_bio.pdf.

This test comparison approximates the B50 blend in Scenario 3 in the discussion above. That scenario showed a reduction in B50 with DOC of 25% in TC compared to LSD with a DOC. The corresponding EC change was -43% and OC change of -12%. These results from the MSHA tests compare fairly well with in-mine study, considering with differences in basic method, as well as fuel, engine and DOC differences.

The study also noted the increased NO2 generation through the use of DOCs. In raw exhaust emissions during the torque stall testing, NO2 emissions downstream of the DOC increased by 185% for D-2 and 233% for the biodiesel blend compared to upstream of the DOC. These results are of the same order as those found during MSHA's testing. The in-mine air testing revealed that this increase in raw emissions did not equate to large NO2 in the mine atmosphere; usual readings for D-2 were around 2ppm, for the blend around 2.3ppm.

There was no sampling of the equipment while running with no DOC and LSD. There was a one day sample collected for the biodiesel without the DOC. (conducted at the request of the mining company). The sample was too small for comparison to the other data, and could not be compared to D-2 without a DOC. It is interested to note in this sample that the 5040 analysis of this one day sample showed a mean OC reading of 0.22 µg/m3 and an EC of 0.14 µg/m3. This is an unusual reversal of the normal ratio of OC to EC; the emissions of OC are 1.57 times the EC emissions. Though this implies increased OC emissions with the use of biodiesel, there is not enough data in the sampling, or comparative data for D-2 to make a determination.

Part 3C: Engine Tests of a Caterpillar 3304 PCNA engine.

A series was conducted[42] by J. F. McDonald, et al, and published in 1995[43]. These tests were conducted by the University of Minnesota (Center for Diesel Research) and the U.S. Bureau of Mines. This test used a Caterpillar 3304 naturally aspirated, indirect injection engine (100hp) to laboratory test the effect of soy-based biodiesel with and without a DOC, and compared to D-2 LSD with and without a DOC.

Tests were conducted in laboratory using 100% biodiesel, a 30/70 blend of biodiesel and D-2, and D-2 LSD as a baseline for comparison. Each fuel was tested with and without a DOC.

The test cycle was the ISO-8178 8-mode steady state test, essentially identical to MSHA test cycle. The DPM emissions results were gravimetrically analyzed by the same techniques as used in the MSHA tests. In addition, the DPM samples were characterized using vacuum oven sublimation to separate the volatile organic portion of the DPM from non-volatile portion. Though a different technique, this

[42] See SAE 950400.
[43] A paper on in-mine testing from 1997 was prepared by McDonald and may be reviewed in future updates to the MSHA report.

analysis roughly reproduces and EC/OC analysis in that the volatile organics equate to OC and the non-volatile to EC.

The results of the testing showed that for the bare engine overall DPM reductions were insignificant for the 30/70 blend, while the B100 biodiesel reduced total DPM by about 31%. The B100 biodiesel on the bare engine had reduced the non-volatile portion of DPM by greater than 50%, but increased volatiles (~OC) had offset some of the reduction.
The results for use of the DOC showed that total DPM was reduced by the DOC by 19% for D-2, for the blend by 35%, and for B100 biodiesel the total reduction was 59%. The analysis of the volatile vs. non-volatile portions of the DPM showed that the DOC was not having a significant effect on non-volatile portion of the DPM, but was dramatically reducing the volatile portion.

The tests also measured the gas emissions of the engine. The variations in gas emissions were generally small, with the exception of CO and NO2. Weighted average emissions of CO were lowered 69-74% with the use of the DOC. Weighted average NO2 emissions increased by 50% with the DOC on the blended fuel, and 125% for the 100% biodiesel with a DOC.

Part 3D: Biodiesel Evaluation at Homestake Gold Mine.

McDonald, et al conducted another study of biodiesel in 1997 at the Homestake gold mine. Participants included the University of Minnesota (Center for Diesel Research) and NIOSH. This test was a field trial using a Wagner LHD[44] machine powered by a Caterpillar 3306 PCNA 150 hp engine. The machine was equipped with an Engelhard DOC for the study. The testing involved sampling air upstream, downstream, and near the machine operator while the machine was working hauling waste material in the test section of the mine. Tests were conducted using LSD D-2 fuel and B100 biodiesel fuel supplied by Twin Rivers Technology.

The emissions of the machine were monitored over a six week period while using the two fuel types. Sampling methods were by the RCD method and size selective sampling using personal diesel exhaust aerosol samplers (PDEAS). The RCD method provides a gravimetric measurement (mass emission) changes and the size selective sampling also provides a time weighted average exposure to particulate mass. Emissions were calculated in an energy specific and Time Weighted Average (TWA) exposure for mining personnel. These measurements did not analyze for the carbon types, EC and OC, in the samples collected.

Results of the tests showed a dramatic change in mass DPM emissions between the two fuel types. The RCD sampling showed a reduction in RCD TWA combustible dust by 67% between D-2 and B100. The PDEAS sampling showed a reduction of 49% between D-2 and B100.

[44] LHD=load, haul, dump.

The authors noted that the reduction in DPM emissions was greater than previous laboratory results (see section 3C above). They postulated that the greater reduction could be partially due to a heavier in-mine load-cycle for the LHD in comparison with the load-cycles used during previous laboratory emissions evaluations. They noted that higher loads typically increase emissions of EC and reduce the contribution of OC to total DPM emissions, in contrast to lighter load modes which generally do the opposite.

Part 3E NIOSH Isolated Zone Study 2004:

NIOSH conducted an extensive study, published in 2004[45] on several technologies for emissions reductions in underground mining. Some of the technologies included ceramic diesel particulate filters (DPFs), DOCs, disposable exhaust filters, and alternate fuels. This study was performed in an isolate section of the Nye Mine under controlled conditions while the machine under test was performing a simulated duty cycle of loading and hauling material within the isolated zone of the mine.

Extensive sampling procedures were used for measuring gas and DPM emissions upstream, on the vehicle and downstream air from the zone. Descriptions of the methods and equipment are detailed in the report. Some of the measurements included samples for NIOSH 5040 carbon analysis, a high volume sampler for gravimetric mass analysis, real time particulate monitoring, and a size distribution / particle count analyzer for aerosol particle measurement.

The machine used during fuel testing was a Wagner LHD equipped with a Caterpillar 3126B turbocharged, after cooled engine of 200hp. Fuels tested of interest here were a D-1 diesel fuel, an ULSD D-2 fuel, and a blend of soy biodiesel[46] blended as B20 and B50 blend with D-1 diesel fuel. Also tested was a yellow grease[47] biodiesel also blended as B20 and B50 with D-1. The machine was tested with and without the use of a DOC provided by DCL International for some, but not all of the fuels.

Some of the results of the testing applicable here are that EC emissions between D-1 and ULSD were not significantly different. The B20 soy reduced EC emissions by 49%, while B50 soy reduced EC emissions by 66% as compared with D-1. The corresponding yellow grease blends reduced EC emissions by 33% and 56% compared to D-1. The MSHA B50 blend produced an EC reduction of 46% for comparison.

Use of the B50 soy in combination with the DOC, produced an EC reduction of 68% compared to D-1 (the DOC not producing a significant EC improvement over B50 alone). ULSD with a DOC did reduce EC emissions by 24% compared to ULSD alone.

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[45] See http://www.cdc.gov/niosh/mining/pubs/pubreference/outputid2094.htm.
[46] Supplied by Sustainable Systems, LLC
[47] Griffin Industries, Ltd.

OC results were not provided in the report. NIOSH does not typically report that data.

The gravimetric analysis samples showed B20 and B50 soy emissions reductions of 32% and 48% in total particulate mass (TPM) compared to D-1. The B20 and B50 yellow grease results showed reductions of 30% and 44% compared to D-1. The MSHA B50 test produced a gravimetric DPM reduction of only 13.8% for comparison.

The use of the B50 soy blend with DOC produced a 15% reduction in TPM compared with B50 alone, and a 57% reduction in TPM compared to D-1. The MSHA B50 test produced a 47.5% gravimetric DPM reduction for comparison.

Conclusions and Comments:

The following are some conclusions and comments on the testing, analysis and literature review contained in this report. It is divided into three parts. The first is conclusions and comments relating specifically to the laboratory testing conducted by MSHA. The second is comments concerning the analysis and literature discussed in the report. The third part contains some comments concerning issues with variability in emissions reductions using (B100) biodiesel fuels, or any alternative fuel.

Part 1:

The results of laboratory testing conducted by MSHA produced several items of interest, relative to diesel emissions from different fuel formulations. These are listed below:

- DPM production from the petroleum diesel fuels was similar, whether measured by overall mass or total carbon (TC) production, though there was some variability.
- TC emissions of petroleum diesels were reduced by the use of a DOC, though overall mass emissions from some petroleum diesels can be increased by the use of a DOC due to formation of sulfates, nitrates, etc.
- Use of B100 biodiesel resulted in a modest reduction in TC and DPM mass emissions when compared to petroleum diesel *on a bare engine*.
- Use of a B50 blend reduced DPM mass and TC emission *on a bare engine*.
- Use of F-T synthetic reduced TC and DPM mass emissions significantly *on a bare engine*.
- Use of B100 biodiesel in combination with a DOC resulted in the greatest reductions in both TC emissions and DPM mass emissions of any fuel and engine condition tested. The combination of B100 and a DOC achieved greater TC and DPM mass reductions than either B100 on a bare engine or a DOC used with petroleum diesel fuel.
- Use of F-T synthetic fuel in combination with a DOC reduced DPM mass and TC emissions but the reduction was similar with the F-T fuel on a bare engine.

- Use of a B50 blend in combination with a DOC reduced DPM mass and TC emission, this reduction being greater than B50 on a bare engine, but less than B100 in combination with a DOC.
- There was some advantage when using the alternative fuels for reduced CO and reduced NO2 emissions *on the bare engine*. CO2 and NO are not significantly affected.
- Use of a DOC uniformly eliminated nearly all CO emissions from the engine.
- Use of a DOC will increase NO2 production, though not to dangerous levels as long as adequate mine ventilation is maintained.
- Engine performance did not significantly vary with any of the fuels tested, save for the F-T fuel, which lowered engine power by less than 10%.

Some comments specifically relating to the MSHA testing include the following:

- The EC reductions shown for the B100 fuels were significant when tested on the bare engine. The increase in OC production offset much of this improvement, which resulted in low TC reductions for the B100 tests on the bare engine. All three B100 fuels showed this EC reduction and OC increase.
- Based on the data generated in this report, the behavior of the three biodiesel fuels, when tested as B100 were very similar. These B100 test fuels were all soy based fuels, though one was a blend of soy and animal fats. Though biodiesels from other sources, such as yellow grease, were not tested here, some of the information from the literature would suggest it would also yield similar results when tested under like conditions.
- It appears variability in emission reductions when using B100 in either a test or field application is not primarily a fuel issue; i.e. one B100 should perform like another.
- Other alternative fuels, such as the F-T fuel and blends of biodiesel and petroleum diesel will differ in performance from a B100, but will also produce useful reductions in TC emissions. It is notable that blended biodiesel has less of an OC penalty than B100, and the F-T fuel does not shows OC reductions at all load conditions.
- There is an inherent difference in the resulting emissions reductions when using B100 fuels, or any fuel, on a bare engine compared to an engine equipped with a DOC. In MSHA tests, the use of a DOC always enhanced any TC emission reduction produced by the biodiesel fuel.
- For the MSHA tests detailed in this report the goal of the tests was to determine if there were significant differences in emissions between available alternate fuels and to determine what changes are induced by the use of a DOC. The tests show how the variables change emissions when tested under a particular test cycle and provide information for evaluating fuel and after treatment choices. Applying any specific data point, or percent reduction, as a blanket answer to all use conditions is misusing the information presented.

Part 2: Analysis and literature review:

Some commentary based on the data analysis and the other research in the discussion section includes the following.

- Variability in emission reductions when using B100 fuels is clearly demonstrated when comparing the MSHA data and other literature, *at least on a bare engine*. It is clearly demonstrated in the EPA literature review and the laboratory and field studies discussed. As noted above, the MSHA testing does not find the variability due to fundamental differences between typical B100 fuels.
- The increase in OC production with use of biodiesels is extensively documented by the MSHA tests and other research. This change in OC production with the use of biodiesels appears to be the primary source of the variability in TC results between various tests. EC reductions with biodiesels are generally consistent with B100 fuels producing EC reductions of around 50% on a consistent basis.
- There is an inherent difference in the resulting emissions reductions when using B100 fuels, or any fuel, on a bare engine compared to the engine equipped with a DOC. It is demonstrated by the MSHA test results and the literature discussed above.
- The use of the DOC will always enhance any TC emission reduction produced by the biodiesel fuel by consuming part of the OC emissions. A combination of B100 with a DOC has demonstrated significant DPM reductions using a variety of test methods and analytical techniques. The MSHA test analysis and comparison to other literature shows a combination B100 and DOC as the most significant and consistent emission reduction technique[48] of those studied herein.

Part 3 B100 Variability:

Some comments on the variability in emissions reductions when using B100 fuel (on bare engines primarily) may be found below.

- Due to the demonstrable difference in resulting emissions between biodiesel alone and biodiesel with a DOC, it must be made clear to the mining industry there is a difference, and confusion resulting from misapplying data from one condition to the other must be avoided, whether that confusion emanates within MSHA or the industry. There is concern by the author that some performance expectations for B100 alone are based on data from a B100 with a DOC. It is also a concern that some "common knowledge" as it were, is mixing the two fundamentally different behaviors into an aggregate B100 performance.
- Since EC reductions when testing B100 fuels appear to be uniformly significant and similar in value, then the likely source of most TC variability is conditions that change OC production, specifically conditions that enhance biodiesels inherent OC increase over petroleum diesel.

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[48] The B100 with DOC is the most significant reduction combination short of some form of active DPM filtration, such as a ceramic DPF.

- There are some indications that engine type may play a role in biodiesel variability. This was discussed in the EPA report where their statistical analysis suggested that there was some difference between heavy duty and light duty engines, or on-highway and off-highway engines not fully explainable by variations in test method. Engine differences such as naturally aspirated vs. turbocharged, turbochargers with and without after cooling, direct vs. indirect injection (and others) are potential variables that could affect OC emissions. Further literature research and/or laboratory testing might be able to correlate some engine parameters to OC emission changes, but this is *beyond the scope of this report.*
- When using laboratory or field experimental data, the test method plays a role in the resulting reductions measured. The EPA statistical analysis appeared to indicate some difference between on-highway transient and off-highway steady state testing for example. Some tests, such as steady state and field experiments might be compared and analyzed to better correlate the data to like conditions, to eliminate some of the perceived variations in test results, but this is *beyond the scope of this report.*
- For in mine field applications, *duty cycle* of the machine will play a role in any emissions changes from the use of biodiesels such as B100. This effect can be implied from the MSHA steady state EC and OC data; it can be shown that the EC/OC ratio (and absolute value of the respective carbon portions of TC) changes depending on engine load. Specifically, lower engine loads at a given engine speed increased OC's relative contribution to TC; this is a small but measurable effect for petroleum diesels, but is a large dramatic shift for the B100 fuels. It is possible to use data from the MSHA tests, and other literature, to build a simplified "model" of this effect to better characterize this variability under a variety of duty cycles. In this fashion, it should be possible to map the boundaries of B100 variability from a duty cycle perspective, but this is *beyond the scope of this report*.
- For B100 fuels, it can be predicted that TC reductions should be more significant for engines working hard more of the time, than an engine running at low load conditions most of the time, where a significant shift to OC production would offset the inherent EC reduction capability of B100. However, since this duty cycle cannot be in detail defined from machine to machine, nor mine to mine, this potential variability will remain just that - TC reductions will vary.

Items above *beyond the scope of this report* may be studied and reported upon if of value and interest to MSHA and the mining industry.

Acknowledgments:

This work has been completed with the assistance several people within and without of MSHA. Keith Storch, lab technician for the Mechanical Engineering and Safety Division, was indispensible to the project for setup, testing and analyzing samples. This work would never have been accomplished without him.

Several A&CC personnel have had input to the analysis of the data, and comments and improvements to this report. Robert Setren, Jeff Moninger and Denise Coyle from the Mechanical and Engineering

Safety Division have reviewed the work and provided helpful commentary. George Saseen of the Quality Assurance Division also reviewed the work and provided helpful commentary.

Other MSHA personnel have also been integral to the project. Joyce Swank, Pittsburgh S&HC Dust Group, took care of the NIOSH 5040 analysis of the samples collected. William Pomroy, MSHA M/NM, provided helpful information and commentary as the work progressed.

Those suppliers who provided the fuel for testing to MSHA should also be thanked for their participation and aid in providing data for the mining industry.

Appendix A:

Fuel Property Information
DOC Information

CoA Date: 04/02/2008

Certificate of Analysis

Shipped To: MINE SAFETY & hEALTH ADMINISTRATION
251 INDUSTRIAL PARK ROAD
TRIADELPHIA WV 26059
USA

Recipient:
Fax:

PO #: 311455
CPC Delivery #: 87623902
Ship Date: 04/02/2008
Package/Mode: 54 GAL DRUM
Quantity: 4 EA
Certification Date: 03/05/2008
Transportation ID:
Shelf Life: Undetermined

Product: DIESEL 2007 ULS FUEL, 54 GAL DRUM

CERTIFIED ULSD

Material Code:1069147

Lot Number: 8APUL702

Property	Test Method	Specification	Value	Unit
Specific Gravity 60/60	ASTM D-4052	0.8400 - 0.8550	0.8489	
API Gravity	ASTM D-4052	34.0 - 37.0	35.2	
Particulate Matter	ASTM D-6217	<= 15.0	0.0	mg/l
Cloud Point	ASTM D-2500		-5	FAH
Flash Point, PM	ASTM D-93	>= 130	150	FAH
Pour Point	ASTM D-97		-20	FAH
Sulfur	ASTM D-5453	7.0 - 15.0	9.0	ppm
Viscosity @ 40C	ASTM D-445	2.0 - 3.0	2.2	cSt
Hydrogen	ASTM D-3343		13.1	WT%
Carbon	Calculated		86.9	WT%
Polynuclear Aromatics	ASTM D-5186		11.9	WT%
SFC Aromatics	ASTM D-5186		31.0	WT%
Net Heat of Combustion	ASTM D-3338		18430	BTU/LB
Cetane Number	ASTM D-613	43 - 47	44	
Cetane Index	ASTM D-976	42.0 - 48.0	44.1	
HFRR Lubricity	ASTM D-6079	<= 0.4	0.3	mm
Distillation - IBP	ASTM D-86	340 - 400	351	FAH
Distillation - 5%	ASTM D-86		388	FAH
Distillation - 10%	ASTM D-86	400 - 460	408	FAH
Distillation - 20%	ASTM D-86		435	FAH
Distillation - 30%	ASTM D-86		453	FAH
Distillation - 40%	ASTM D-86		470	FAH
Distillation - 50%	ASTM D-86	470 - 540	486	FAH
Distillation - 60%	ASTM D-86		502	FAH
Distillation - 70%	ASTM D-86		520	FAH
Distillation - 80%	ASTM D-86		544	FAH

CoA Date: 04/02/2008
CPC Delivery #: 87623902
PO #: 311455

Certificate of Analysis

Product: DIESEL 2007 ULS FUEL, 54 GAL DRUM

Material Code:1069147

Distillation - 90%	ASTM D-86	560 - 630	583	FAH
Distillation - 95%	ASTM D-86		620	FAH
Distillation - EP	ASTM D-86	610 - 690	650	FAH
Distillation - Loss	ASTM D-86		0.4	ML
Distillation - Residue	ASTM D-86		1.2	ML
Aromatics	ASTM D-1319	28.0 - 32.0	28.5	LV%
Olefins	ASTM D-1319		3.2	LV%
Saturates	ASTM D-1319		68.3	LV%

The following tests, HFRR Lubricity, Polynuclear Aromatics, and SFC Aromatics, are conducted after initial release. If the results do not appear on your Certificate of Analysis and you would like to receive them, please e-mail cpcrashippingclerks@cpchem.com

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

K E Inkrott

Ken Inkrott
Quality, Applications and Technical Service Manager

For CoA questions contact Kim Lindley at 806-275-5577

VRON PHILLIPS CHEMICAL CO. LP

Box 4910, The Woodlands, TX 77387
10001 Six Pines Dr, The Woodlands, TX 77380

Packing List

Delivery Number/Date:
87623902 / 04/02/2008
Employee Responsible:
Krissi Henson
Customer P.O./Date:
311455 / 03/12/2008
Sales Order no./Date:
6611280 / 03/28/2008
Ship-From:
X301/H / PHILTEX COMPLEX
Via:
LTL Carrier-Road /
Transportation Charges:
COL FOB Origin/Collect
Route:
FXFE
FEDEX FREIGHT EAST

Sold-To customer number: 10038882
Bill-To customer number: 10037406
MINE SAFETY & hEALTH ADMINISTRATION
251 INDUSTRIAL PARK ROAD
TRIADELPHIA WV 26059
Ship-To customer number: 20048351
MINE SAFETY & hEALTH ADMINISTRATION
251 INDUSTRIAL PARK ROAD
TRIADELPHIA WV 26059

TERMS: Net 30 Days FROM DATE OF INVOICE
REQUESTED SHIP DATE: 04/02/2008
LOAD DATE: 04/02/2008

Item	Material Description	Qty
000010		4.00 EA

DIESEL 2007 ULS FUEL, 54 GAL DRUM
1069147

NW:	1512.001 LB	685.832 KG	EA: 378.000 LB / EA	171.458 KG/EA
GW:	1692.104 LB	767.525 KG	EA: 423.026 LB / EA	191.881 KG/EA

65.55 C
FREIGHT NAME: DISTILLATES
API GRAVITY:35.9 Density: 7.01
QTY SHIP: 4.00 EA
QTY SHIP: 215.692 UG6
LOTS: 8APUL702

PO # 311455

Specific Gravity Reduction to 60°F

Specific Gravity Reduction to 60°F (ASTM D-1250 – Table 23)
PAR No.
Company:
Trade Name: 2007 Cert. VLSD ULSD
Hydraulic Fluid Type: Diesel Fuel
Tested By: Don Peiffer
Date: May 9, 2008
Test Sheet _____ of _____
Sample 1 Product Specification for the SG at 60°F/60°F = 0.84 - 0.855
Specific Gravity of product at ambient (room temperature) = 0.8425 at 71.4°F (21.9°C)
SG at 60°F (15.5°C) = 0.8461 + 0.0001 = 0.8462
SG at ambient (72.3 °F/ 22.4 °C) = 0.8425
SG at 100°F (37.7°C) = 0.828
SG at 150°F (65.5°C) = 0.794
Sample 2 Product Specification for the SG at 60°F/60°F = _____
Specific Gravity of product at ambient (room temperature) = _____ at _____ °F
SG at 60°F (15.5°C) = _____
SG at ambient (°F/ °C) = _____
SG at 100°F (37.7°C) = _____
SG at 150°F (65.5°C) = _____
Comments

CHEVRON PHILLIPS CHEMICAL CO. LP
Box 4910, The Woodlands, TX 77387
10001 Six Pines Dr, The Woodlands, TX 77380

Packing List

Delivery Number/Date:
87567936 / 01/14/2008
Employee Responsible:
Krissi Henson
Customer P.O./Date:
311310 / 01/03/2008
Sales Order no./Date:
6570188 / 01/08/2008
Ship-From:
X301/G / PHILTEX COMPLEX
Via:
LTL Carrier-Road /
Transportation Charges:
PPD FOB Dest./Prepaid & Added
Route:
FXFE
FEDEX FREIGHT EAST

Sold-To customer number: 10038882
Bill-To customer number: 10038882
NETT TECHNOLOGIES INC
2-6707 GOREWAY DRIVE
MISSISSAUGA ON L4V 1P7
CANADA
Ship-To customer number: 20048351
MINE SAFETY & hEALTH ADMINISTRATION
ATTN BOB SETREN
251 INDUSTRIAL PARK ROAD
TRIADELPHIA WV 26059

TERMS: Net 30 Days FROM DATE OF SHIPMENT
REQUESTED SHIP DATE: 01/14/2008
LOAD DATE: 01/14/2008

CERTIFIED LSD

Item	Material Description	Qty
000010		4.00 EA

DIESEL .05 5Y5 CERT FUEL, 54 GAL DRUM
1024295

NW:	1520.008 LB	689.464 KG	EA: 380.002 LB / EA	172.366 KG/EA
GW:	1699.976 LB	771.096 KG	EA: 424.994 LB / EA	192.774 KG/EA

+62C
FREIGHT NAME: PETROLEUM DISTILLATES
API GRAVITY:35.4 Density: 7.06
QTY SHIP: 4 EA
LOTS: 7JP05201

Chevron Phillips
Chemical Company LP

CoA Date: 01/14/2008

Certificate of Analysis

Shipped To: MINE SAFETY & hEALTH ADMINISTRATION
ATTN BOB SETREN
251 INDUSTRIAL PARK ROAD
TRIADELPHIA WV 26059
USA

Recipient:
Fax:

PO #: 311310
CPC Delivery #: 87567936
Ship Date: 01/14/2008
Package/Mode: 54 GAL DRUM
Quantity: 4 EA
Certification Date: 10/31/2007
Transportation ID:
Shelf Life: Undetermined

Product: DIESEL .05 5Y5 CERT FUEL, 54 GAL DRUM

Material Code:1024295

Lot Number: 7JP05201

Property	Test Method	Specification	Value	Unit
Specific Gravity 60/60	ASTM D-4052	0.8398 - 0.8654	0.8406	
API Gravity OK	ASTM D-4052	32.0 - 37.0	36.8	
Corrosion (3 hrs @ 50C)	ASTM D-130		1A	
Particulate Matter	ASTM D-6217	<= 15.0	1.8	mg/l
Cloud Point	ASTM D-2500	<= 10	-2	FAH
Flash Point, PM OK	ASTM D-93	>= 130	158	FAH
Pour Point	ASTM D-97	<= 0	-12	FAH
Sulfur OK	ASTM D-5453	300.0 - 500.0	322.0	ppm
Viscosity @ 40C OK	ASTM D-445	2.2 - 3.2	2.5	cSt
Hydrogen	ASTM D-3343		13.2	WT%
Carbon	Calculated		86.8	WT%
Carbon Density	Calculated	2,750 - 2,806	2756	g/gal
Net Heat of Combustion	ASTM D-3338		18467	BTU/LB
Cetane Number OK	ASTM D-613	46 - 48	45	
Cetane Index OK	ASTM D-976	46.0 - 48.0	47.3	
Distillation - IBP ✓	ASTM D-86	340 - 400	389	FAH
Distillation - 5%	ASTM D-86		417	FAH
Distillation - 10% ✓	ASTM D-86	400 - 460	427	FAH
Distillation - 20%	ASTM D-86		443	FAH
Distillation - 30%	ASTM D-86		460	FAH
Distillation - 40%	ASTM D-86		475	FAH
Distillation - 50% ✓	ASTM D-86	470 - 540	489	FAH
Distillation - 60%	ASTM D-86		503	FAH
Distillation - 70%	ASTM D-86		520	FAH
Distillation - 80%	ASTM D-86		544	FAH
Distillation - 90% ✓	ASTM D-86	560 - 630	585	FAH
Distillation - 95%	ASTM D-86		623	FAH
Distillation - EP ✓	ASTM D-86	610 - 690	656	FAH

OK - RStachprob
3/18/08

CoA Date: 01/14/2008
CPC Delivery #: 87567936

Certificate of Analysis

Distillation - Loss	ASTM D-86		0.3	ML
Distillation - Residue	ASTM D-86		0.6	ML
Aromatics OK	ASTM D-1319	28.0 - 31.0	30.2	LV%
Olefins	ASTM D-1319		1.0	LV%
Saturates	ASTM D-1319		68.8	LV%

The following tests, Polynuclear Aromatics and SFC Aromatics, are conducted after initial release. If the results do not appear on your Certificate of Analysis and you would like to receive them, please e-mail cpcrashippingclerks@cpchem.com

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

K E Inkrott

Ken Inkrott
Quality, Applications and Technical Service Manager

For CoA questions contact Kim Lindley at 806-275-5577

Within 30 CFR §7.86
R Stackpole 3/18/08

Specific Gravity Reduction to 60°F

Specific Gravity Reduction to 60°F (ASTM D-1250 – Table 23)
PAR No.
Company:
Trade Name: 2005 Cert. low sulfur
Hydraulic Fluid Type: Diesel Fuel
Tested By: Don Peiffer
Date: May 9, 2008
Test Sheet _____ of _____
Sample 1 Product Specification for the SG at 60°F/60°F = 0.837 - 0.865
Specific Gravity of product at ambient (room temperature) = 0.833 at 70.9°F (21.6°C)
SG at 60°F (15.5°C) = 0.8367 + 0.0003 = 0.8370
SG at ambient (72.3 °F/ 22.4 °C) = 0.833
SG at 100°F (37.7°C) = 0.822
SG at 150°F (65.5°C) = 0.788
Sample 2 Product Specification for the SG at 60°F/60°F = _____
Specific Gravity of product at ambient (room temperature) = _____ at _____ °F
SG at 60°F (15.5°C) = _____
SG at ambient (°F/ °C) = _____
SG at 100°F (37.7°C) = _____
SG at 150°F (65.5°C) = _____
Comments

HIGHWAY ULSD

Ergon - West Virginia, Inc.
a company that works™

Material Safety Data Sheet

Ultra Low Sulfur Diesel

Date of Preparation: June 2, 2008

Section 1 - Chemical Product and Company Identification

Product Name: Ultra Low Sulfur Diesel
Synonyms: Complex mixture of paraffinic and aromatic hydrocarbons
CAS Number: 68476-34-6
Manufacturer: Ergon -- West Virginia, Inc., P.O. Box 356, Newell, WV 26050
Company Contact: Will Poe, Phone (601) 630-8319 (Vicksburg, MS)

EMERGENCY TELEPHONE NUMBERS:
Ergon -- West Virginia, Inc. (304) 387-7000 Normal Business Hours
Chemtrec (800) 424-9300 After Business Hours

Section 2 - Composition / Information on Ingredients

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher.

Ingredient Name	CAS Number	% vol
Diesel Fuel	68476-34-6	100
Xylene (total)	1330-20-7	0.25
Toluene	108-88-3	< 0.1
Ethyl benzene	100-41-4	< 0.1

This product is considered a hazardous product under 29 CFR 1910.1200 (Hazard Communication).

Ingredient	OSHA PEL TWA	OSHA PEL STEL	ACGIH TLV TWA	ACGIH TLV STEL	NIOSH REL TWA	NIOSH REL STEL	NIOSH IDLH
Diesel Fuel	5 mg/m^3 (oil mist)	none estab.	5 mg/m^3 (oil mist) 100 mg/m^3 (total hydrocarbons to skin)	10 mg/m^3 (oil mist)	5 mg/m^3 (oil mist)	10 mg/m^3 (oil mist)	none estab.
Xylene (total)	100 ppm		100 ppm	150 ppm	100 ppm	150 ppm	900ppm
Toluene	200 ppm	300 ppm	50 ppm		100 ppm	150 ppm	500 ppm
Ethyl benzene	100 ppm		100 ppm	100 ppm	100 ppm	125 ppm	800 ppm

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

This product is a clear, bright liquid with a mild petroleum odor. It will burn at temperatures above 150°F. Extinguish fire with carbon dioxide, dry chemical, foam or water fog. Do not point solid water stream directly into burning oil to avoid spreading. Wear full set of protective equipment including chemical goggles and gloves. May cause skin hazard, repeated skin contact may increase risk of skin cancer.

LABEL INFORMATION: COMBUSTIBLE

HMIS
H 1
F 2
R 0
PPE†
†Sec. 8

Potential Health Effects

Inhalation: Vapors may cause headaches, dizziness, drowsiness, unconsciousness, and other central nervous system effects.
Eyes: This product may cause severe irritation, redness, or blurred vision.
Skin: This product may be severely irritating to the skin. Symptoms may include redness, edema, drying, defatting and cracking of the skin. Long term repeated exposure may cause skin cancer.
Ingestion: This product may be harmful or fatal if swallowed. Pulmonary aspiration hazard if swallowed. Ingestion can cause gastrointestinal irritation, nausea, vomiting and diarrhea.

Note: IARC has classified diesel engine exhaust as group 2A carcinogen and diesel fuel as group 2B carcinogen, which determined there is inadequate evidence for carcinogenicity of diesel fuel in humans, limited evidence for carcinogenicity of marine diesel fuel in animals, and sufficient evidence for carcinogenicity in experimental animals for diesel engine exhaust and extracts of exhaust particles, with limited evidence for carcinogenicity in humans for diesel exhaust.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. Get medical attention if symptoms persist.
Eye Contact: Flush eyes with large amounts of water for 15 minutes. Get medical attention.
Skin Contact: Remove contaminated clothing. Wash affected area with mild soap and water. Launder contaminated clothing before reuse. Get medical attention if skin disorder develops.
Ingestion: If the material is swallowed, get immediate medical attention or advice -- Do not induce vomiting.
Notes to Physician: This material, if aspirated into the lungs, may cause chemical pneumonitis; treat the affected person appropriately. Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: 150 °F (65.56°C)
Flash Point Method: PMCC
Burning Rate: not determined
Autoignition Temperature: > 500 °F (260 °C)
Lower Flammable Limit (LFL): 0.6%
Upper Flammable Limit (UFL): 7.5%
Flammability Classification: Combustible Liquid

NFPA

Extinguishing Media: Dry chemical, foam, carbon dioxide, water fog. Use water to cool fire-exposed containers and to protect personnel.
General Fire Hazards: Fire and explosion hazards are moderate when this product is exposed to heat or flame. Empty containers may retain product residue including flammable or explosive vapors. Do not cut, drill, grind, or weld near full, partially full, or empty product containers. Container my rupture on heating.
Hazardous Combustion Products: . Carbon dioxide, carbon monoxide, aldehydes and oxides of sulfur. May form toxic materials under fire conditions.
Fire-Fighting Equipment/Instructions: Do not point solid water stream directly into burning oil to avoid spreading. Use water spray to cool fire-exposed containers and as a protective screen. Wear full set of protective equipment including chemical goggles and gloves. Minimize breathing gases, vapor, fumes or decomposition products.

Section 6 - Accidental Release Measures

Containment Procedures: Contain the discharge material. Eliminate all sources of ignition or flammables that may come into contact with a spill of this material.
Clean-Up Procedures: Absorb with inert absorbent such as dry clay, sand or diatomaceous earth. Scoop up used absorbent into drums. Dispose of spent absorbent in an approved industrial waste landfill. Do not allow the spilled product to enter public drainage system or open water courses.
Evacuation Procedures: Isolate area. Keep unnecessary personnel away.
Special Instructions: Surfaces may become slippery after spillage. Wear appropriate protective equipment and clothing during clean-up.

Section 7 - Handling and Storage

Procedures for Handling: Avoid getting this material into contact with your skin and eyes, use chemical resistant gloves and goggles. Use this product with adequate ventilation. Use a NIOSH-approved respirator if exposed to oil mist, and adequate ventilation is not available. Wash hands after handling and before eating. Launder work clothes frequently.

Recommended Storage Methods: Keep the container tightly closed and in a cool, well-ventilated place. Do not store this material in open or unlabeled containers or near open flames or strong oxidants. Eliminate all sources of ignition. Store away from strong oxidizers.

01/15/2008 13:32 FAX 002/004

Section 8 - Exposure Controls / Personal Protection

Exposure Guidelines:
A. General Product Information - If oil mists are generated, observe the OSHA exposure limit of 5 mg/m3.
B. Component Exposure Limits - ACGIH, NIOSH or OSHA exposure guidelines listed for the product's components.
Engineering Controls: Use in a well-ventilated area.
Eye / Face Protection: Wear goggles and/or safety glasses with side-shields.
Skin Protection: Wear oil impervious garments if contact is unavoidable. The use of neoprene gloves is recommended.
Respiratory Protection: Not normally required for ambient air concentrations not exceeding the Occupational Exposure Limit. If mist is generated (heating, spraying) and engineering controls are not sufficient, wear approved organic vapor respirator suitable for oil mist.
General: Use good hygiene when handling petroleum product.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: Clear
Color: Clear, pale yellow, or straw color
Odor: Petroleum hydrocarbon odor
Odor Threshold: not available
Vapor Pressure: 2 mm Hg
Vapor Density (Air=1): > 3
Specific Gravity (H_2O=1): 0.81

Water Solubility: negligible
Boiling Point: 330°F
Melting Point: not applicable
% Volatile: 100
Evaporation Rate: <0.1 (butyl acetate = 1)
pH: not determined

Section 10 - Stability and Reactivity

Chemical Stability: Stable
Hazardous Polymerization: Hazardous polymerization will not occur.
Chemical Incompatibilities: This product may react with strong oxidizing agents.
Conditions to Avoid (Stability): Avoid excessive heat and all sources of ignition.
Hazardous Decomposition Products: Carbon dioxide, carbon monoxide, aldehydes, and oxides of sulfur.

Section 11- Toxicological Information

Acute Toxicity / Target Organ Information:

A. General Product / Component Information

No data available on the product as a whole. Petroleum products may affect the skin and eyes. Petroleum mists or vapors may affect the lungs. Excessive inhalation of oil mist may produce accumulation of mineral oil in the lungs accompanied by pulmonary fibrosis. Exhaust fumes may have limited evidence for carcinogenicity in humans.

B. Component LD50 / LC50 - No data available for product.

Epidemiology: No data available for product.

Carcinogenicity:

A. General Product / Component Information - Prolonged and repeated skin contact with some mildly treated or untreated mineral oils have produced skin cancer in laboratory animals.

B. Component Carcinogenicity Listings - Possibly carcinogenic to humans, IARC category 2B.

Teratogenicity / Reproductive Effects: . No data available for the product as a whole. May contain ingredient that has limited evidence of damage to developing fetus.

Neurotoxicity: Excessive exposure can cause dizziness and central nervous system depression.

Mutagenicity: No data available on this product as a whole.

Other Information: Prolonged exposure can cause drying, scaling, rash or blistering of skin..

01/15/2008 13:32 FAX 003/004

Section 12 - Ecological Information

Ecotoxicity: Keep product out of sewers and waterways. Dangerous to aquatic life in high concentrations.
Environmental Fate: No information is available.

Section 13 - Disposal Considerations

U.S. EPA Waste Number & Descriptions:

A. General Product Information - Material, if discarded, is not expected to be a characteristic hazardous waste under RCRA. As waste, other state and local regulations may apply to this product.

B. Component Waste Numbers - No EPA Waste Numbers are applicable for this product's components.

Disposal Instructions:

Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulation.

Section 14 - Transport Information

Proper Shipping Name: Combustible Liquid, n.o.s. (Diesel Fuel oil)
Hazard Class: Combustible
DOT ID No.: NA1993
Packing Group: III
DOT Shipping Label: NONE required

Additional Shipping Information:
Package in accordance with 49 CFR, and observe quantity limitations for aircraft.
International Transportation Regulations:
Not regulated as dangerous goods.

Section 15 - Regulatory Information

U.S. Federal Regulatory Information:

A. General Product Information - All components of this product are listed on the U.S. EPA TSCA Inventory.

B. Component Information - None of this product's components are listed under SARA Section 302 (40 CFR 355 App. A) Product as a whole not listed under SARA Section 313 (40 CFR 372.65) or CERCLA (40 CFR 302.4).

State Regulations:

A. General Product Information - No components require labeling under California Proposition 65. This material may contain the following carcinogens: toluene, diesel engine exhaust.

B. Component Information - This product not listed on the state lists from CA, FL, MA, MN, PA and NJ; may contain ingredients (xylene) listed on state list.

Other Regulations:

A. General Product Information - All known (non-proprietary) components of this product are listed on the EINECS inventory of existing chemicals.

B. Component Information - None of this product's components are listed on the Canadian Controlled Product Ingredient Disclosure List.

Section 16 - Other Information

Key / Legend
N = no; Y = yes; ppm - parts per million; mg/m3 = milligrams per cubic meter of air; ACGIH = American Conference of Governmental Industrial Hygienists; OSHA = Occupational Safety and Health Administration; TLV = Threshold Limit Value; NIOSH = National Institute of Occupational Safety and Health; NTP = National Toxicology Program; IARC = International Agency for Research on Cancer.

Prepared By: Will Poe **Phone:** (601) 630-8319

Supersedes MSDS Dated: New

This MSDS complies with OSHA Hazard Communication Standard (HCS) 29 CFR 1910.1200 and conforms to ANSI Z 400.1 16-Section Format.

Disclaimer: Ergon -- West Virginia, Inc. believes this information is accurate but not all-inclusive in all circumstances. It is the responsibility of the user to determine suitability of the material for their purposes. No warranty, expressed or implied, is given.

ERGON – WEST VIRGINIA, INC.

P.O. Box 1639
Jackson, MS 39215-1639
Phone: 601-933-3000
Fax: 601-933-3353

Fax Transmittal

To: Bob Setren		From:	Greg Binkley
Company:		Fax #:	601-933-3353
Fax #: 304-547-2071		Direct #:	601-933-3335
Phone #:		Date:	April 9, 2007

Pages including cover: 3

Bob – please find our Marketing spec sheet along with a tank certificate of analysis on our Ultra Low Sulfur Diesel. Please understand the tank cert is only a snap shot of the diesel fuel on a particular day; however, since you requested distillations and our Marketing Specifications don't carry that data we are sending you both.

If I can offer you any further assistance please let me know.

Thanks,

Greg Binkley
Ergon-West Va. Fuels Marketing

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Ergon - West Virginia, Inc.
a company that works™

An ISO 9001:2000 Certified Company

Ultra Low Sulfur Diesel (ULSD)

TEST DESCRIPTION	TEST METHOD	ERGON MARKETING SPECIFICATIONS		MARKETING VALUES
Physical Properties		MIN	MAX	
Viscosity, cSt @ 100°F (37.8°C)	ASTM D 445	2.0	3.6	2.2
API Gravity, 60°F (15.6°C)	ASTM D 1250	30.0		43.8
Flash Point, PMCC, °F (°C)	ASTM D 93	130 (54)		
Color, ASTM	ASTM D 6045		2.5	UNDYED
Pour Point, °F (°C)	ASTM D 5949			
October 1 to March 14			-15 (-26)	-20 (-29)
March 15 to September 30			10 (-12)	5 (-15)
Cloud Point, °F (°C)	ASTM D 5773			
October 1 to March 14			6 (-14)	2 (-17)
March 15 to September 30			20 (-7)	12 (-11)
Cetane Index	ASTM D 976	52		57
Distillation, °F (°C)	ASTM D 86			
90%		540 (282)	640 (338)	605 (318)
EP			690 (366)	635 (335)
Chemical Properties				
Carbon Residue, wt% on 10% bottoms	ASTM D 524		0.35	
Sulfur, ppm	ASTM D 4294		15	10
Ash, wt%	ASTM D 482		0.01	NIL
Copper Strip Corrosion, 3 hrs. @ 122°F	ASTM D 130		1	

ERGON WEST VIRGINIA, INC

P.O. BOX 356
Newell, WV 26050

6.697

ULTRA LOW SULFUR DIESEL TANK CERTIFICATE OF ANALYSIS

Date: 4-8-08 Time: 0905

EPC #: AD 25344

Storage Tank #: 4009

Test Description	Test Method	Result
API Gravity, 60°F	ASTM D 287	44.4
Viscosity, cSt, 100°F	ASTM D 445	2.15
Viscosity, SUS, 100°F	ASTM D 445	33.1
Sulfur, ppm	ASTM D 2622	8.0
Flash Point, PMCC, °F	ASTM D 93	137
Color, ASTM	ASTM D 6045	0.1
Cloud Point, °F	ASTM D 5772	4
Pour Point, °F	ASTM D 5949	-15
Distillation, IBP, °F	ASTM D 86	334
Distillation, 5%, °F	ASTM D 86	357
Distillation, 10%, °F	ASTM D 86	364
Distillation, 20%, °F	ASTM D 86	383
Distillation, 30%, °F	ASTM D 86	405
Distillation, 40%, °F	ASTM D 86	432
Distillation, 50%, °F	ASTM D 86	463
Distillation, 60%, °F	ASTM D 86	498
Distillation, 70%, °F	ASTM D 86	534
Distillation, 80%, °F	ASTM D 86	567
Distillation, 90%, °F	ASTM D 86	597
Distillation, 95%, °F	ASTM D86	613
Distillation, EP, °F	ASTM D 86	626
Cetane Number	ASTM D 976	57.06

Ergon West Virginia, Inc.

SD

Authorized Representative

ERGON – WEST VIRGINIA, INC.

P.O. Box 1639
Jackson, MS 39215-1639
Phone: 601-933-3000
Fax: 601-933-3353

Fax Transmittal

To: Bob Setren		From:	Greg Binkley
Company:		Fax #:	601-933-3353
Fax #: 304-547-2071		Direct #:	601-933-3335
Phone #:		Date:	April 9, 2007

Pages including cover: 3

Bob – please find our Marketing spec sheet along with a tank certificate of analysis on our Ultra Low Sulfur Diesel. Please understand the tank cert is only a snap shot of the diesel fuel on a particular day; however, since you requested distillations and our Marketing Specifications don't carry that data we are sending you both.

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Ultra Low Sulfur Diesel (ULSD)

TEST DESCRIPTION	TEST METHOD	ERGON MARKETING SPECIFICATIONS		MARKETING VALUES
Physical Properties		MIN	MAX	
Viscosity, cSt @ 100°F (37.8°C)	ASTM D 445	2.0	3.6	2.2
API Gravity, 60°F (15.6°C)	ASTM D 1250	30.0		43.8
Flash Point, PMCC, °F (°C)	ASTM D 93	130 (54)		
Color, ASTM	ASTM D 6045		2.5	UNDYED
Pour Point, °F (°C)	ASTM D 5949			
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Chemical Properties				
Carbon Residue, wt% on 10% bottoms	ASTM D 524		0.35	
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Ash, wt%	ASTM D 482		0.01	NIL
Copper Strip Corrosion, 3 hrs. @ 122°F	ASTM D 130		1	

ERGON WEST VIRGINIA, INC

P.O. BOX 356
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6,697

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Distillation, EP, °F	ASTM D 86	626
Cetane Number	ASTM D 976	57.06

Ergon West Virginia, Inc.

S.D.

Authorized Representative

Specific Gravity Reduction to 60°F

Specific Gravity Reduction to 60°F (ASTM D-1250 – Table 23)
PAR No.
Company:
Trade Name: ~~2007 Cert. VLSD~~ HW ULSD
Hydraulic Fluid Type: Diesel Fuel
Tested By: Don Peiffer
Date: May 9, 2008
Test Sheet _____ of _____
Sample 1 Product Specification for the SG at 60°F/60°F = 0.81
Specific Gravity of product at ambient (room temperature) = 0.804 at 72.3°F (22.4°C)
SG at 60°F (15.5°C) = 0.8087 + 0.0001 = 0.8088
SG at ambient (72.3 °F/ 22.4 °C) = 0.804
SG at 100°F (37.7°C) = 0.793
SG at 150°F (65.5°C) = 0.757
Sample 2 Product Specification for the SG at 60°F/60°F = _____
Specific Gravity of product at ambient (room temperature) = _____ at _____ °F
SG at 60°F (15.5°C) = _____
SG at ambient (°F/ °C) = _____
SG at 100°F (37.7°C) = _____
SG at 150°F (65.5°C) = _____
Comments

Stepan

Tech Services:
1 (800) 745-STEP
1 (847) 446-7500

CERTIFICATE OF ANALYSIS

Lot No: **7276903**
Date of Manufacture: 07-JAN-2008

Location: Elwood, IL
Phone No: 1 (815) 727-4944
FAX No: 1 (815) 774-5393

STEPAN BIODIESEL SB-W

Specification: PD099 C OF A BIODIESEL
Issue: 3 (05-Jun-2007)

Component	Limits	Spc	Result	Units
070-C ACID VALUE	0.5 Max.	IN	0.04	MG KOH/G
022-0 WATER (%)	0.05 MAX	IN	0.02	%
C14 + BELOW	Record	IN	0	%
103-G CARBON CHAIN DISTRIBUTION	SEE BELOW	IN	SEE BELOW	
C16 + C18	95 Min.	IN	99.6	%
113-K FREE GLYCERINE	0.02 Max.	IN	0.0001	%
113-K TOTAL GLYCERINE	0.24 Max.	IN	0.0805	%
573-D WATER AND SEDIMENT	0.05 Max. (By Volume)	IN	0.01	%
114-B* FLASH POINT	130C Min.	IN	COMPLIES	
000-0* SULFATED ASH	0.02% Max.	IN	COMPLIES	
000-0* COPPER CORROSION	3 Max.	IN	COMPLIES	
000-0* CETANE	47 Min.	IN	COMPLIES	
000-0* SULFUR	0.05% Max.	IN	COMPLIES	
000-0* CARBON RESIDUE	0.05% Max.	IN	COMPLIES	
000-0* PHOSPHORUS	0.001% max.	IN	COMPLIES	
000-0* DISTILLATION RANGE	360C Max.	IN	COMPLIES	

John D. McCormick
QA Manager

3

THIS ANALYSIS IS NOT TO BE CONSTRUED AS A WARRANTY, EXPRESSED OR IMPLIED. The preceding data is provided at the request of and for the convenience of the customer and does not relieve the customer of its responsibility to verify data contained on this report and to perform any other analysis necessary to determine suitability of the product described above for the use intended by the customer.

DEDICATED TO CONTINUOUS IMPROVEMENT THROUGH SQC & SPC

Stepan

Tech Services:
1 (800) 745-STEP
1 (847) 446-7500

CERTIFICATE OF ANALYSIS *(Reprint)*

Customer PO No: DON SCOTT

Lot No: **7276903**
Date of Manufacture: 07-JAN-2008
Certify Date: 08-JAN-2008
Load No: 411530

Order No: 10275634 Line: 00010
Quantity: 39 DR
Material Number: 1051375 Old SKU: PD09921

INTERSTATE OIL COMPANY
183 W MAIN ST
WOODLAND, CA. 95695

Location: Elwood, IL
Phone No: 1 (815) 727-4944
FAX No: 1 (815) 774-5393

STEPAN BIODIESEL SB-W

Specification: PD099 STEPAN
Issue: 5 (05-Jun-2007)

Component	Limits	Spc	Result	Units
110-0 APPEARANCE	Clear liquid, FFM @ 25C	IN	PASSES	
070-C ACID VALUE	2.0 Max.	IN	0.04	MG KOH/G
022-0 WATER (%)	0.05 MAX.	IN	0.02	%
103-G CARBON CHAIN DISTRIBUTION	SEE BELOW	IN	SEE BELOW	
C14 + BELOW	Record	IN	0	%
C16 + C18	95 Min.	IN	99.6	%

John D. McCormick
QA Manager

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DEDICATED TO CONTINUOUS IMPROVEMENT THROUGH SQC & SPC

Specific Gravity Reduction to 60°F

Specific Gravity Reduction to 60°F (ASTM D-1250 - Table 23)
PAR No.
Company:
Trade Name: SB-W Biodiesel
Hydraulic Fluid Type: Diesel Fuel
Tested By: Don Peiffer
Date: May 9, 2008
Test Sheet _____ of _____
Sample 1 Product Specification for the SG at 60°F/60°F = Not Provided
Specific Gravity of product at ambient (room temperature) = 0.882 at 70.9°F (21.6°C)
SG at 60°F (15.5°C) = 0.8856+ 0.0002 = 0.8858
SG at ambient (72.3 °F/ 22.4 °C) = 0.882
SG at 100°F (37.7°C) = 0.868
SG at 150°F (65.5°C) = 0.734
Sample 2 Product Specification for the SG at 60°F/60°F = _____
Specific Gravity of product at ambient (room temperature) = _____ at _____ °F
SG at 60°F (15.5°C) = _____
SG at ambient (°F/ °C) = _____
SG at 100°F (37.7°C) = _____
SG at 150°F (65.5°C) = _____
Comments

REG-9000™ Biodiesel Product Line-Up

REG-9000-1		REG-9000-5		REG-9000-10	
Cloud Point	0-2°C (32-36°F)	Cloud Point	4-6°C (39-43°F)	Cloud Point	8-12°C (46-54°F)
Oxidation Stability	3-6 hr	Oxidation Stability	5-8 hr	Oxidation Stability	7-10 hr
Cetane	47-50	Cetane	50-53	Cetane	53-59

Test	ASTM Limit	REG-9000™ Limit	
Free Glycerin	0.020 %mass, max	0.014 %mass, max	REG-9000™ Exceeds ASTM Limits
Total Glycerin	0.24 %mass, max	0.16 %mass, max	
Free Water & Sediment	0.05 %vol, max	0.02 %vol, max	
Acid Number	0.5 mg KOH/g, max	0.4 mg KOH/g, max	
Visual Inspection	2, max	1, max	
Relative Density @ 15 °C	Report	0.85—0.90	
Kinematic Viscosity @ 40 °C	1.9 – 6.0 mm^2/sec	3.8 – 5.0 mm^2/sec	
Sulfur: S 15 Grade	15 ppm, max	10 ppm, max	
S 500 Grade	500 ppm, max		
Copper Strip Corrosion	No. 3, max	No. 1, max	
Na and K, combined	5.0 ppm, max	1.5 ppm, max	
Ca and Mg, combined	5.0 ppm, max	1.0 ppm, max	
Monoglycerides	Not required	0.50 %mass, max	Testing Beyond Requirements
Diglycerides	Not required	0.20 %mass, max	
Triglycerides	Not required	0.15 %mass, max	
Moisture (Karl-Fischer)	Not required	400 ppm, max	
Cold Soak Filtration Time	Not required	200 sec	
Oxidation Stability*	3.0 hrs, min	3.0 hrs, min	
Cetane	47, min	47, min	
Alcohol Control (A): Flashpoint	130°C, min	130°C, min	
Alcohol Control (B): Methanol	0.2 %vol, max	0.2 %vol, max	
Phosphorous	0.001 %mass, max	0.001 %mass, max	
Carbon Residue, 100% sample	0.050 %mass, max	0.050 %mass, max	
Sulfated Ash	0.020 %mass, max	0.020 %mass, max	
Distillation at 90% Recovered	360°C, max	360°C, max	

** REG can add antioxidant to meet any customer stability requirement up to 10 hours.*

www.regfuel.com

REG™ [9000]
BIODIESEL

Renewable Energy Group® is one of the nations leading biodiesel companies, having sold approximately 25% of all biodiesel utilized in the United States in 2007. REG has been in the biodiesel business for more than a decade, and has more than 302 million gallons of production capacity.

Biodiesel Production Capacity Supported by Natural Infrastructure:

- Current: The REG network includes nine biodiesel plants with 302 million gallons of production capacity. This ensures that REG can be a reliable nationwide supplier to its customers on a year-round basis.
- In Construction: The REG network has three biodiesel plants currently under construction: Alberta, Canada; Emporia, Kansas; and New Orleans, Louisiana.
- REG-9000™ biodiesel is marketed through existing petroleum infrastructure.

Redefining Quality:

- REG takes exceptional measures to ensure it produces and markets only the highest quality biodiesel available for purchase in the market today.
- Every gallon of REG-9000™ biodiesel sold by REG exceeds ASTM D6751 industry specifications.
- REG is the only biodiesel company that markets a line-up of biodiesel products, REG-9000-1, REG-9000-5 and REG-9000-10. Each product has specific attributes important to individual customers.
- REG is one of only 4 companies in the industry to have achieved BQ-9000 status as Producers and Marketers.
- A Certificate of Analysis is provided for each lot of REG-9000™ biodiesel sold.

Sales & Marketing Resources:

- REG has both inside sales and outside sales personnel that can assist you with your biodiesel purchase. These sales representatives have extensive experience marketing biodiesel with customers across the country and can address technical issues you may have.
- REG sales representatives have a strong working knowledge of federal and state incentives that may be available for biodiesel in your local markets.
- REG markets biodiesel via rail and truck in all 48 continental states across the US. You can purchase biodiesel via long-term contracts or on a spot basis. Please contact REG at (888) REG-8686 to receive a price quote.

Call **(866) REG-8686** or visit **regfuel.com** to learn more.

www.regfuel.com

IRE		Form	Commingled Production Lots Report FM.LB.20 Commingled Lot Report 20080422	REG

Reference Number: B31-080422T3T4-5				
Lot Numbers:	31BD080417T003	31BD080410T004	**Product Type:**	REG-9000-5
Inlet Seal Numbers:	2451252	2451260	**Date Reported:**	22-April-2008

ASTM D 6751 Analysis of REG-9000™ Biodiesel

Test Parameter		Certification Results		ASTM Limit	REG-9000 Limit	Units	Test Method (current revision)
		31BD080417T003	31BD080410T004				
Cloud point:		6 (42.8 °F)**		Report	Report	°C	D 2500
Free Glycerin:		.003	.007	0.020, max	0.014	% Mass	D 6584
Total Glycerin:		.139	.086	0.240, max	0.160	% Mass	D 6584
Monoglycerides[1]:		.456	.258	n/a	0.50	% Mass	D 6584
Diglycerides[2]:		.100	.069	n/a	0.20	% Mass	D 6584
Triglycerides[3]:		.023	.018	n/a	0.15	% Mass	D 6584
Water & Sediment:		<0.010	<0.010	0.050, max	0.020	% Volume	D 2709
Acid Number:		.39	.10	0.50, max	0.40	mg KOH/g	D 664
Visual Inspection:		1	1	2, max	1	Haze	D 4176, procedure 2
Relative Density at 60°F:		.8847	.8765	n/a	0.85 – 0.90	n/a	D1298
Oxidation Stability (110 °C):		6.14	8.87	3.0, min	3.0	hrs	EN 14112
Flash point (closed cup):		119	146	93, min	93	°C	D 93
Alcohol Control	**Option 1: Methanol**	.13	n/a	0.2, max	0.2	% Volume	EN 14110
	Option 2: Flashpoint	n/a	n/a	130, min	130	°C	D 93
Moisture[4]:		.013	.016	n/a	0.040	% Volume	E203
Cold Soak Filtration[5]:		86	115	360, max	200	seconds	D 6217 Modified
Sulfur:		<1.0	5.1	15	10	ppm	D 5453
Sodium & Potassium Combined:		<0.53*	<0.2*	5, max	1.5	ppm (µg/g)	EN 14538
Calcium & Magnesium Combined:		<0.2*	<0.2*	5, max	1.0	ppm (µg/g)	EN 14538
Phosphorus:		<0.0001*	<0.0001*	0.001, max	0.001	% Mass	D 4951
Carbon Residue:		<0.05*	<0.05*	0.050, max	0.050	% Mass	D 4530
Sulfated Ash:		<0.005*	<0.005*	0.020, max	0.020	% Mass	D 874
Kinematic Viscosity at 40 °C:		4.088*	4.379*	1.9-6.0	3.8 – 5.0	mm^2/sec.	D 445
Copper Corrosion (3 hrs at 50 °C):		1a*	1a*	No. 3, max	No. 1	n/a	D 130
Distillation at 90% Recovered:		353*	350*	360, max	360	°C	D 1160
Cetane Number:		50.9*	59.4*	47, min	47	n/a	D 613

[1,2,3,4,5] These are not ASTM D 6751 nor BQ9000 specification requirements.

* This result is an average of the 3 previous results for this product from this plant. In accordance with BQ-9000 requirements, this test is performed periodically.

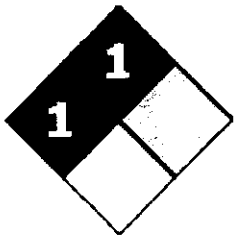
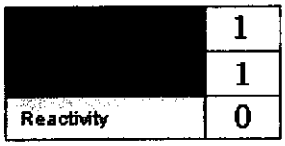
** This is an actual test result for a representative blend of these two lots. All other test results are from each lot's individual Certificate of Analysis.

Prepared by: *Marty Symmonds, Quality Assurance Manager; Iowa Renewable Energy, LLC* *22-April-2008*

Please contact Inside Sales at Renewable Energy Group, Inc. at (888)734-8686 with any questions or comments about this product.

Material Safety Data Sheet

A product of Renewable Energy Group® biodiesel

NFPA	HMIS	PPE	Transport Symbol
			

Issuing Date 28-Aug-2007 **Revision Date** **Revision Number** 0

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name **Biodiesel (B100)**

Product Code(s) **CAS# 67784-80-9 / 73891-99-3 / 61788-61-2**

Synonyms Biodiesel from soybean oil, B100, methyl soyate, soy methyl esters, rapeseed methyl esters (RME), methyl tallowate, fatty acid methyl esters, fatty acid alkyl esters.

Recommended Use Fuel, Solvent, Cleaning agent.

Supplier Address
Renewable Energy Group, Inc.
416 S. Bell Ave.
Ames, IA 50010
TEL: 1-888-734-8686

Company Emergency Phone Number 1-800-633-8253

Emergency Telephone Number CHEMTREC: +1-703-527-3887 (INTERNATIONAL)
1-800-424-9300 (NORTH AMERICA)

2. HAZARDS IDENTIFICATION

CAUTION!

Emergency Overview

May cause skin and eye irritation

Appearance Pale yellow to golden if undyed **Physical State** Liquid **Odor** Mild

2. HAZARDS IDENTIFICATION

Potential Health Effects

Principle Routes of Exposure Skin contact, Eye contact.

Acute Toxicity

Eyes May cause irritation.

Skin May cause irritation.

Inhalation Not an expected route of exposure. Inhalation of vapors in high concentration may cause irritation of respiratory system.

Ingestion Ingestion may cause stomach discomfort.

Chronic Effects No known effect.

Aggravated Medical Conditions Skin disorders.

Environmental Hazard See Section 12 for additional Ecological Information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Common Name Methyl esters.

Chemical Family Fatty acid alkyl esters.

Formula R-COO-CH_3

Chemical Name	CAS-No	Weight %
Soybean oil methyl esters	67784-80-9	0-100
Rape oil methyl esters	73891-99-3	0-100
Tallow methyl esters	61788-61-2	0-100

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin Contact Wash off immediately with soap and plenty of water.

Inhalation Move to fresh air.

Ingestion Clean mouth with water and afterwards drink plenty of water.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flammable Properties Combustible material: may burn but does not ignite readily.

Flash Point 130°C / 266°F

Method PMCC

Suitable Extinguishing Media Water spray, dry chemical, carbon dioxide (CO_2), or foam.

Unsuitable Extinguishing Media Do not use a solid water stream as it may scatter and spread fire.

Hazardous Combustion Products Carbon monoxide, Carbon dioxide (CO_2), Nitrogen oxides (NOx), Hydrocarbons.

Explosion Data

Sensitivity to mechanical impact None

Sensitivity to static discharge None

Specific Hazards Arising from the Chemical	Keep product and empty container away from heat and sources of ignition.
Protective Equipment and Precautions for Firefighters	Wear self-contained breathing apparatus and protective suit.

NFPA	**Health Hazard** 1	**Flammability** 1	**Stability** 0	**Physical and Chemical Hazards** -
HMIS	**Health Hazard** 1	**Flammability** 1	**Stability** 0	**Personal Precautions** B

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Use personal protective equipment.
Methods for Containment	Dike to collect large liquid spills. Cover with dry sand/earth.
Methods for Cleaning Up	Soak up with inert absorbent material. Take up mechanically and collect in suitable container for disposal. Clean contaminated surface thoroughly. After cleaning, flush away traces with water.
Other Information	Refer to protective measures listed in Sections 7 and 8.

7. HANDLING AND STORAGE

Handling	Wear personal protective equipment. Avoid contact with skin and eyes.
Storage	Keep tightly closed in a dry and cool place.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.
Engineering Measures	Showers, eyewash stations, and ventilation systems.
Personal Protective Equipment	
Eye/Face Protection	Safety glasses with side-shields.
Skin and Body Protection	Protective gloves.
Respiratory Protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Pale yellow to golden if undyed	**Odor**	Mild
Odor Threshold	No information available	**Physical State**	Liquid
pH	Not applicable		
Flash Point	130°C / 266°F	**Method**	PMCC
Autoignition Temperature	No information available	**Decomposition Temperature**	No information available
Boiling Point/Range	> 280°C / 536°F (at 1 atm)	**Melting Point/Range**	-1°C / 30°F
Flammability Limits in Air	No information available	**Explosion Limits**	No information available
Specific Gravity	0.87-0.88 @ 25°C	**Water Solubility**	Negligible
Solubility	No information available	**Evaporation Rate**	No information available
Vapor Pressure	No data available	**Vapor Density**	No data available
VOC Content	Not applicable	**Viscosity**	3.9-4.4 cst @ 40°C

10. STABILITY AND REACTIVITY

Stability	Stable under recommended storage conditions.
Incompatible Products	Strong oxidizing agents. Strong reducing agents. Strong acids. Strong bases.
Conditions to Avoid	Heat, flames and sparks.
Hazardous Decomposition Products	Carbon monoxide (CO). Carbon dioxide (CO_2). Nitrogen oxides (NOx). Hydrocarbons.
Hazardous Polymerization	Hazardous polymerization does not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information .

Irritation .

LD50 Oral VALUE (mg/kg) 17.4 g/kg (rat) estimated

Chronic Toxicity

Chronic Toxicity No known effect.

Target Organ Effects Skin.

12. ECOLOGICAL INFORMATION

Ecotoxicity

The environmental impact of this product has not been fully investigated.

Persistence and Degradability	Product is biodegradable.
Bioaccumulation/ Accumulation	All components of this material will potentially bioaccumulate.
Mobility	The product is insoluble and floats on water.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method	This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with 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 state, regional, or local regulations for additional requirements.
Contaminated Packaging	Dispose of in accordance with local regulations.

14. TRANSPORT INFORMATION

DOT	Not regulated
TDG	Not regulated
MEX	Not regulated
ICAO	Not regulated
IATA	Not regulated
IMDG/IMO	Not regulated
RID	Not regulated
ADR	Not regulated
ADN	Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Does not comply
EINECS/ELINCS	Complies
ENCS	Does not Comply
IECSC	Does not Comply
KECL	Does not Comply
PICCS	Does not Comply
AICS	Does not Comply

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, does not contain any substances 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.

U.S. State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

This product does not contain any substances regulated by state right-to-know regulations.

International Regulations

Mexico - Grade Minimum risk, Grade 0

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
Non-controlled

16. OTHER INFORMATION

Issuing Date	28-Aug-2007
Revision Date	
Revision Note	No information available

Specific Gravity Reduction to 60°F

Specific Gravity Reduction to 60°F (ASTM D-1250 – Table 23)
PAR No.
Company:
Trade Name: IRE T003 – T004
Hydraulic Fluid Type: Diesel Fuel
Tested By: Don Peiffer
Date: May 9, 2008
Test Sheet _____ of _____
Sample 1 Product Specification for the SG at 60°F/60°F = 0.87 - 0.88
Specific Gravity of product at ambient (room temperature) = 0.8740 at 71.4°F (21.9°C)
SG at 60°F (15.5°C) = 0.8780 + 0.0001 = 0.8781
SG at ambient (72.3 °F/ 22.4 °C) = 0.8740
SG at 100°F (37.7°C) = 0.860
SG at 150°F (65.5°C) = 0.828
Sample 2 Product Specification for the SG at 60°F/60°F = _____
Specific Gravity of product at ambient (room temperature) = _____ at _____ °F
SG at 60°F (15.5°C) = _____
SG at ambient (°F/ °C) = _____
SG at 100°F (37.7°C) = _____
SG at 150°F (65.5°C) = _____
Comments

IRE		Form	Biodiesel Certificate of Analysis FM.LB.21 Biodiesel Certificate of Analysis (REG) 20080418.doc	REG

Lot Number: 31BD080420T005	**Product Type:** REG-9000-10
Inlet Seal Number: 2451296	**Date Reported:** 29-April-2008
CFPP: 7°C	

ASTM D 6751 Analysis of REG-9000™ Biodiesel

Test Parameter		Result	ASTM Limit	REG-9000 Limit	Units	Test Method (current revision)
Cloud point:		10 (*50°F*)	Report	Report	°C	D 2500
Free Glycerin:		.006	0.020, max	0.014	% Mass	D 6584
Total Glycerin:		.090	0.240, max	0.160	% Mass	D 6584
Monoglycerides[1]:		0.253	n/a	0.50	% Mass	D 6584
Diglycerides[2]:		0.078	n/a	0.20	% Mass	D 6584
Triglycerides[3]:		0.062	n/a	0.15	% Mass	D 6584
Water & Sediment:		<0.010	0.050, max	0.020	% Volume	D 2709
Acid Number:		0.18	0.50, max	0.40	mg KOH/g	D 664
Visual Inspection:		1	2, max	1	Haze	D 4176, Procedure 2
Relative Density at 60°F:		.877	n/a	0.85 – 0.90	n/a	D1298
Oxidation Stability (110 °C):		7.23	3.0, min	3.0	hrs	EN 14112
Flash point (closed cup):		128	93, min	93	°C	D 93
Alcohol Control	**Option 1: Methanol**	0.11	0.2, max	0.2	% Volume	EN 14110
	Option 2: Flash point	n/a	130	130	°C	D 93
Moisture[4]:		.016	n/a	0.040	% Volume	E203
Cold Soak Filtration[5]:		110	360, max	200	seconds	D 6217 Modified
Sulfur:		7.0	15	10	ppm	D 5453
Sodium & Potassium Combined:		<0.2*	5, max	1.5	ppm (µg/g)	EN 14538
Calcium & Magnesium Combined:		<0.2*	5, max	1.0	ppm (µg/g)	EN 14538
Phosphorus:		<0.0001*	0.001, max	0.001	% Mass	D 4951
Carbon Residue:		<0.05*	0.050, max	0.050	% Mass	D 4530
Sulfated Ash:		<0.005*	0.020, max	0.020	% Mass	D 874
Kinematic Viscosity at 40 °C:		4.379*	1.9-6.0	3.8 – 5.0	mm^2/sec.	D 445
Copper Corrosion (3 hrs at 50 °C):		1a*	No. 3, max	No. 1	n/a	D 130
Distillation at 90% Recovered:		350*	360, max	360	°C	D 1160
Cetane Number:		59.4*	47, min	47	n/a	D 613

[1,2,3,4,5] These are not ASTM D 6751 nor BQ9000 specification requirements.

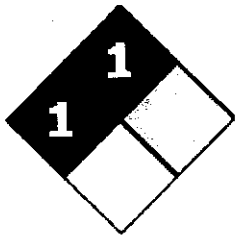
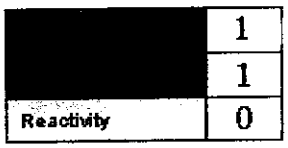
* This result is an average of the 3 previous results for this product from this plant. In accordance with BQ-9000 requirements, this test is performed periodically.

Prepared by: *Marty Symmonds, Quality Assurance Manager; Iowa Renewable Energy, LLC* *29-April-2008*

Please contact Inside Sales at Renewable Energy Group, Inc. at (888)734-8686 with any questions or comments about this product.

Material Safety Data Sheet

SOYPOWER®
A product of Renewable Energy Group® biodiesel

NFPA	HMIS	PPE	Transport Symbol
			

Issuing Date 28-Aug-2007 **Revision Date** **Revision Number** 0

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name **Biodiesel (B100)**

Product Code(s) **CAS# 67784-80-9 / 73891-99-3 / 61788-61-2**

Synonyms Biodiesel from soybean oil, B100, methyl soyate, soy methyl esters, rapeseed methyl esters (RME), methyl tallowate, fatty acid methyl esters, fatty acid alkyl esters.

Recommended Use Fuel, Solvent, Cleaning agent.

Supplier Address
Renewable Energy Group, Inc.
416 S. Bell Ave.
Ames, IA 50010
TEL: 1-888-734-8686

Company Emergency Phone Number 1-800-633-8253

Emergency Telephone Number CHEMTREC: +1-703-527-3887 (INTERNATIONAL)
1-800-424-9300 (NORTH AMERICA)

2. HAZARDS IDENTIFICATION

CAUTION!

Emergency Overview
May cause skin and eye irritation

Appearance Pale yellow to golden if undyed **Physical State** Liquid **Odor** Mild

2. HAZARDS IDENTIFICATION

Potential Health Effects

Principle Routes of Exposure Skin contact, Eye contact.

Acute Toxicity

Eyes May cause irritation.

Skin May cause irritation.

Inhalation Not an expected route of exposure. Inhalation of vapors in high concentration may cause irritation of respiratory system.

Ingestion Ingestion may cause stomach discomfort.

Chronic Effects No known effect.

Aggravated Medical Conditions Skin disorders.

Environmental Hazard See Section 12 for additional Ecological Information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Common Name Methyl esters.
Chemical Family Fatty acid alkyl esters.
Formula R-COO-CH_3

Chemical Name	CAS-No	Weight %
Soybean oil methyl esters	67784-80-9	0-100
Rape oil methyl esters	73891-99-3	0-100
Tallow methyl esters	61788-61-2	0-100

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin Contact Wash off immediately with soap and plenty of water.

Inhalation Move to fresh air.

Ingestion Clean mouth with water and afterwards drink plenty of water.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flammable Properties Combustible material: may burn but does not ignite readily.

Flash Point 130°C / 266°F
Method PMCC

Suitable Extinguishing Media Water spray, dry chemical, carbon dioxide (CO_2), or foam.

Unsuitable Extinguishing Media Do not use a solid water stream as it may scatter and spread fire.

Hazardous Combustion Products Carbon monoxide, Carbon dioxide (CO_2), Nitrogen oxides (NOx), Hydrocarbons.

Explosion Data
Sensitivity to mechanical impact None
Sensitivity to static discharge None

Specific Hazards Arising from the Chemical	Keep product and empty container away from heat and sources of ignition.
Protective Equipment and Precautions for Firefighters	Wear self-contained breathing apparatus and protective suit.

NFPA	**Health Hazard** 1	**Flammability** 1	**Stability** 0	**Physical and Chemical Hazards** -
HMIS	**Health Hazard** 1	**Flammability** 1	**Stability** 0	**Personal Precautions** B

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Use personal protective equipment.
Methods for Containment	Dike to collect large liquid spills. Cover with dry sand/earth.
Methods for Cleaning Up	Soak up with inert absorbent material. Take up mechanically and collect in suitable container for disposal. Clean contaminated surface thoroughly. After cleaning, flush away traces with water.
Other Information	Refer to protective measures listed in Sections 7 and 8.

7. HANDLING AND STORAGE

Handling	Wear personal protective equipment. Avoid contact with skin and eyes.
Storage	Keep tightly closed in a dry and cool place.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.
Engineering Measures	Showers, eyewash stations, and ventilation systems.
Personal Protective Equipment	
Eye/Face Protection	Safety glasses with side-shields.
Skin and Body Protection	Protective gloves.
Respiratory Protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Pale yellow to golden if undyed	**Odor**	Mild
Odor Threshold	No information available	**Physical State**	Liquid
pH	Not applicable		
Flash Point	130°C / 266°F	**Method**	PMCC
Autoignition Temperature	No information available	**Decomposition Temperature**	No information available
Boiling Point/Range	> 280°C / 536°F (at 1 atm)	**Melting Point/Range**	-1°C / 30°F
Flammability Limits in Air	No information available	**Explosion Limits**	No information available
Specific Gravity	0.87-0.88 @ 25°C	**Water Solubility**	Negligible
Solubility	No information available	**Evaporation Rate**	No information available
Vapor Pressure	No data available	**Vapor Density**	No data available
VOC Content	Not applicable	**Viscosity**	3.9-4.4 cst @ 40°C

10. STABILITY AND REACTIVITY

Stability	Stable under recommended storage conditions.
Incompatible Products	Strong oxidizing agents. Strong reducing agents. Strong acids. Strong bases.
Conditions to Avoid	Heat, flames and sparks.
Hazardous Decomposition Products	Carbon monoxide (CO). Carbon dioxide (CO_2). Nitrogen oxides (NOx). Hydrocarbons.
Hazardous Polymerization	Hazardous polymerization does not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information .

Irritation .

LD50 Oral VALUE (mg/kg) 17.4 g/kg (rat) estimated

Chronic Toxicity

Chronic Toxicity No known effect.

Target Organ Effects Skin.

12. ECOLOGICAL INFORMATION

Ecotoxicity

The environmental impact of this product has not been fully investigated.

Persistence and Degradability	Product is biodegradable.
Bioaccumulation/ Accumulation	All components of this material will potentially bioaccumulate.
Mobility	The product is insoluble and floats on water.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method	This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with 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 state, regional, or local regulations for additional requirements.
Contaminated Packaging	Dispose of in accordance with local regulations.

14. TRANSPORT INFORMATION

DOT	Not regulated
TDG	Not regulated
MEX	Not regulated
ICAO	Not regulated
IATA	Not regulated
IMDG/IMO	Not regulated
RID	Not regulated
ADR	Not regulated
ADN	Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Does not comply
EINECS/ELINCS	Complies
ENCS	Does not Comply
IECSC	Does not Comply
KECL	Does not Comply
PICCS	Does not Comply
AICS	Does not Comply

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, does not contain any substances 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.

U.S. State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

This product does not contain any substances regulated by state right-to-know regulations.

International Regulations

Mexico - Grade Minimum risk, Grade 0

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
Non-controlled

16. OTHER INFORMATION

Issuing Date	28-Aug-2007
Revision Date	
Revision Note	No information available

Specific Gravity Reduction to 60°F

Specific Gravity Reduction to 60°F (ASTM D-1250 – Table 23)

PAR No.

Company:

Trade Name: IRE T003 B100

Hydraulic Fluid Type: Diesel Fuel

Tested By: Don Peiffer

Date: May 9, 2008

Test Sheet _____ of _____

Sample 1
Product Specification for the SG at 60°F/60°F = 0.877

Specific Gravity of product at ambient (room temperature) = 0.875 at 72.3°F (22.4°C)

SG at 60°F (15.5°C) = 0.8793 + 0.0001 = 0.8794

SG at ambient (72.3 °F/ 22.4 °C) = 0.875

SG at 100°F (37.7°C) = 0.861

SG at 150°F (65.5°C) = 0.828

Sample 2
Product Specification for the SG at 60°F/60°F = _____

Specific Gravity of product at ambient (room temperature) = _____ at _____ °F

SG at 60°F (15.5°C) = _____

SG at ambient (°F/ °C) = _____

SG at 100°F (37.7°C) = _____

SG at 150°F (65.5°C) = _____

Comments

MATERIAL SAFETY DATA SHEET

PS 150

Date Issued 18 March 2002

Company Details
Name PM Group International Inc.
Address PO Box 101512
Cape Coral, FL 33910

Emergency Phone Number

General Assistance 239-274-0074
24 HOUR EMERGENCY ASSISTANCE
Chemtrec 800-424-9300

1. Product and Company Identification:

Trade / Commercial Name	**PS 150**
Chemical Name	**Alkanes,C10-C13, branched**
Synonyms	SYNTHETIC HYDROCARBON.
Un No	**Not Classified**
DOT Hazard	**Not Classified**
SA Standard (SABS 0228)	CLASS 3.4 (*High Flashpoint exceeding 61°C up to 100°C*)
Hazchem Code	3 [Y]
NAERG	GUIDE 128
Mossgas Material No.	50203

2. CAS NUMBER **642928-30-1**

3. Hazards Identification

Fire: Combustible Liquid. Flammable when exposed to heat or flame. Can react with oxidizing agents. Vapours may form explosive mixtures with air. Vapours may travel to sources of ignition and flash back. Vapours are heavier than air and will spread along the ground and collect in low or confined areas. Vapour explosion hazard indoors, outdoors and in sewers. Run-off to sewer may create fire or explosion hazard. Containers may explode when heated. Liquid is lighter than water. Combustion will produce CO and other asphyxiants. Fire could produce irritating or poisonous gases. Runoff from fire-control or dilution water could cause pollution.

Inhalation: Vapours and mists may cause irritation of the nose and throat. Inhalation causes coughing, distress and rapidly developing pulmonary oedema. It may also cause a burning sensation in the chest, headache, nausea, weakness, restlessness, inc-ordination, confusion, vomiting, diarrhea.

In poorly ventilated areas or confined spaces, unconsciousness and asphyxiation may result. Prolonged or overexposure may result in absorption of potentially harmful amounts of material.

Skin contact: Contact could irritate or burn skin. Prolonged or repeated contact may cause irritation, de-fatting or even dermatitis.

Eye contact: Eye irritation. May cause burning sensation in eyes.

Ingestion: Liquid irritates stomach. Harmful or fatal if swallowed. May cause nausea, vomiting, cramping. Central nervous system depression may occur, ranging from anesthesia, coma and respiratory arrest. Kidney and liver damage signs may be delayed after exposure. If aspirated, chemical pneumonia may occur.

4. First Aid Measures

First Aid Inhalation: Move victim to fresh air. Loosen all tight clothing. Sit patient up if conscious. A qualified person must administer oxygen if breathing is difficult. Begin rescue breathing if breathing has stopped. Begin CPR if heart action has stopped. Get medical attention promptly.

First Aid Skin: Remove contaminated clothing. Wash affected area with copious amounts of water and soap. Apply moisturising cream if necessary.

First Aid Eyes: Flush eyes under running water for 15 minutes. Hold both eyelids open. Continue irrigating. Seek immediate medical attention.

First Aid Ingestion: Do not induce vomiting. Do not give liquids. Small amounts which accidentally enter the mouth, should be rinsed out until taste of kerosene is gone. Seek immediate medical attention.

MATERIAL SAFETY DATA SHEET

PS 150

5. Fire Fighting Measures

Small fires: Dry chemical, CO_2, water fog or alcohol foam.

Large fires: Water spray, fog or alcohol foam is recommended. Move container from fire area if you can do it without risk. Cool containers that are exposed to flames with water from the side until well after the fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discolouration of tank due to fire. Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing will provide limited protection.

6. Accidental Release Measures

Spills or Leaks: Contain (avoid spillage from entering drains or water courses) Restrict access to area. Provide adequate protective equipment and ventilation. Remove sources of heat and flame. Stay upwind and out of low areas. Contaminated soil to be excavated and transported to a hazardous materials waste disposal site. Notify Environmental and Safety officials to ensure all relevant reporting and control methods are complied with.
Eliminate all ignition sources. No smoking, flares, sparks or flames in immediate area. All equipment used when handling the product, must be grounded. Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent entry into water ways, sewers, basements or confined areas. A vapour suppressing foam may be used to reduce vapours. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean, non-sparking tools to collect absorbed material. Water spray may reduce vapour; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other inert material. Collect and deposit in sealed containers for disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

7. Handling And Storage

Storage in the same room or space is prohibited with the following classes:

Separation of at least 3 metres from Corrosives is recommended.

Fire separation of at least 5 metres or 4-hour fire resistant wall from the following classes is recommended:

Flammable Gases	Flammable solids	Poison
Spontaneously Combustible	Dangerous when wet	

The spaces should be at least 10 metres apart from the following classes:

Explosives	Poisonous Gases	Radioactive
Oxidizing Agents	Organic Peroxides	

Avoid contact with strong oxidizers. Store in tightly closed, containers in a well-ventilated area. . Smoking, heat, sparks and open flames are prohibited in the storage area. Avoid prolonged inhalation of mist or vapour. Avoid prolonged or repeated contact with the skin. Wash thoroughly after handling.

8. Exposure Controls/Personal Protection

Occupational Exposure Limits 100 mg/M^3

Controls Store in tightly closed containers in a cool, dry place, away from sources of heat or ignition. Wear appropriate personal protective equipment when conditions warrant. Do not get in eyes. Do not breathe vapours. Wash thoroughly after handling. Immediately remove and launder contaminated clothing before re-use. Have a safety shower/eye wash fountain readily available in the immediate work area.
The control measures appropriate for a particular work site depend on how this material is used and extent of exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Use a non-sparking, grounded ventilation system separate from other exhaust ventilation systems. Exhaust directly to the outside. Supply sufficient replacement air to make up for air removed. Have a safety shower/eye wash fountain readily available in the immediate work area

Personal Protection — If engineering controls and work practices are not effective in controlling this material, then wear suitable personal protection equipment, including chemical safety goggles & face shield, boots, imperious gloves, overalls, & respiratory protection. Have appropriate equipment available for use in emergencies.

9. Physical & Chemical Properties

Boiling Range °C	(°F)	180 - 230	(358-446)
Flash Point °C	(°F)	82	(144)
Auto ignition temperature °C	(°F)	228	(442.4)
Relative density (water = 1)		0,77	
Relative vapour density (air = 1)		4.50	
Vapour pressure in mm Hg @ 20°C		0.48	
Freezing point°C	(°F)	minus 45	(minus 49)
Physical state and appearance		Water white liquid.	
Flammability limits in air, % by volume		0.7 – 5.0	

PS 150 is a water white, oily liquid composed of a mixture of C10-C13 branch chain hydrocarbons, having a faint characteristic odour. Insoluble in water. Miscible with petroleum solvents. Odour threshold is 0.6 ppm. Taste threshold in water is 0.1 mg/L.

10. Stability And Reactivity

Conditions to Avoid — Avoid contact with strong oxidizers, strong acids and alkalis.

Incompatible Materials — Strong oxidizers, strong acids and alkalis.

11. Toxicological Information

Routes of entry — Inhalation of vapour, ingestion, eye and skin contact.

Chronic effects on humans — Not suspected to be a human carcinogen

Other Toxic Effects on humans — Aggravates pre-existing medical disorders of the skin, eye, nervous system, respiratory/pulmonary system.

12. Ecological Information

No information available.

13. Disposal Considerations

Disposal Method Product — Disposal in accordance with local legal provisions. Incinerate

14. Transport Information

UN No	Not Classified
Hazchem Code	Not Required
Hazard label	Not Required
NAERG	128
IMDG Code	Not Classified
IMDG-Packaging Group	Not Listed
Marine pollutant	Not listed.
DOT HAZARD	Not Classified

Passenger instruction = 309 for passenger aircraft (60 litres On Passenger)
Passenger instruction = 310 for cargo aircraft (220 litres on cargo aircraft)

15. Regulatory Information

1. EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION
2. OEL-POLAND: MAC(TWA) 100 mg/m3, MAC(STEL) 300 mg/m3, JAN1999

Hazard Classification

Risk Phrases	Not Required
Safety Phrases	S9 Keep container in a well-ventilated place

16.Other information

NIOSH DOCUMENTS

1. **National Occupational Exposure Survey 1983: Hazard Code T1768; Number of Industries 321; Total Number of Facilities 89564; Number of Occupations 186; Total Number of Employees 1075728; Total Number of Female Employees 96255**
2. **National Occupational Exposure Survey 1983: Hazard Code X6889; Number of Industries 1; Total Number of Facilities 22; Number of Occupations 3; Total Number of Employees 790**

NOTE: The information contained herein has been presented in good faith and is to the best of PM Group International Inc's true and accurate. It is provided for informational purposes only and without warranty whatsoever. PM Group International inc. does not accept responsibility or liability whatsoever which may result form the use of this information. If in doubt, please contact PM Group International Inc.

PETROSA

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Cape Coral, FL 33910
Tel: 239-274-0274
Fax: 239-274-0074

PS 150

Properties	Units	Test method	Typical value	Specification
Appearance	Visual	ASTM D 4176	Clear and bright and free of suspended matter	Pass
Density @ 20 °C	kg/l	ASTM D 4052	0.765	0.780 max
Color Saybolt	Saybolt	ASTM D 156	+ 30	+ 30 min
Distillation range:		ASTM D 1078		
Initial boiling point	°C		194	180 min
Dry point	°C		218	220 max
Flash point (PMcc)	°C	ASTM D 93	64	64 min
Aromatic content	% m/m	UOP 495	<0.006	0.05 max
Bromine Index	mg Br/100g	ASTM D 2710	3	50 max
Total Sulphur	ppm (m/m)	ASTM D 3120 or ASTM D5453	<1	2 max
Aniline point	°C	ASTM D 611	61	Report
Kinematic Viscosity @ 25 °C	cSt	ASTM D 445	1.6	1.30 min
Water Content	% v/v	ASTM D 6304	0.003	0.01 max

The information contained herein has been presented in good faith and is to the best of PM Group International Inc. knowledge true and accurate. It is provided for informational purposes only and without warranty whatsoever. PM Group International Inc. does not accept responsibility or liability whatsoever which may result form the use of theis information. Typical data are provided for information only, and do not from part of guaranteed specification.

Specific Gravity Reduction to 60°F

Specific Gravity Reduction to 60°F (ASTM D-1250 – Table 23)

PAR No. (MSRS: 080304)

Company: VOPAK Terminal

Trade Name: Petro SA

Hydraulic Fluid Type: Diesel Fuel

Tested By: Donald Peiffer

Date: Sept. 25, 2008

Test Sheet _____1_____ of _____1_____

Sample 1
Product Specification for the SG at 60°F/60°F = Unknown

Specific Gravity of product at ambient (room temperature) = 0.760 at 73.4°F (23.0°C)

SG at 60°F (15.5°C) = 0.7655 + 0.00016 = 0.7657

SG at ambient (73.4 °F/ 23.0 °C) = 0.760

SG at 100°F (37.7°C) = 0.743

SG at 150°F (65.5°C) = 0.703

Sample 2
Product Specification for the SG at 60°F/60°F = _____

Specific Gravity of product at ambient (room temperature) = _____ at _____ °F

SG at 60°F (15.5°C) = _____

SG at ambient (°F/ °C) = _____

SG at 100°F (37.7°C) = _____

SG at 150°F (65.5°C) = _____

Comments

Engine Control Systems

AZ Purifiers™ and Purimufflers™

Diesel Oxidation Catalysts

VERIFIED PRODUCT

Mining

Earth-Moving

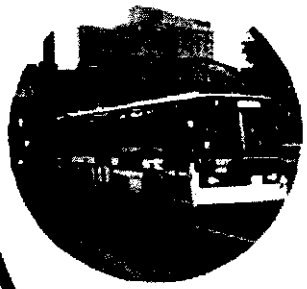
Construction

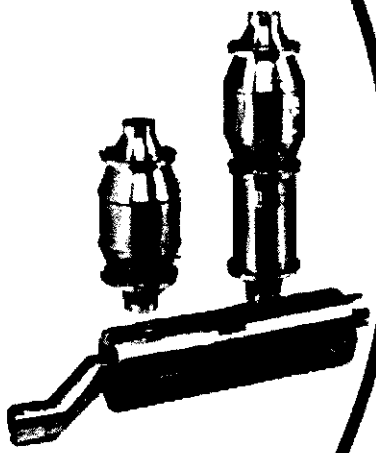
Heavy Industrial

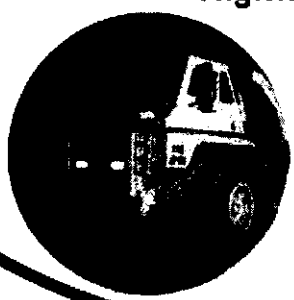
Urban Buses

School Buses

Highway Trucks







AZ Purifiers and Purimufflers are now verified for 40% PM reduction for on-road vehicles under US EPA Verifications!

Today's Leading Technology for Tomorrow's Future

What is a Diesel Oxidation Catalyst
What does it do?

Diesel Oxidation Catalyst, DOC, scrubber, purifier, catalytic converter, etc. all refer to the same product. A diesel oxidation catalyst is a coated substrate that when exhaust passes through, converts harmful compounds found in exhaust into safe components.

Engine Control Systems designs and manufactures the diesel oxidation catalyst in both a purifier, the AZ Purifier and a muffler configuration, the AZ Purimuffler™.

The harmful elements of exhaust are both gaseous and solid in form. There are also components of exhaust that are not harmful. Below is a list of the major harmful components as well as the harmless components that are involved in the basic chemical reaction of exhaust passing through an AZ Purifier or Purimuffler.

The solid elements include:
SOF: Soluble Organic Fraction (absorbed)
C: Carbon

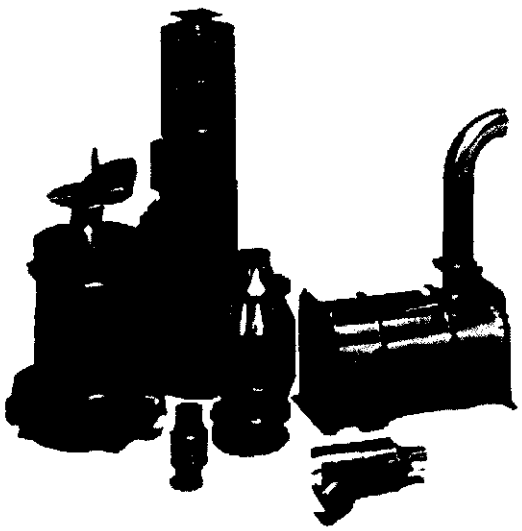
The gaseous elements include:
CO: Carbon Monoxide
CO2: Carbon Dioxide
O2: Oxygen
THC: Total Hydrocarbons

The liquid elements include:
H2O: Water (as vapour)

AZ Chemistry

Below listed are the major chemical reactions that occur within the AZ Purifier and AZ Purimuffler to change hazardous exhaust into harmless carbon dioxide and water.

$$CO + O_2 \Rightarrow CO_2 + H_2O$$
$$THC + O_2 \Rightarrow CO_2 + H_2O$$
$$SOF + O_2 \Rightarrow CO_2 + H_2O$$
$$C + O_2 \Rightarrow CO_2 + H_2O \ (<<10\%)$$



Why use an AZ Purifier™ or Purimuffler™?

AZ Purifiers and Purimufflers reduce the chance of carbon monoxide build up in enclosed work environments. They also reduce the diesel odor by reducing hydrocarbons and the soluble organics of the emitted particulate. The high SOF exhaust will result in higher TPM reductions and should decrease opacity. AZ Purifiers and Purimufflers can reduce the exposure to known diesel toxins and reduce associated health risks.

AZ products work with almost all fuel types. The catalyst will work best on lower sulfur fuels (less than 50ppm sulfur) but will also tolerate higher fuel sulfur contents (between 50 ad 500ppm sulfur). AZ products can also be used with biodiesel as well as emulsified diesel fuels.

Engine Control Systems AZ Product Line

Engine Control Systems AZ products consist of a Corning LFA 300 cell ceramic monolith coated with an advanced precious metal based catalyst and packaged into a stainless steel housing. The AZ family of products oxidize carbon monoxide (CO) and hydrocarbons (HC) to form harmless carbon dioxide and water (see chemical reactions to the left of the page). Engine Control Systems AZ products will also reduce the total particulate emissions by typically 25%-40% by oxidizing the soluble organic fraction of the particulate.

The AZ catalyst offers a unique zeolite containing washcoat that allows for the adsorption of PM at lower exhaust temperatures until sufficient temperature for oxidation is achieved. The superior low temperature performance of the AZ catalyst is beneficial in applications where installation 2 to 6 feet from the engine is required. Temperatures as low as 215oC are required for chemical reactivity.

AZ products do not increase toxic NOX. Unwanted chemical reactions are prevented by catalyst and washcoat formulation chemistry.

ECS Crankcase Ventilation Filter System™

The ECS CCV Crankcase ventilation Filter Systems offer an effective solution to reduce crankcase emissions. The Racor CCV system removes crankcase emissions, providing protection for your engine and the environment. Keeps engine compartments and components clean. Prevents clogging of engine intakes, turbochargers and intercoolers

- Improves reliability and of diesel engines
- More efficient than other products available on the market
- Reduces environmental pollution from crankcase emissions
- "Green" element is completely burnable and crushable
- Reduces smoke and odor in the immediate environment
- Installed as original equipment by manufacturers worldwide

AZ Heavy Duty Purifiers™

AZ Heavy Duty Purifiers consist of a removable catalyst center body and separate inlet and outlet cones to allow easy incorporation into a variety of exhaust pipe sizes. They are combined using machined flanges and sealing gaskets held together with quick release v-band clamps.

The AZ Heavy Duty Purifier is ideal in applications where catalyst removal is required to allow vehicle or engine maintenance, as well as engine-out smoke measurements:
Urban buses
School buses
Highway trucks

The AZ Purifier is also ideal for applications where there is insufficient room for the installation of an integrated converter muffler. The AZ HD Purifier can also be combined with DMS and DMXS-II add-on silencers (see catalog).

AZ Heavy Duty Purimufflers™

Often purifiers cannot be used due to space restrictions or exhaust backpressure limitations. For these applications, Engine Control Systems offers a wide variety of integrated catalytic mufflers. AZ Heavy Duty Purimufflers offer extremely rugged construction with equivalent or better noise attenuation and low exhaust backpressure.

Severe Duty AZ Purifiers and Purimufflers

Often Heavy Duty is not enough, Severe Duty AZ Purifiers and Severe Duty AZ Purimuffler designs are ideal for demanding applications in:
Mining and tunneling
Earth moving and construction
Power generation and heavy industrial applications

The Severe Duty AZ family integrates the AZ catalyst into an insulated double wall, heavy 14 and 16 gauge, 304 series stainless steel design. The Purimuffler option combines these features with catalytic muffler that affords 12-15 dB(A) sound attenuation and low exhaust backpressures (typically less than 20" of water).

The insulated skin serves to maximize catalyst performance while reducing external skin temperatures. This results in reduced heat radiation which can be beneficial on equipment with electronically controlled engines, hydraulic lines, or operators and other workers in close proximity. AZ Severe Duty Purifiers and Purimufflers are available with slip fit or flanged inlet / outlets.

Why Choose the ECS AZ Product Family?

Demanding applications require products that outperform general aftermarket grade diesel purifiers. The AZ product family provides superior emissions control and sound attenuation with lower exhaust restriction over the broadest range of diesel engine applications.

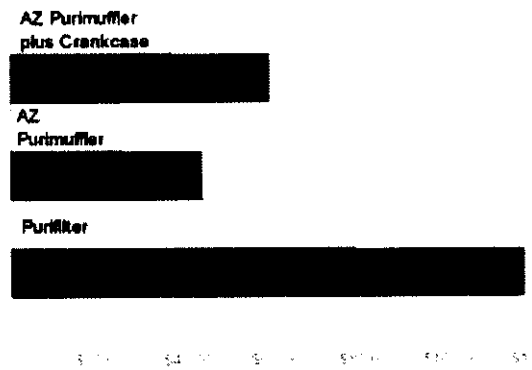
Our products are tested and retested in our in-house testing facility as well as at outside testing labs. Our list of verifications, approvals, and certifications is always growing. Talk to your customer service representative for details.

The varying quality of exhaust aftertreatment products in the marketplace is influenced by numerous factors:
Catalyst technology
Design and manufacturing process,
Facilities and people.

Engine Control Systems products are designed to offer ease of installation, peak performance, long life, and a proven service history. Each product is manufactured in an ISO 9001 approved facility.

Engine Control Systems products have been proven over the last 20 years in the most severe conditions, including underground and open pit mining, tunneling, stationary power generation, urban and school bus routes as well as other industrial applications. Our products help to ensure air quality, productivity, and more importantly, health and safety.

AZ Performance



EPA Verified Results	AZ Purimuffler plus Crankcase	Other DOC plus crankcase	AZ Purimuffler	Other DOC	Purifilter	Other DPF
PM Reduction	40%*	25-33%	40%	20-26%	90%	60%
Cost without installation**	$1700	$1700	$1000	$1000	$7000	$7000
Cost per % PM Reduction	$36.17	$58.62	$25.00	$43.48	$77.78	$116.67

*Not yet verified
** Actual costs will vary depending on unit configuration and sizing

Engine Control Systems

CUSTOMER SERVICE LINES
North America

Canada and Eastern USA
Tel: 1-800-661-9963
Tel: 905-707-7746
Fax: 905-707-7686

Western USA
Tel: 1-800-331-9247
Fax: 1-775-827-1670

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Engine Control Systems Limited
(WORLD HEADQUARTERS)
83 Commerce Valley Drive East
Thornhill, Ontario, L3T 7T3

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(EUROPEAN HEADQUARTERS)
Box 9015, Agnesfridsvagen, 184
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Tel: +46 (40) 670 1550
Fax: +46 (40) 210 335

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ecseurope@enginecontrolsystems.com

AZ DOC's are a Verified Emissions Reduction Technology

- ✓ *Verified by the California Air Resources Board*
  - ✓ *Level 1 PM reduction for off-road*
  - ✓ *Level 1 PM reduction for specific on-road vehicles*
  - ✓ *Level 2 PM reduction for off-road vehicles using PuriNOx fuel*
- ✓ *Verified under US EPA urban bus retrofit/rebuild program*
- ✓ *Certified by the US EPA Voluntary Retrofit program for two stroke and four stoke diesel engines.*
- ✓ *Verified by the US EPA for 40% PM reduction for specific on-road engines*
- ✓ *Certified by the Sweden Environmental Zones program*
- ✓ *Approved under the UK Energy Saving Trust TransportEnergy CleanUp Programme*

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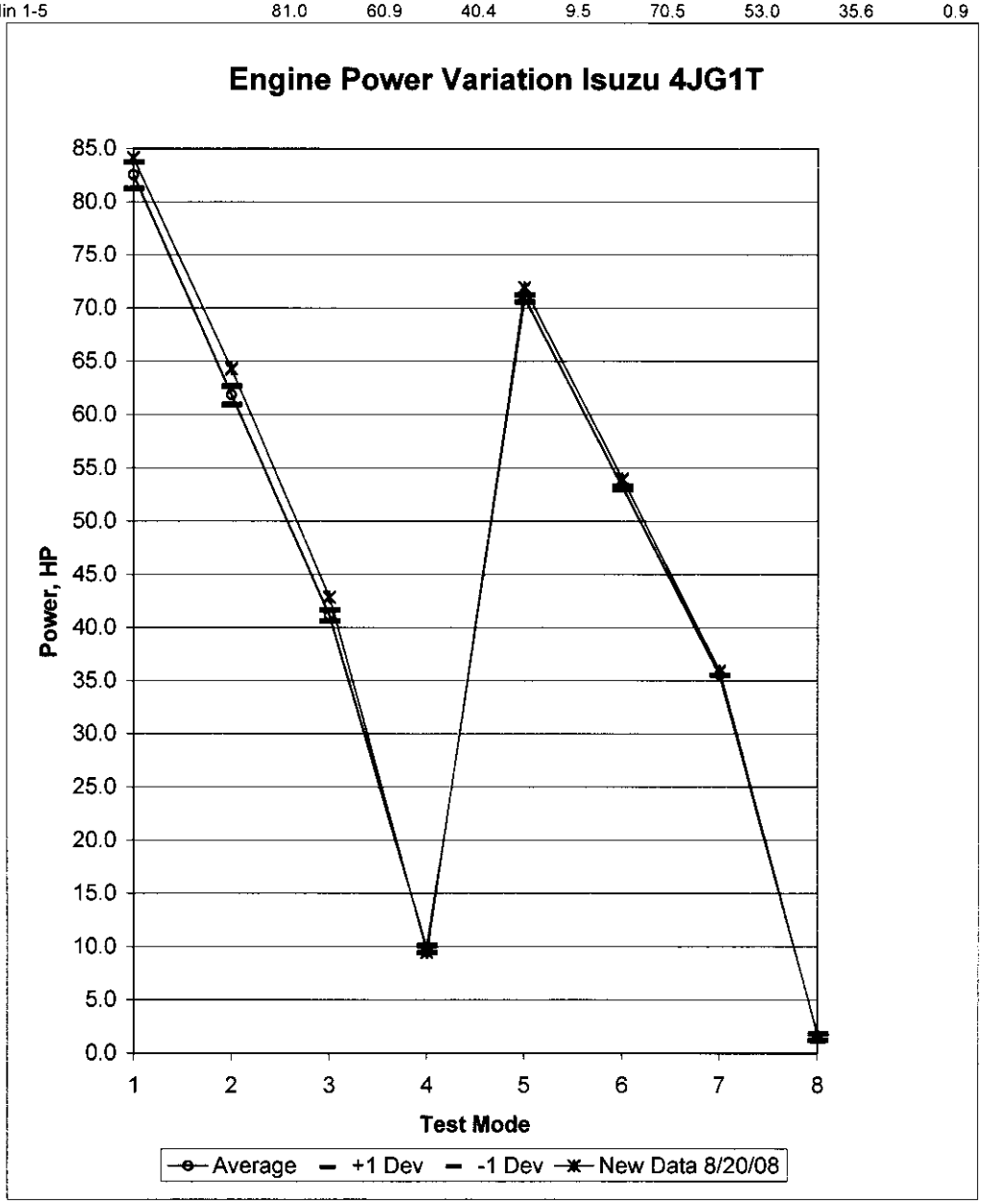
Appendix B:

Isuzu 4JG1T-MA Historic Baseline Data

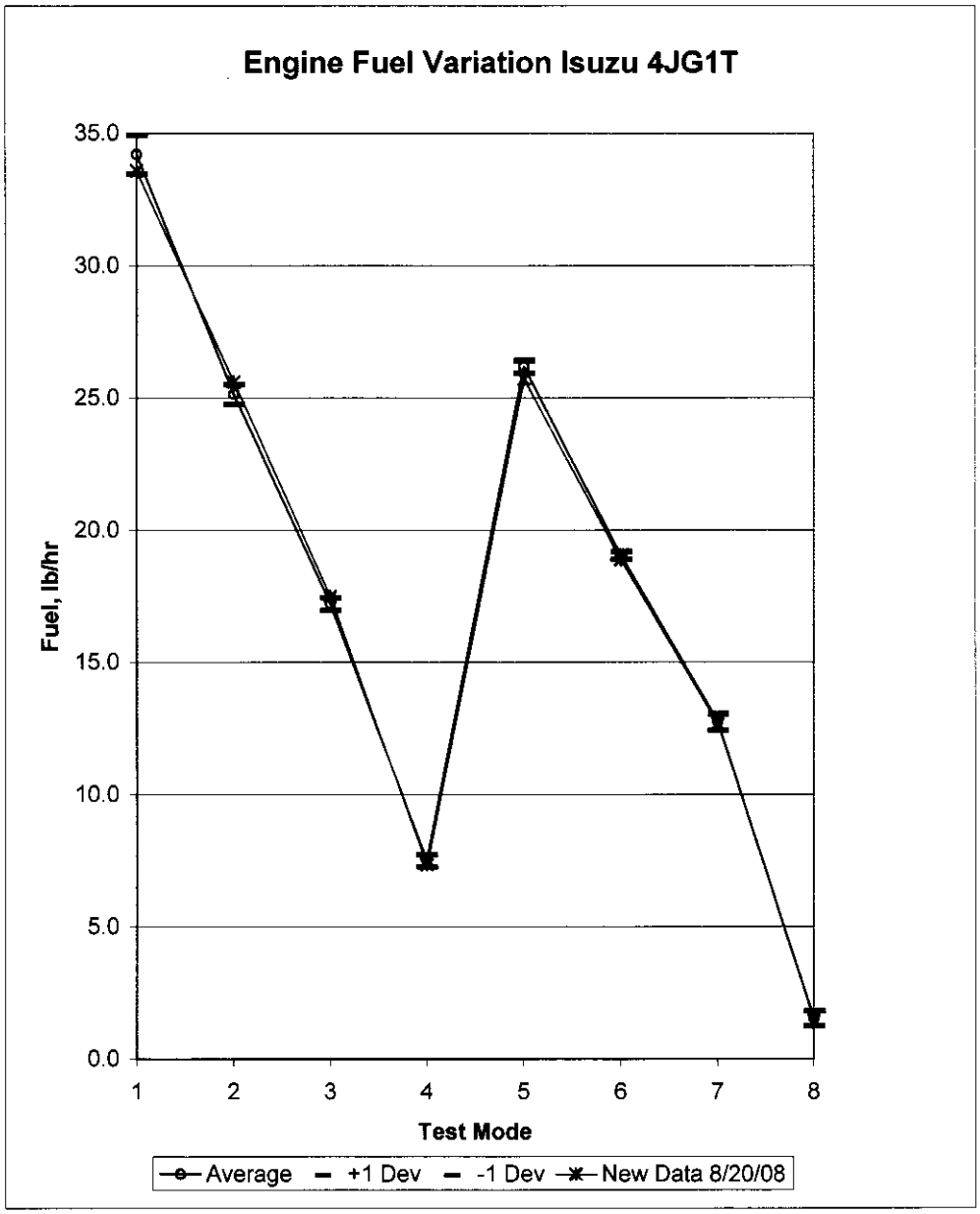
Isuzu 4JG1T Engine
Historical Data for Engine Baseline between 8/05 and 8/08
Test Fuel: D-2 LSD (not same batch for all tests)

Engine Power, HP		Test Modes							
Test #	Test Dates	1	2	3	4	5	6	7	8
1	8/4/2005	83.1	62.4	41.5	10.3	71.0	53.0	35.6	1.7
2	9/9/2005	81.0	61.0	40.4	10.1	70.5	53.2	35.6	1.7
3	9/14/2005	81.5	60.9	40.9	9.7	70.9	53.0	35.6	1.7
4	9/5/2006	83.4	62.3	41.7	9.5	71.2	53.4	35.6	1.8
5	9/6/2006	83.8	62.8	41.5	9.5	71.3	53.4	35.6	0.9
6	8/20/2008	84.2	64.3	42.9	9.5	72.0	54.0	35.9	1.5
Average 1-5		**82.6**	**61.9**	**41.2**	**9.8**	**71.0**	**53.2**	**35.6**	**1.6**
St, Dev 1-5		**1.246**	**0.876**	**0.520**	**0.360**	**0.323**	**0.195**	**0.020**	**0.348**
+1 Dev		**83.8**	**62.8**	**41.7**	**10.2**	**71.3**	**53.4**	**35.6**	**1.9**
-1 Dev		**81.3**	**61.0**	**40.7**	**9.5**	**70.7**	**53.0**	**35.6**	**1.2**
Max 1-5		83.8	62.8	41.7	10.3	71.3	53.4	35.6	1.8
Min 1-5		81.0	60.9	40.4	9.5	70.5	53.0	35.6	0.9



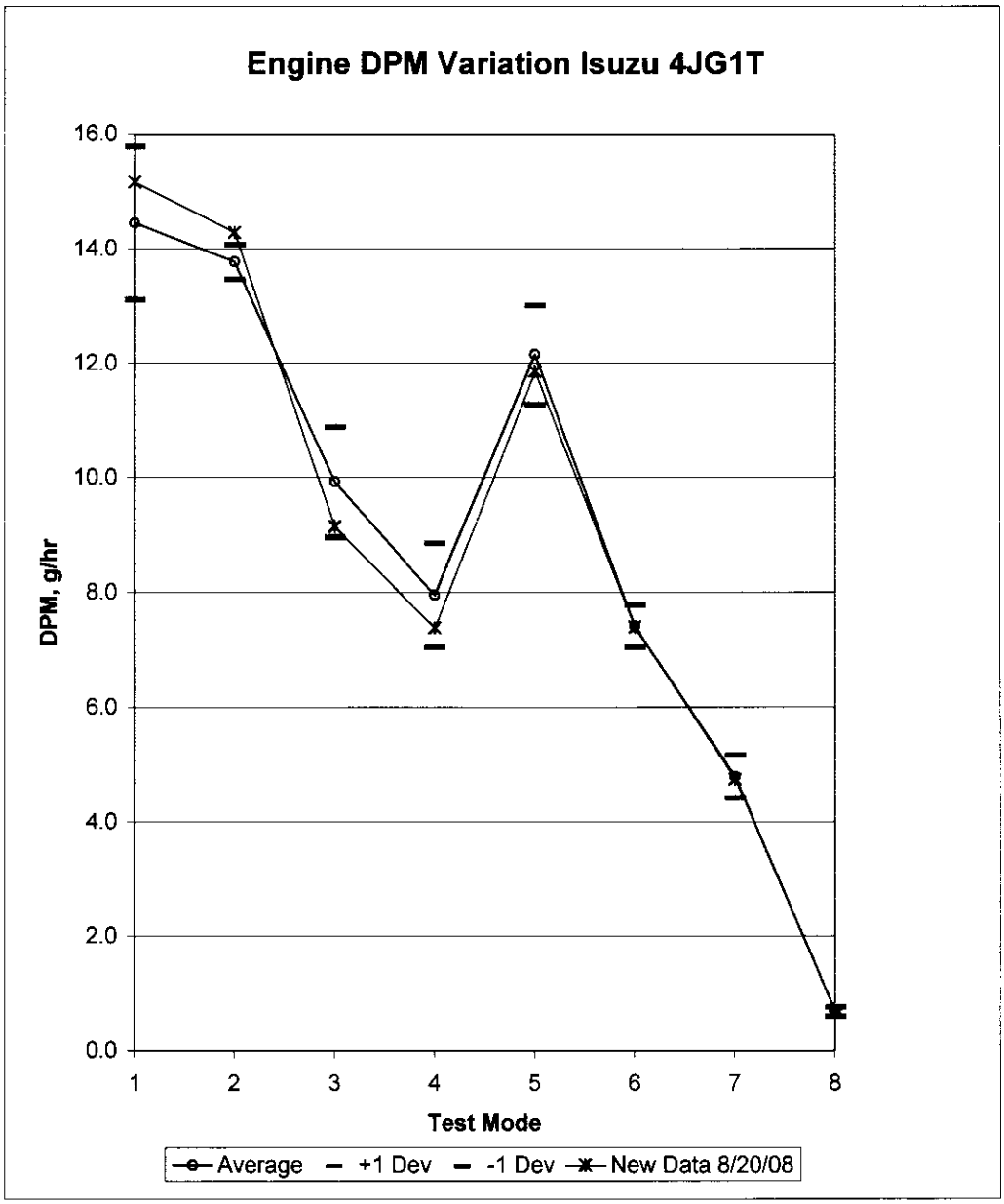
Isuzu 4JG1T Engine
Historical Data for Engine Baseline between 8/05 and 8/08
Test Fuel: D-2 LSD (not same batch for all tests)

Engine Fuel, lb/hr		Test Modes							
Test #	Test Dates	1	2	3	4	5	6	7	8
1	8/4/2005	34.1	25.4	17.3	7.5	26.2	19.0	12.8	1.6
2	9/9/2005	33.4	25.0	17.1	7.6	25.8	19.1	12.9	1.5
3	9/14/2005	33.8	25.1	17.2	7.3	26.4	19.2	13.1	1.2
4	9/5/2006	35.3	24.7	17.0	7.9	26.4	18.9	12.3	2.0
5	9/6/2006	34.4	25.6	17.6	7.3	26.1	19.2	12.8	1.5
6	8/20/2008	33.6	25.6	17.5	7.4	25.7	18.9	12.7	1.4
Average 1-5		**34.2**	**25.1**	**17.2**	**7.5**	**26.2**	**19.1**	**12.8**	**1.5**
St, Dev 1-5		**0.722**	**0.367**	**0.237**	**0.234**	**0.239**	**0.154**	**0.301**	**0.294**
+1 Dev		**34.9**	**25.5**	**17.5**	**7.8**	**26.4**	**19.2**	**13.1**	**1.8**
-1 Dev		**33.5**	**24.8**	**17.0**	**7.3**	**26.0**	**18.9**	**12.5**	**1.3**
Max 1-5		35.3	25.6	17.6	7.9	26.4	19.2	13.1	2.0
Min 1-5		33.4	24.7	17.0	7.3	25.8	18.9	12.3	1.2



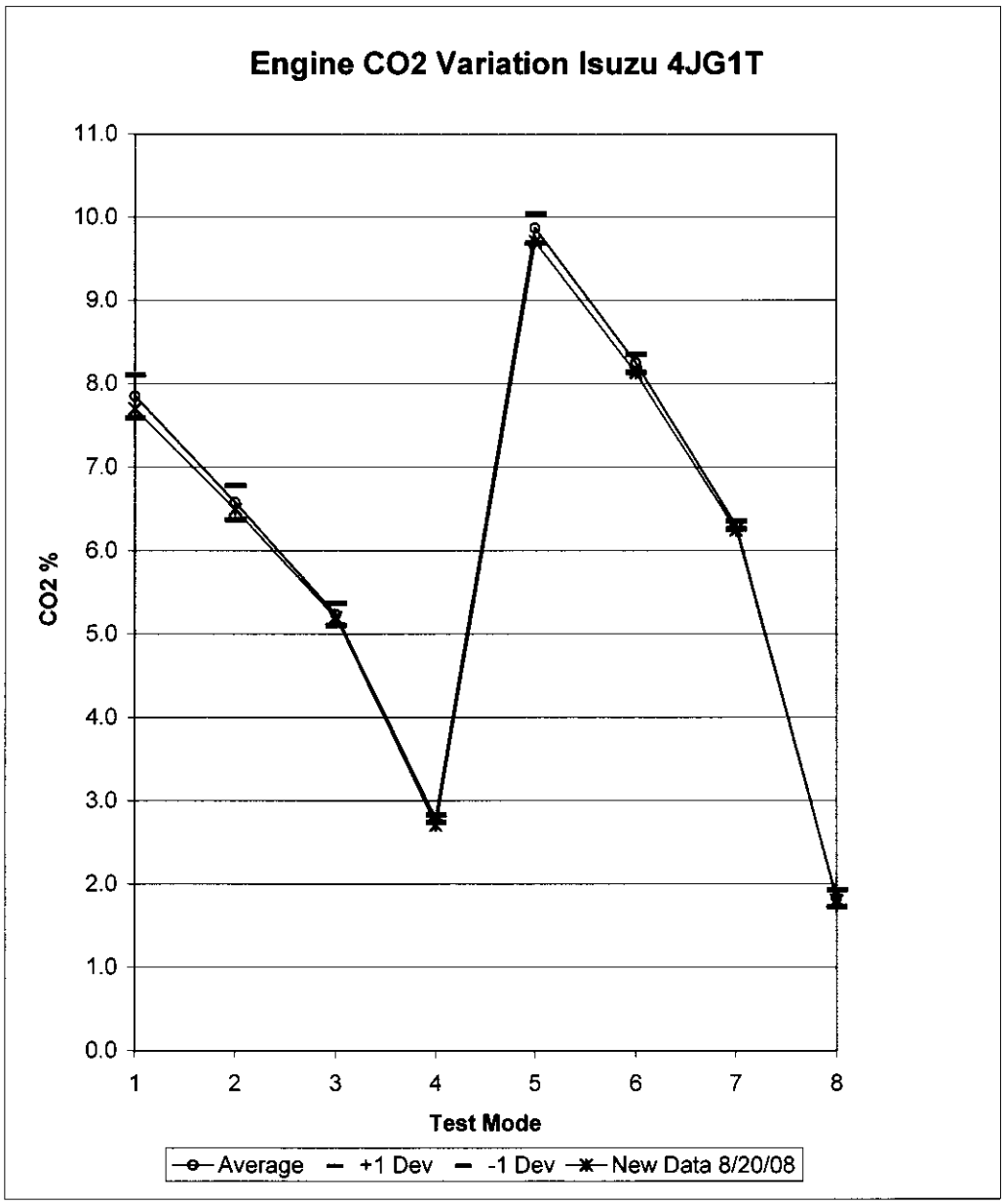
Isuzu 4JG1T Engine
Historical Data for Engine Baseline between 8/05 and 8/08
Test Fuel: D-2 LSD (not same batch for all tests)

DPM Emissions, g/hr		Test Modes								DPM
Test #	Test Dates	1	2	3	4	5	6	7	8	Weighted Average
1	8/4/2005	13.5	13.6	8.9	6.8	13.5	7.1	4.2	0.6	8.638
2	9/9/2005	16.6	13.6	9.1	7.3	11.7	7.4	5.1	0.6	9.144
3	9/14/2005	13.9	13.7	9.8	8.0	11.2	7.3	4.8	0.6	8.835
4	9/5/2006	14.8	14.3	11.0	8.9	12.5	7.2	4.8	0.7	9.47
5	9/6/2006	13.5	13.8	10.8	8.8	11.8	8.0	5.1	0.8	9.211
6	8/20/2008	15.2	14.3	9.2	7.4	11.9	7.4	4.7	0.7	9.031
Average 1-5		**14.5**	**13.8**	**9.9**	**8.0**	**12.2**	**7.4**	**4.8**	**0.7**	**9.1**
St, Dev 1-5		**1.333**	**0.308**	**0.960**	**0.908**	**0.862**	**0.366**	**0.372**	**0.079**	**0.292**
+1 Dev		**15.8**	**14.1**	**10.9**	**8.9**	**13.0**	**7.8**	**5.2**	**0.8**	**9.3**
-1 Dev		**13.1**	**13.5**	**9.0**	**7.1**	**11.3**	**7.0**	**4.4**	**0.6**	**8.8**
Max 1-5		16.6	14.3	11.0	8.9	13.5	8.0	5.1	0.8	**9.5**
Min 1-5		13.5	13.6	8.9	6.8	11.2	7.1	4.2	0.6	**8.6**



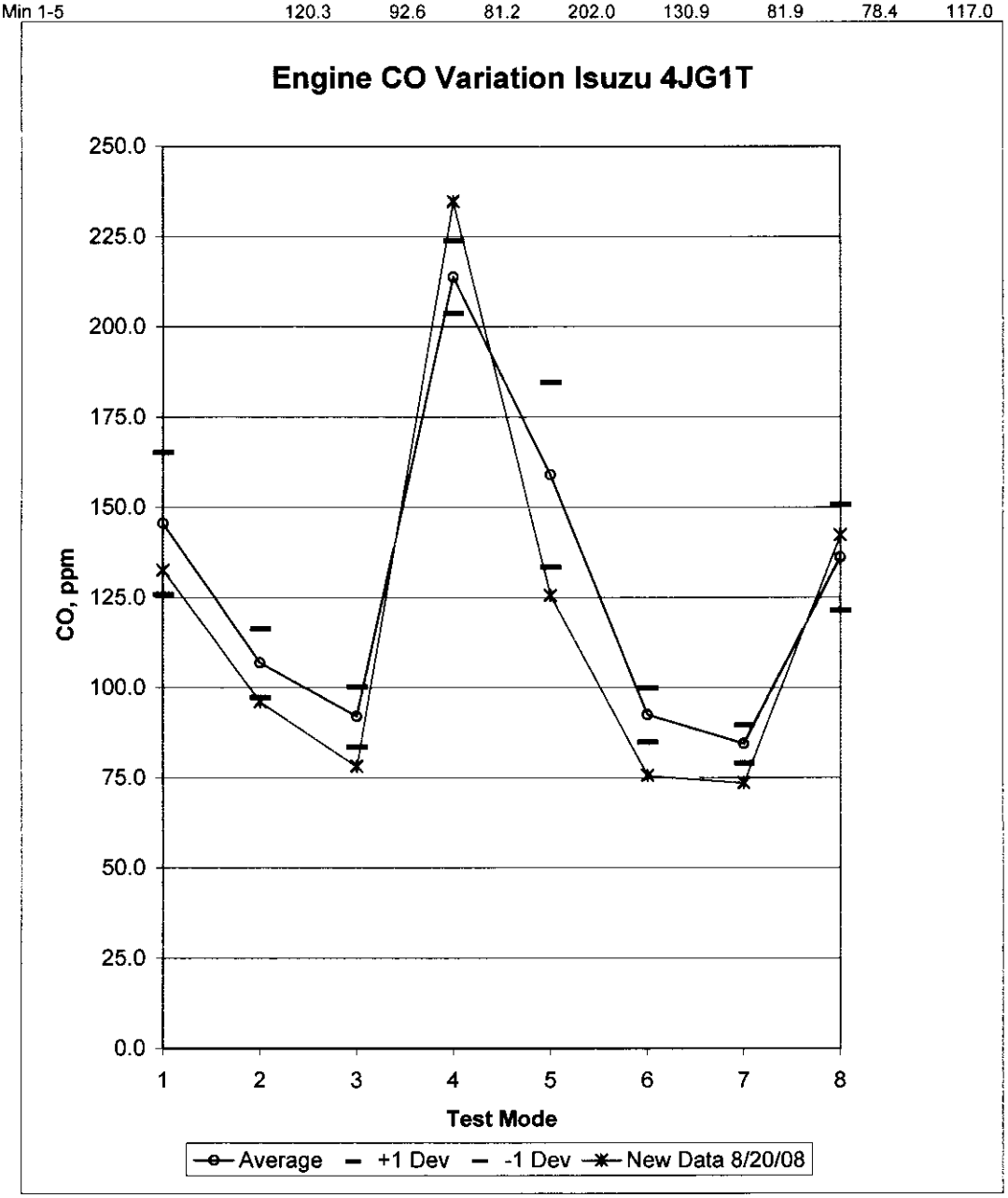
Isuzu 4JG1T Engine
Historical Data for Engine Baseline between 8/05 and 8/08
Test Fuel: D-2 LSD (not same batch for all tests)

CO2 Emissions, %		Test Modes							
Test #	Test Dates	1	2	3	4	5	6	7	8
1	8/4/2005	8.0	6.7	5.3	2.9	10.0	8.3	6.4	1.9
2	9/9/2005	7.6	6.4	5.1	2.8	9.7	8.2	6.3	1.9
3	9/14/2005	7.6	6.4	5.1	2.7	9.7	8.1	6.2	1.9
4	9/5/2006	8.1	6.7	5.3	2.8	10.0	8.3	6.3	1.9
5	9/6/2006	8.1	6.8	5.4	2.8	10.0	8.3	6.4	1.7
6	8/20/2008	7.7	6.5	5.2	2.7	9.7	8.1	6.3	1.8
Average 1-5		**7.9**	**6.6**	**5.2**	**2.8**	**9.9**	**8.3**	**6.3**	**1.8**
St, Dev 1-5		**0.258**	**0.201**	**0.130**	**0.047**	**0.178**	**0.106**	**0.047**	**0.098**
+1 Dev		**8.1**	**6.8**	**5.4**	**2.8**	**10.1**	**8.4**	**6.4**	**1.9**
-1 Dev		**7.6**	**6.4**	**5.1**	**2.7**	**9.7**	**8.1**	**6.3**	**1.7**
Max 1-5		8.1	6.8	5.4	2.9	10.0	8.3	6.4	1.9
Min 1-5		7.6	6.4	5.1	2.7	9.7	8.1	6.2	1.7



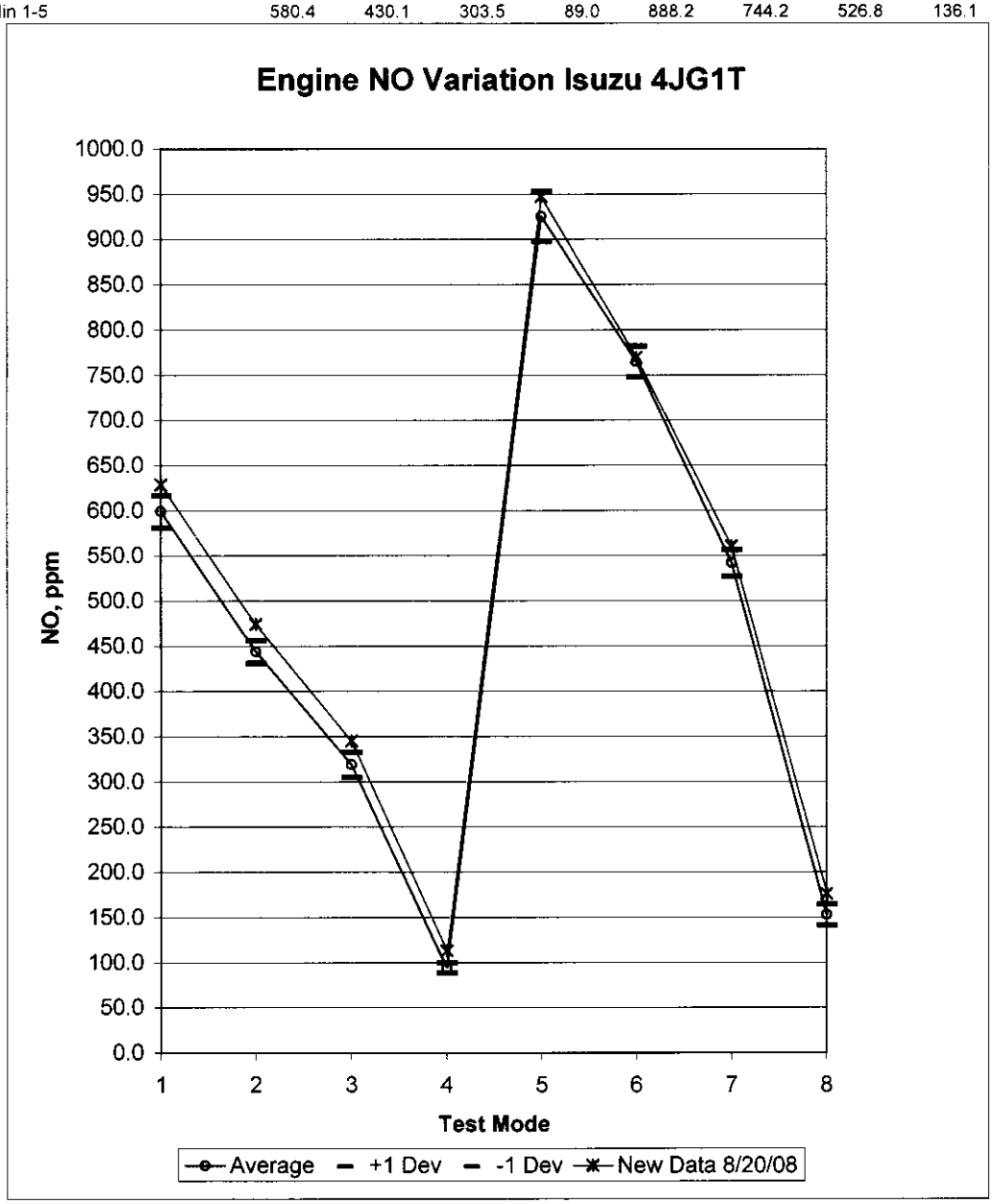
Isuzu 4JG1T Engine
Historical Data for Engine Baseline between 8/05 and 8/08
Test Fuel: D-2 LSD (not same batch for all tests)

CO Emissions, ppm		Test Modes							
Test #	Test Dates	1	2	3	4	5	6	7	8
1	8/4/2005	141.4	106.0	89.9	202.0	179.5	90.1	82.3	134.8
2	9/9/2005	120.3	92.6	81.2	227.6	130.9	81.9	78.4	151.5
3	9/14/2005	136.5	105.0	89.0	219.5	131.3	91.5	81.7	149.8
4	9/5/2006	169.7	116.3	102.5	213.2	174.4	98.3	90.0	128.3
5	9/6/2006	160.3	114.8	98.0	207.1	179.2	101.1	90.0	117.0
6	8/20/2008	132.7	96.2	78.2	234.8	125.6	75.7	73.7	142.3
Average 1-5		**145.6**	**106.9**	**92.1**	**213.9**	**159.1**	**92.6**	**84.5**	**136.3**
St, Dev 1-5		**19.633**	**9.469**	**8.332**	**10.065**	**25.610**	**7.501**	**5.246**	**14.609**
+1 Dev		**165.3**	**116.4**	**100.4**	**224.0**	**184.7**	**100.1**	**89.8**	**150.9**
-1 Dev		**126.0**	**97.5**	**83.8**	**203.8**	**133.5**	**85.1**	**79.3**	**121.7**
Max 1-5		169.7	116.3	102.5	227.6	179.5	101.1	90.0	151.5
Min 1-5		120.3	92.6	81.2	202.0	130.9	81.9	78.4	117.0



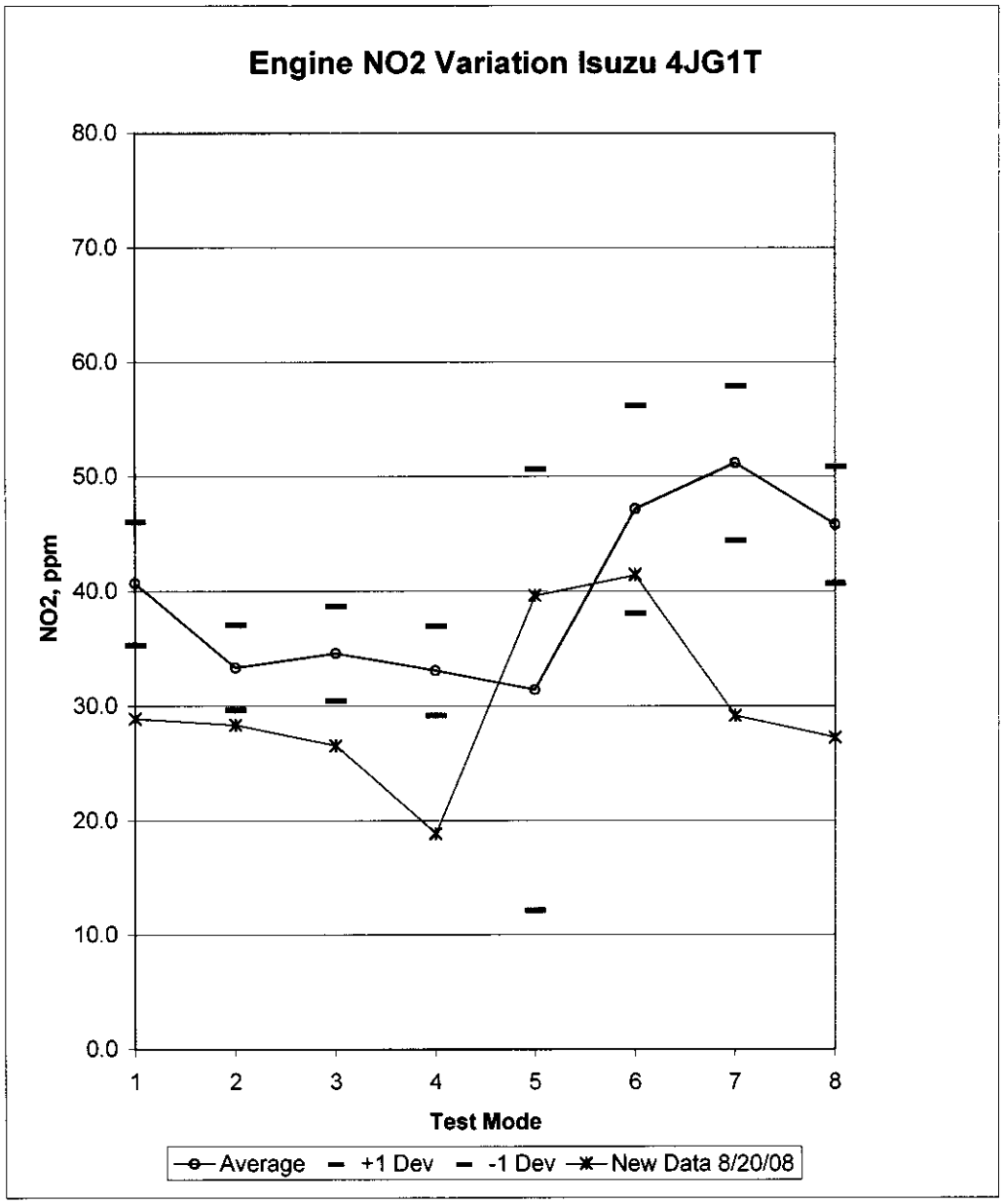
Isuzu 4JG1T Engine
Historical Data for Engine Baseline between 8/05 and 8/08
Test Fuel: D-2 LSD (not same batch for all tests)

NO Emissions, ppm		Test Modes							
Test #	Test Dates	1	2	3	4	5	6	7	8
1	8/4/2005	619.4	453.6	331.6	103.4	948.5	779.8	558.5	162.8
2	9/9/2005	582.1	432.9	305.1	89.2	888.2	744.2	531.1	153.1
3	9/14/2005	580.4	430.1	303.5	89.0	904.2	748.0	526.8	148.9
4	9/5/2006	601.7	448.6	327.4	95.7	947.5	776.5	539.3	165.0
5	9/6/2006	613.7	457.5	329.4	94.9	940.0	775.8	557.5	136.1
6	8/20/2008	628.9	474.8	345.7	113.2	947.5	769.6	560.7	176.1
Average 1-5		**599.5**	**444.5**	**319.4**	**94.4**	**925.7**	**764.9**	**542.6**	**153.2**
St, Dev 1-5		**17.814**	**12.388**	**13.853**	**5.909**	**27.691**	**17.227**	**14.723**	**11.647**
+1 Dev		**617.3**	**456.9**	**333.3**	**100.3**	**953.4**	**782.1**	**557.3**	**164.8**
-1 Dev		**581.6**	**432.1**	**305.5**	**88.5**	**898.0**	**747.6**	**527.9**	**141.5**
Max 1-5		619.4	457.5	331.6	103.4	948.5	779.8	558.5	165.0
Min 1-5		580.4	430.1	303.5	89.0	888.2	744.2	526.8	136.1



Isuzu 4JG1T Engine
Historical Data for Engine Baseline between 8/05 and 8/08
Test Fuel: D-2 LSD (not same batch for all tests)

NO2 Emissions, ppm		Test Modes							
Test #	Test Dates	1	2	3	4	5	6	7	8
1	8/4/2005	32.3	29.0	32.0	31.5	25.4	32.8	42.0	46.5
2	9/9/2005	43.4	39.2	40.7	39.5	60.6	50.1	55.7	51.3
3	9/14/2005	45.6	33.4	36.8	31.2	7.8	46.1	49.6	49.5
4	9/5/2006	43.5	32.9	32.8	29.4	27.4	57.5	59.6	43.0
5	9/6/2006	38.8	32.1	30.7	33.9	36.1	49.5	49.1	38.7
6	8/20/2008	28.9	28.4	26.6	18.9	39.7	41.5	29.2	27.3
Average 1-5		**40.7**	**33.3**	**34.6**	**33.1**	**31.5**	**47.2**	**51.2**	**45.8**
St, Dev 1-5		**5.338**	**3.706**	**4.116**	**3.894**	**19.255**	**9.050**	**6.732**	**5.071**
+1 Dev		**46.0**	**37.0**	**38.7**	**37.0**	**50.7**	**56.2**	**57.9**	**50.9**
-1 Dev		**35.4**	**29.6**	**30.5**	**29.2**	**12.2**	**38.1**	**44.5**	**40.8**
Max 1-5		45.6	39.2	40.7	39.5	60.6	57.5	59.6	51.3
Min 1-5		32.3	29.0	30.7	29.4	7.8	32.8	42.0	38.7



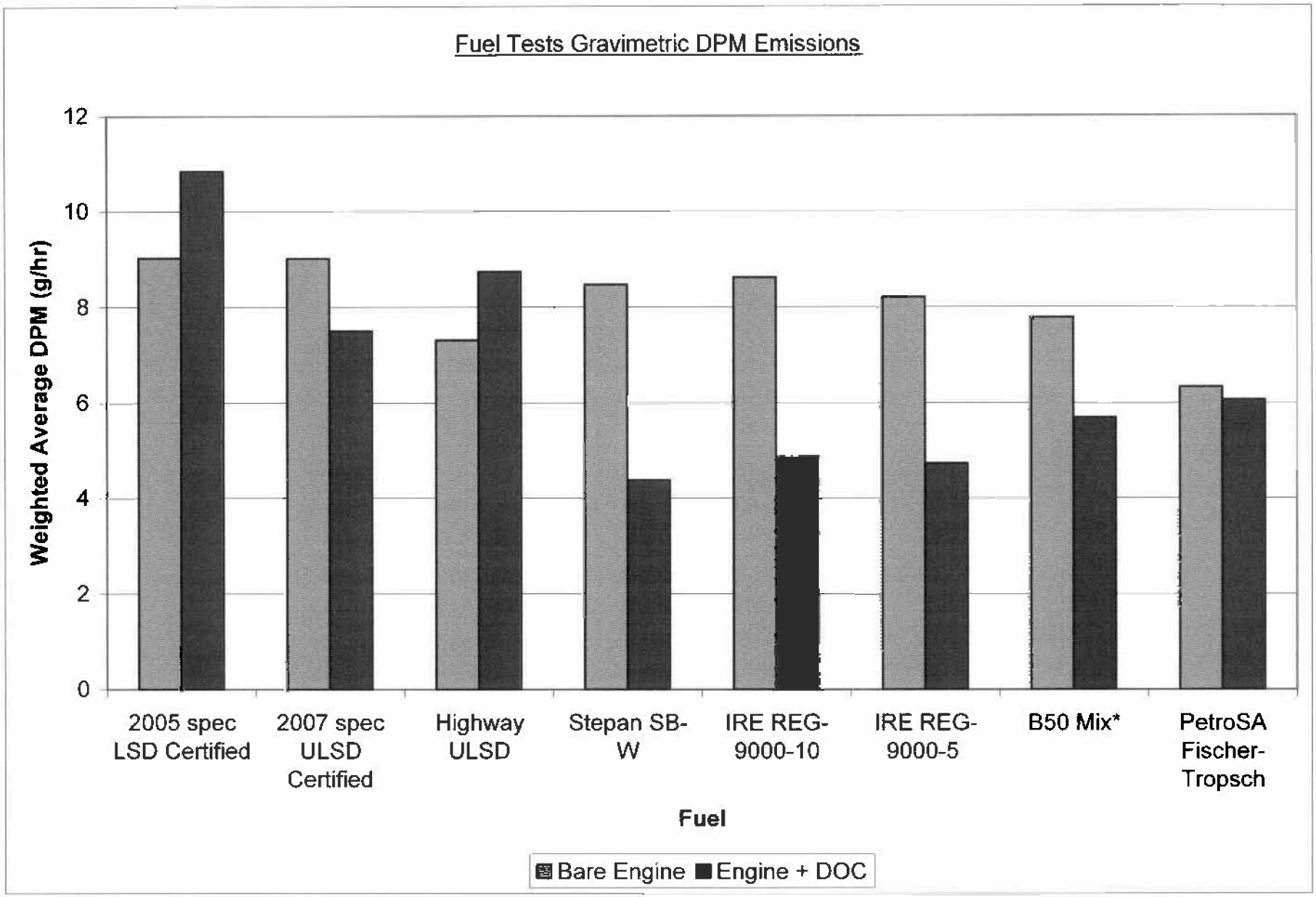
Appendix C-1:

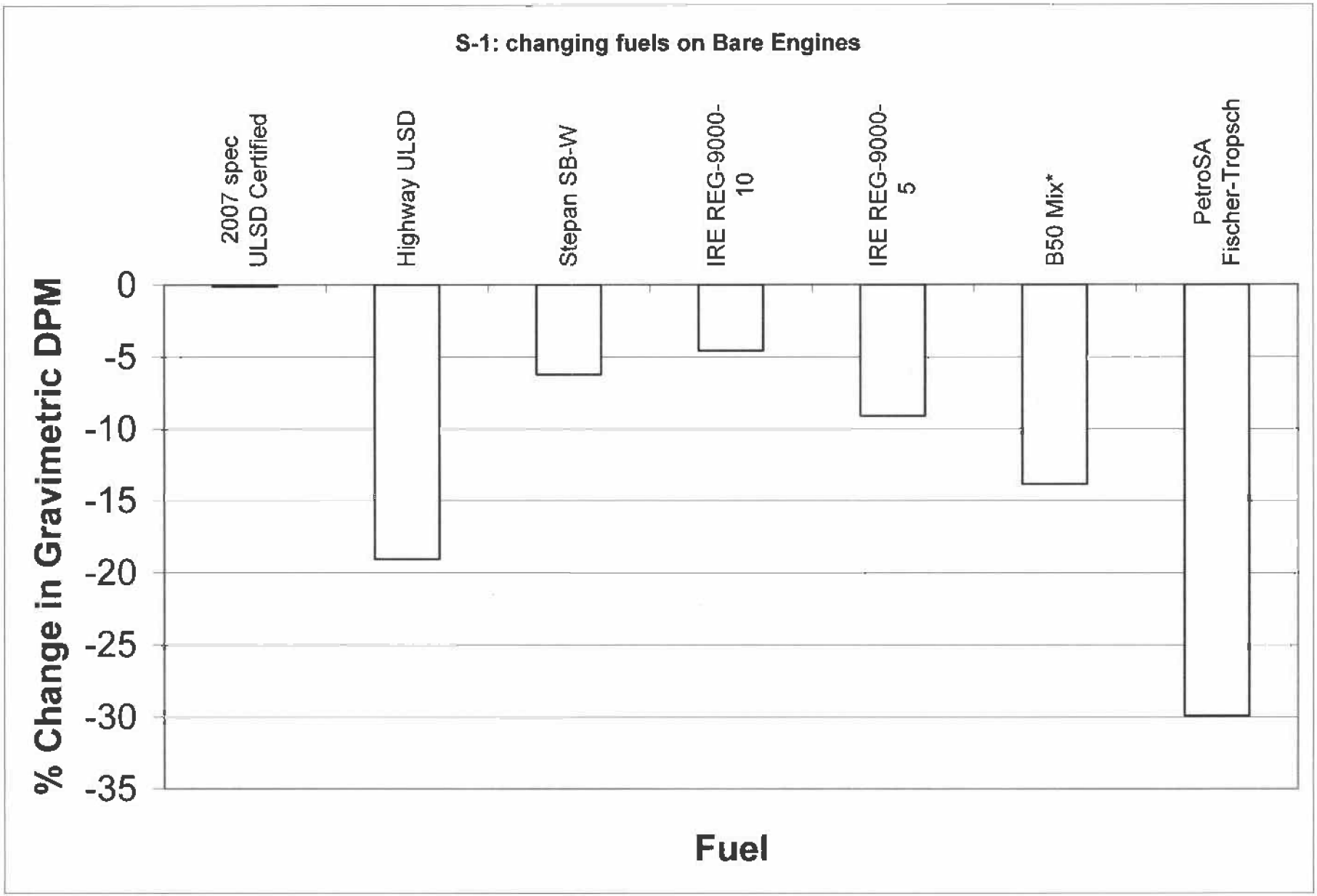
Analysis Tables and Charts

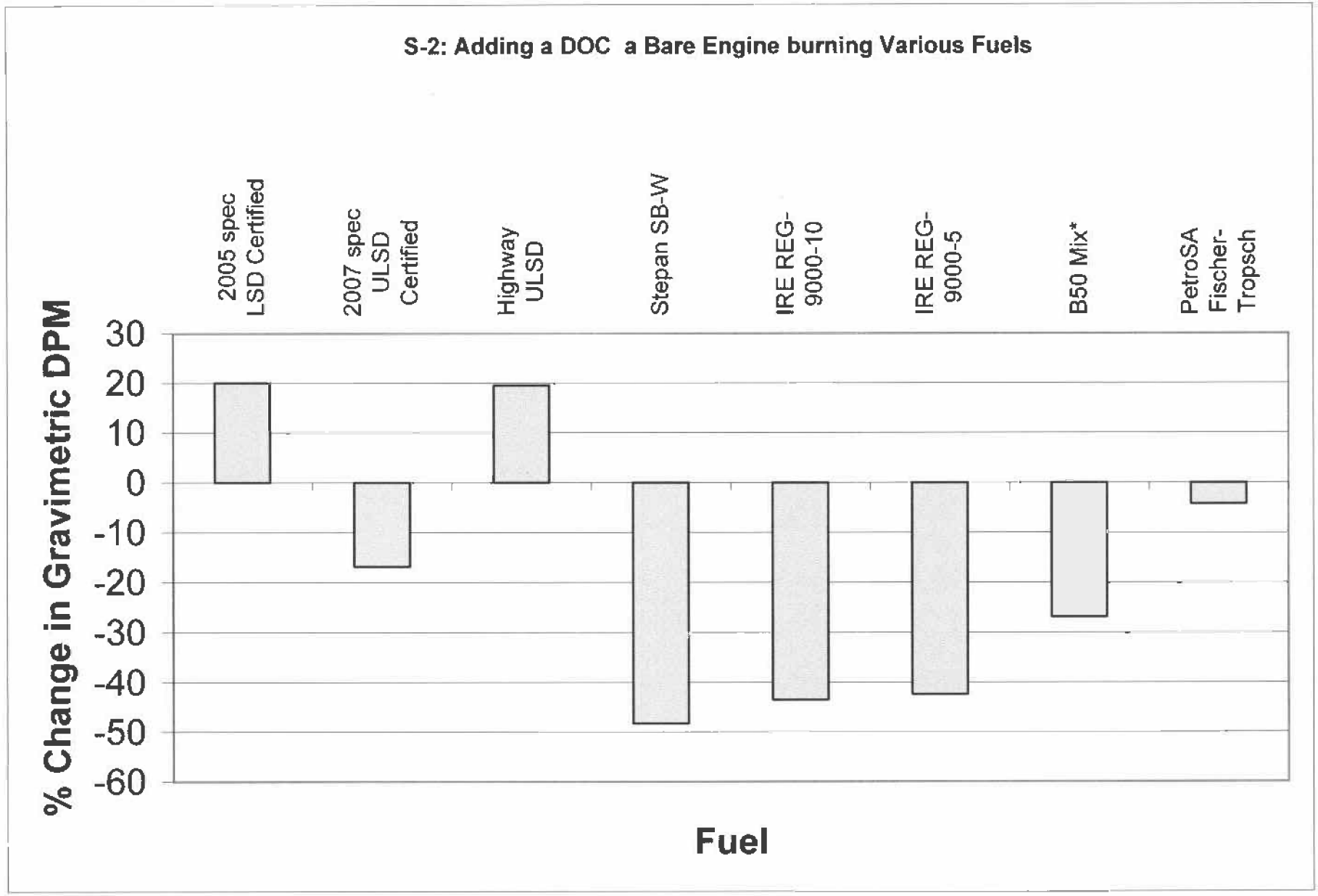
FUEL TESTING on Isuzu 4JG1T Diesel Engine
Gravimetric DPM Weighted Average Data

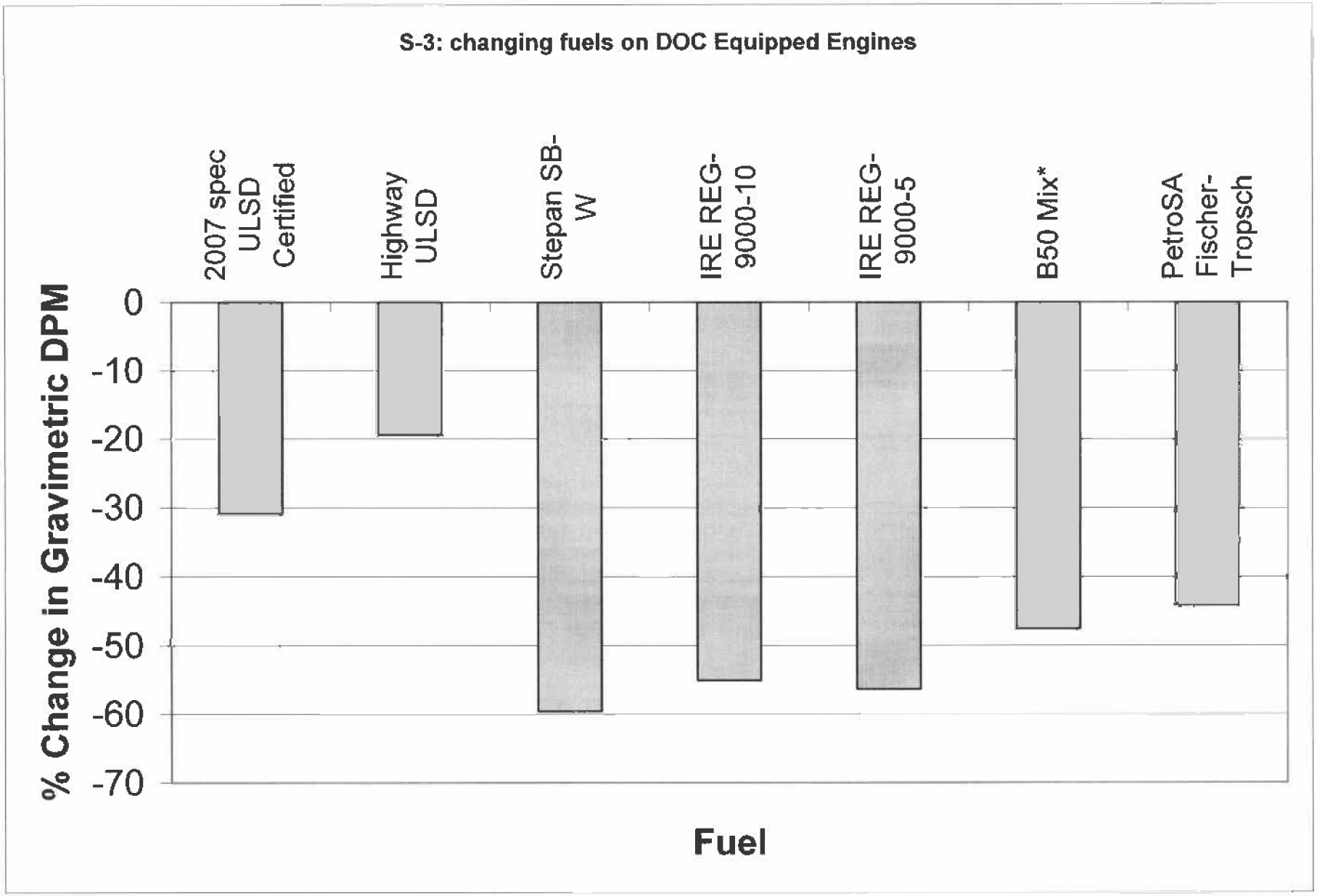
Fuel No.	FUEL		Bare Engine DPM (g/hr)		Engine +DOC DPM (g/hr)	% change w/ DOC	% change from LSD-Bare
1	2005 spec LSD Certified		9.03		10.84	20.0	20.0
2	2007 spec ULSD Certified		9.02		7.5	-16.9	-16.9
	% change fromLSD		-0.1		-30.8		
3	Highway ULSD		7.31		8.74	19.6	-3.2
	% change fromLSD		-19.0		-19.4		
4	Stepan SB-W	biodiesel	8.47		4.38	-48.3	-51.5
	% change fromLSD		-6.2		-59.6		
5	IRE REG-9000-10	biodiesel	8.62		4.87	-43.5	-46.1
	% change fromLSD		-4.5		-55.1		
6	IRE REG-9000-5	biodiesel	8.21		4.73	-42.4	-47.6
	% change fromLSD		-9.1		-56.4		
7	B50 Mix*		7.78		5.69	-26.9	-37.0
	% change fromLSD		-13.8		-47.5		
8	PetroSA Fischer-Tropsch	synthetic	6.33		6.06	-4.3	-32.9
	% change fromLSD		-29.9		-44.1		

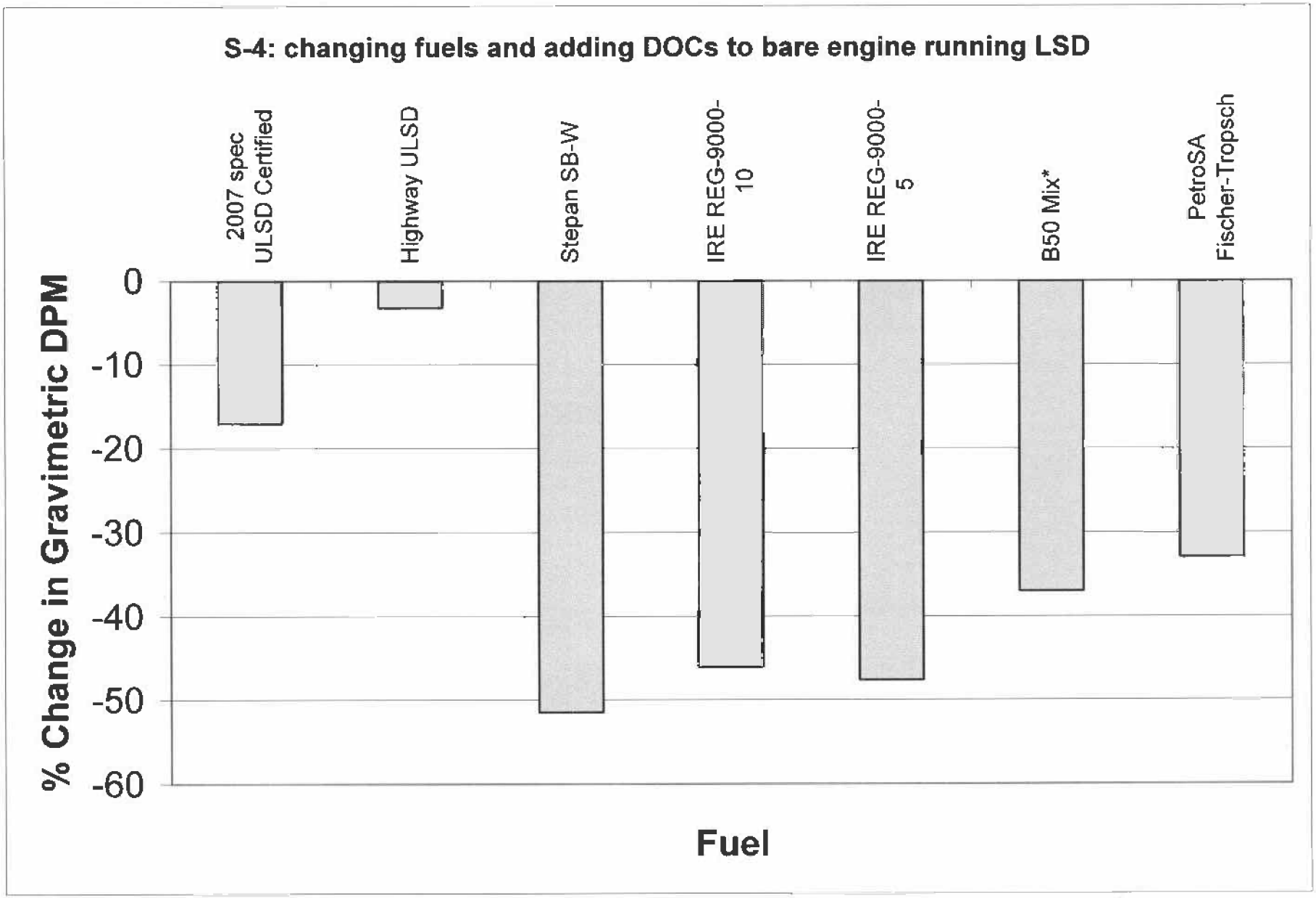
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD


Fuel Tests Gravimetric DPM Emissions
Weighted Average DPM (g/hr)
0
2
4
6
8
10
12
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
Fuel
Bare Engine
Engine + DOC


S-1: changing fuels on Bare Engines
% Change in Gravimetric DPM
0
-5
-10
-15
-20
-25
-30
-35
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
Fuel


S-2: Adding a DOC a Bare Engine burning Various Fuels
% Change in Gravimetric DPM
30
20
10
0
-10
-20
-30
-40
-50
-60
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
Fuel


S-3: changing fuels on DOC Equipped Engines
% Change in Gravimetric DPM
0
-10
-20
-30
-40
-50
-60
-70
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
Fuel


S-4: changing fuels and adding DOCs to bare engine running LSD
% Change in Gravimetric DPM
0
-10
-20
-30
-40
-50
-60
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
Fuel

Summary of Changes In Total Carbon Emissions of Engines using Various Fuels With and Without a DOC

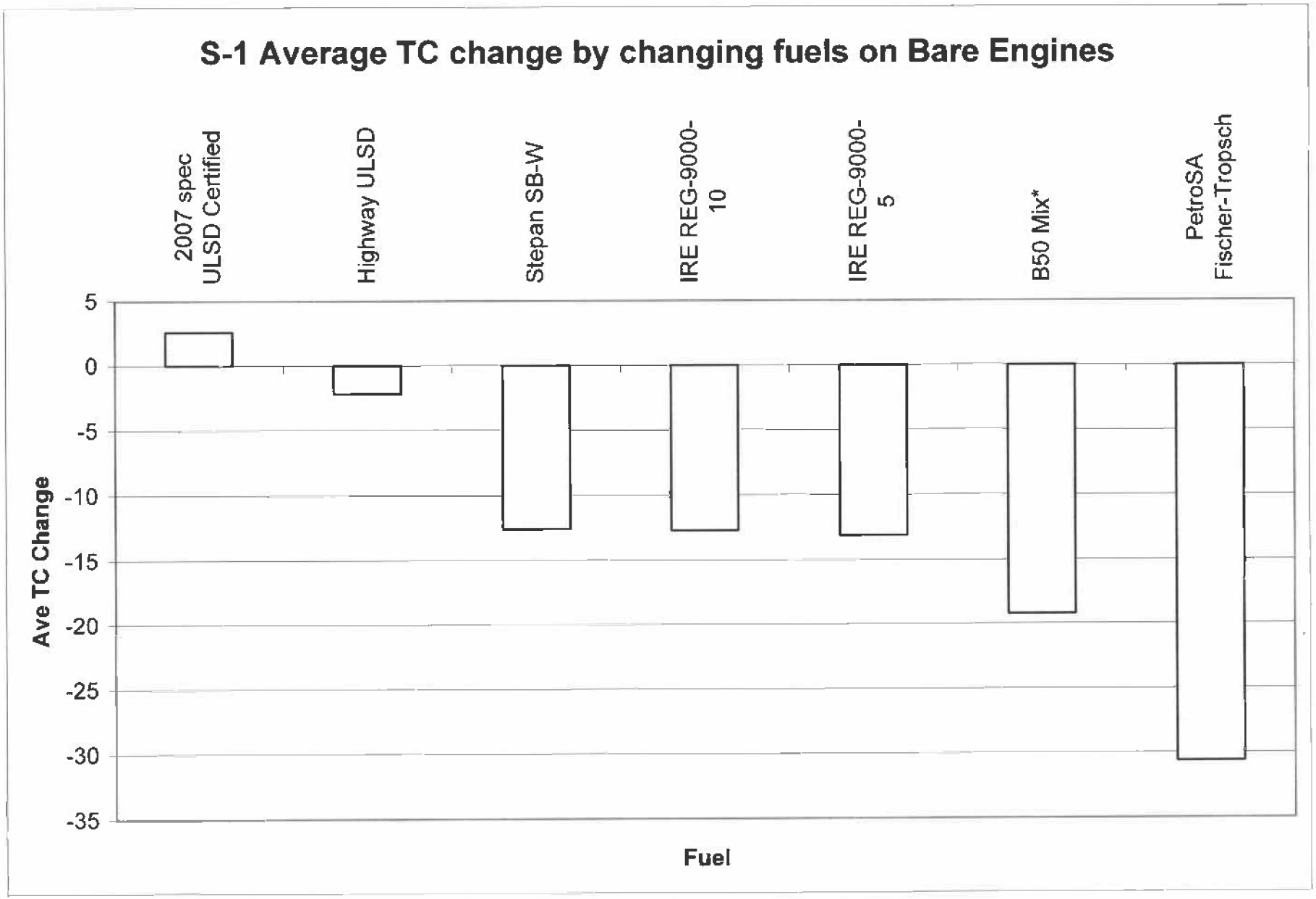
Base Fuel for Comparison 2005 spec Certified Low Sulfer Diesel (LSD) fuel

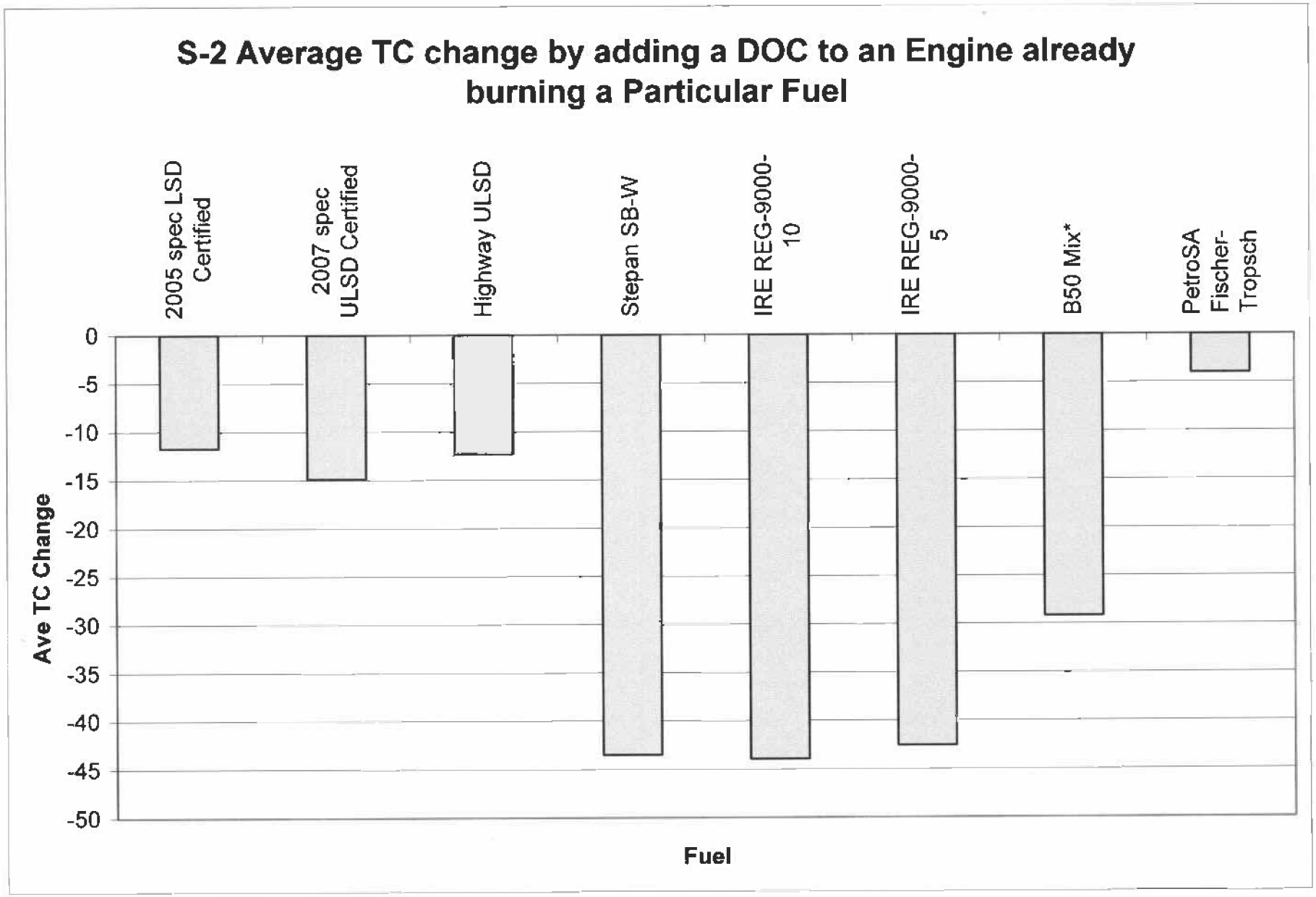
Fuels		Test Mode TC Data (TC (ug/m3)) 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
2005 spec LSD Certified	Bare	34085	36659	29085	27829	46089	33750	25799	8722	**29629.35**	
	with DOC	32037	36377	27320	22224	39857	32156	19604	2791	**26162.85**	
	% change in fuel with DOC	-6.0	-0.8	-6.1	-20.1	13.5	-4.7	-24.0	-68.0		-11.7
2007 spec ULSD Certified	Bare	36093	40713	29292	27498	44872	31874	27058	9002	**30395.2**	
	%change from LSD	5.9	11.1	0.7	-1.2	-2.6	-5.5	4.9	3.2		2.6
	with DOC	28978	34585	26754	18563	46600	32099	21312	3147	**25877**	
	% change in fuel with DOC	-19.7	-15.1	-8.7	-32.5	3.9	0.7	-21.2	-65.0		-14.9
	% change from LSD-DOC	-9.5	-4.9	-2.1	-16.5	16.9	-0.2	8.7	12.8		-1.1
	% change from LSD-BARE	-15.0	-5.7	-8.0	-33.3	1.1	-4.9	-17.4	-63.9		-12.7
Highway ULSD	Bare	33250	36890	26770	30546	52910	31191	18223	7777	**28990.05**	
	%change from LSD	-2.4	0.6	-8.0	9.8	14.8	-7.6	-29.4	-10.8		-2.2
	with DOC	32851	32501	25814	20752	45774	26764	18544	3752	**25421.1**	
	% change in fuel with DOC	-1.2	-11.8	-3.6	-32.1	-13.5	-14.2	1.8	-51.8		-12.3
	% change from LSD-DOC	2.5	-10.7	-5.5	-5.6	14.8	-18.8	-5.4	34.4		-2.8
	% change from LSD-BARE	-3.6	-11.3	-11.2	-25.4	-0.7	-20.7	-28.1	57.0		-14.2
Stepan SB-W	Bare	26009	33370	28968	22962	33070	26132	25556	**12564**	**25908.65**	
biodiesel	%change from LSD	-23.7	-9.0	-0.4	-17.5	-28.2	-22.6	-0.9	**44.0**		-12.6
	with DOC	15427	18546	14559	11509	25657	16898	13098	**4244**	**14632.6**	
	% change in fuel with DOC	-40.7	-44.4	-49.7	-49.9	-22.4	-35.3	-48.7	**-66.2**		-43.6
	% change from LSD-DOC	-51.8	-49.0	-46.7	-48.2	-35.6	-47.4	-33.2	**52.1**		-44.1
	% change from LSD-BARE	-54.7	-49.4	-49.9	-58.6	-44.3	-49.9	-49.2	**-51.3**		-50.6
IRE REG-9000-10	Bare	26400	32913	26760	23195	31956	27819	25107	14260	**25857.65**	
biodiesel	%change from LSD	-22.5	-10.2	-8.0	-16.7	-30.7	-17.6	-2.7	**63.5**		-12.7
	with DOC	17255	20590	14074	10906	22640	15881	11428	**4137**	**14489.4**	
	% change in fuel with DOC	-34.6	-37.4	-47.4	-53.0	-29.2	-42.9	-54.5	**-71.2**		-44.0
	% change from LSD-DOC	-46.1	-43.4	-48.5	-50.9	-43.2	-50.6	-41.7	**47.2**		-44.6
	% change from LSD-BARE	-49.4	-43.8	-51.6	-60.8	-50.8	-52.9	-55.7	**-52.9**		-51.1
IRE REG-9000-5	Bare	27204	35066	26563	24302	28546	25259	25355	13866	**25751.05**	
biodiesel	%change from LSD	-20.2	-4.3	-8.7	-12.7	-38.1	-25.2	-1.7	**59.0**		-13.1
	with DOC	16762	19392	15571	12384	24365	14892	12363	**4179**	**14786**	
	% change in fuel with DOC	-38.4	-44.7	-41.4	-49.0	-14.6	-41.0	-51.2	**-69.9**		-42.6
	% change from LSD-DOC	-47.7	-46.7	-43.0	-44.3	-38.9	-53.7	-36.9	**49.7**		-43.5
	% change from LSD-BARE	-50.8	-47.1	-46.5	-55.5	-47.1	-55.9	-52.1	**-52.1**		-50.1
B50 Mix*	Bare	26470	28770	23271	23259	31045	28225	22281	11163	**23932.1**	
	%change from LSD	-22.3	-21.5	-20.0	-16.4	-32.6	-16.4	-13.6	**28.0**		-19.2
	with DOC	20910	25130	16138	13583	26947	19245	11487	**3298**	**16947.6**	
	% change in fuel with DOC	-21.0	-12.7	-30.7	-41.6	-13.2	-31.8	-48.4	**-70.5**		-29.2
	% change from LSD-DOC	-34.7	-30.9	-40.9	-38.9	-32.4	-40.2	-41.4	**18.2**		-35.2
	% change from LSD-BARE	-38.7	-31.4	-44.5	-51.2	-41.5	-43.0	-55.5	**-62.2**		-42.0
PetroSA Fischer-Tropsch	Bare	32783	27222	17136	15926	31302	21900	14081	**4437**	**20557.6**	
synthetic	%change from LSD	-3.8	-25.7	-41.1	-42.8	-32.1	-35.1	-45.4	**-49.1**		-30.6
	with DOC	31094	25919	15380	16023	32773	23006	12785	**2776**	**19734.05**	
	% change in fuel with DOC	-5.2	-4.8	-10.2	0.6	4.7	5.1	-9.2	**-37.4**		-4.0
	% change from LSD-DOC	-2.9	-28.7	-43.7	-27.9	-1.8	-28.5	-34.8	**-0.6**		-24.6
	% change from LSD-BARE	-8.8	-29.3	-47.1	-42.4	-28.9	-31.8	-50.4	**-68.2**		-33.4

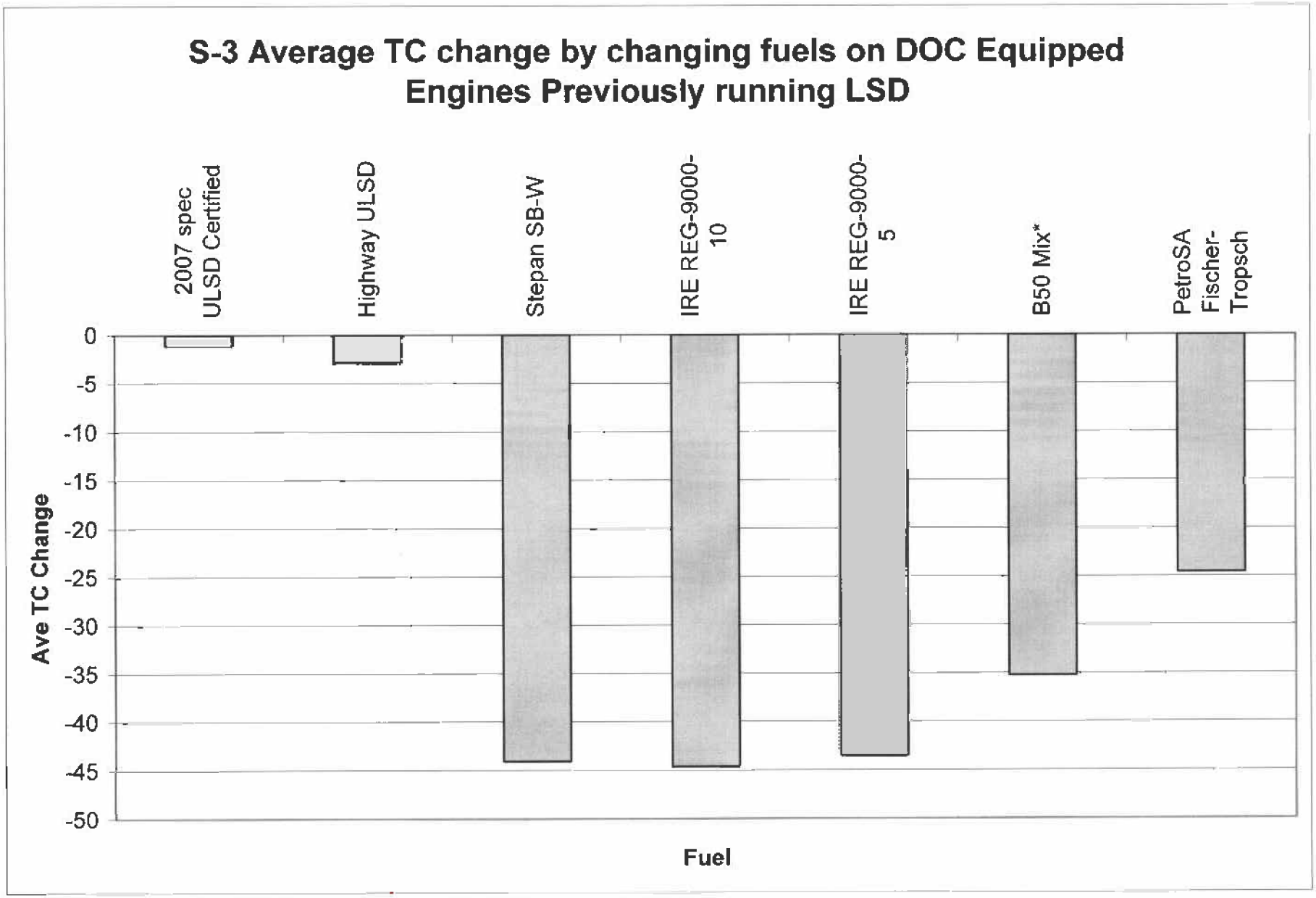
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

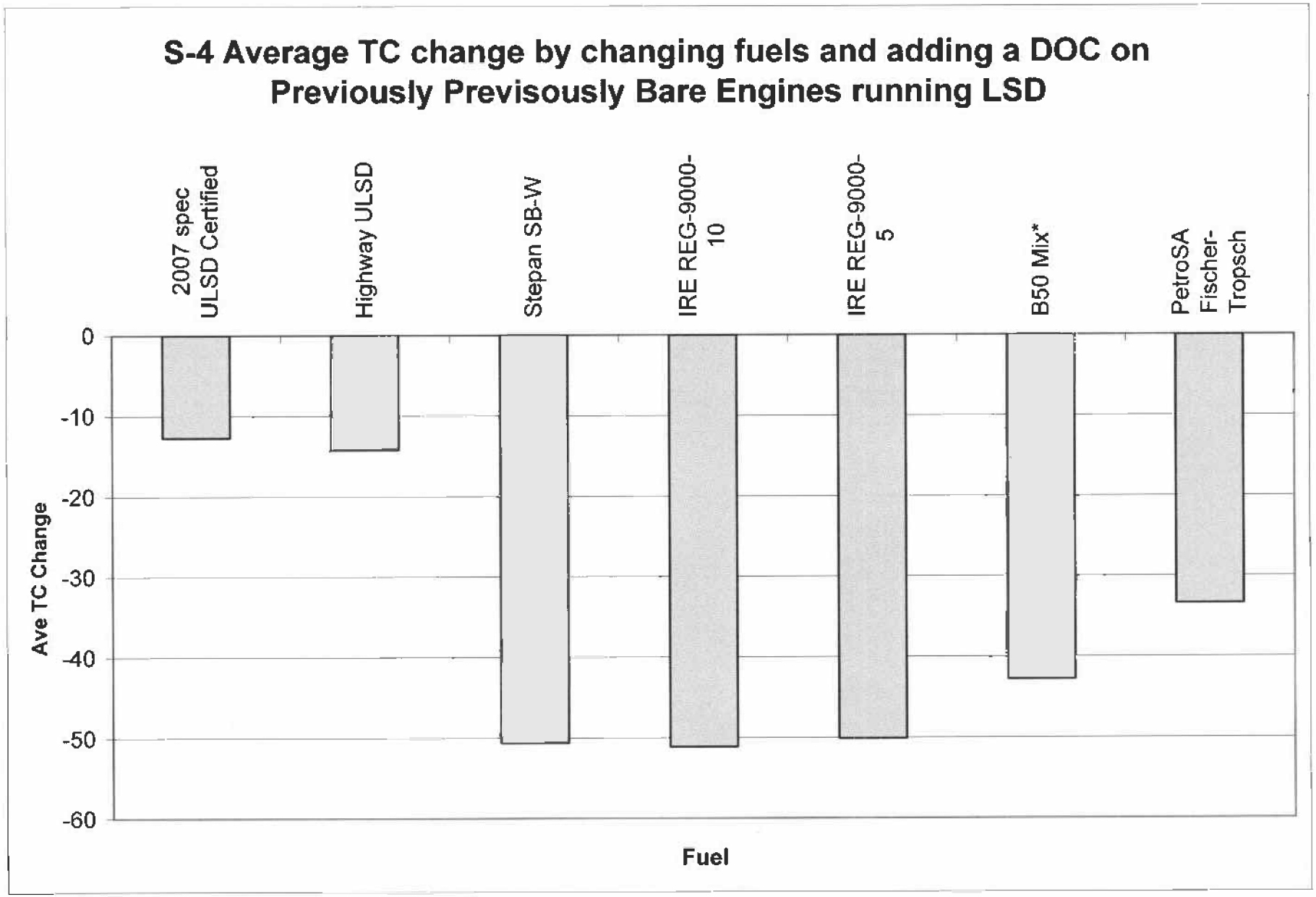
Gravimetric or TC DPM Emission Change Scenarios

S-1	Bare Engine, changing fuels only
S-2	Adding DOC to an Engine Already Burning a Particular Fuel
S-3	Changing Fuels on DOC Equipped Engines previously running LSD
S-4	Changing Fuels and Adding DOC to Bare engines previously running LSD


S-1 Average TC change by changing fuels on Bare Engines
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
5
0
-5
-10
-15
-20
-25
-30
-35
Ave TC Change
Fuel


S-2 Average TC change by adding a DOC to an Engine already burning a Particular Fuel
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
Ave TC Change
Fuel

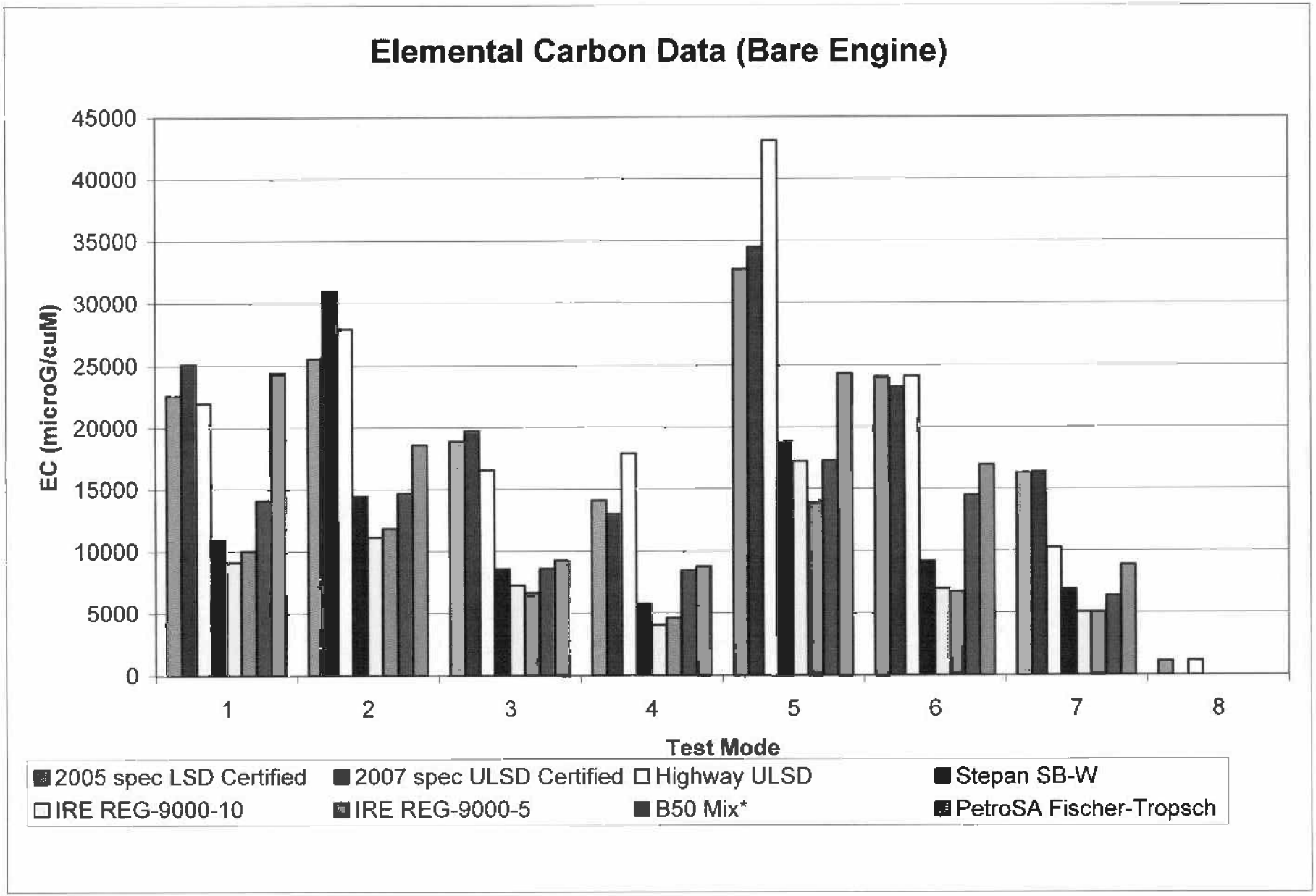

S-3 Average TC change by changing fuels on DOC Equipped Engines Previously running LSD
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
Ave TC Change
Fuel


S-4 Average TC change by changing fuels and adding a DOC on Previously Previsously Bare Engines running LSD
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch
0
-10
-20
-30
-40
-50
-60
Ave TC Change
Fuel

FUEL TESTING on Isuzu 4JG1T Diesel Engine
EC/OC Carbon DPM Data for Bare Engine

Fuel No.	Bare Engine Test FUEL		Test Mode 1 (ug/m3)	2 (ug/m3)	3 (ug/m3)	4 (ug/m3)	5 (ug/m3)	6 (ug/m3)	7 (ug/m3)	8 (ug/m3)	Weighted Average	Weighted Average %Difference
1	**2005 spec LSD Certified**	EC	22617	25554	18887	14111	32748	24076	16282	1106	18948.3	
		OC	11468	11104	10198	13718	13341	9673	9510	7616	10682.1	
		TC	34085	36659	29085	27829	46089	33750	25799	8722	29629.35	
	% OC in TC		33.6	30.3	35.1	49.3	28.9	28.7	36.9	87.3	41.3	Average
2	**2007 spec ULSD Certified**	EC	25116	30935	19728	13010	34517	23256	16370		20082.18	
		OC	10718	9786	9564	14488	10348	8618	10689	8403	10184.95	
		TC	36093	40713	29292	27498	44872	31874	27058	9002	30395.2	
	% OC in TC		29.7	24.0	32.7	52.7	23.1	27.0	39.5	93.3	40.3	Average
	EC % change from LSD		11.0	21.1	4.5	-7.8	5.4	-3.4	0.5	na		6.0
	OC % change from LSD		-6.5	-11.9	-6.2	5.6	-22.4	-10.9	12.4	10.3		-4.7
	TC % change from LSD		5.9	11.1	0.7	-1.2	-2.6	-5.6	4.9	3.2		2.6
3	**Highway ULSD**	EC	21974	27941	16546	17912	43091	24139	10254	1156	19682.15	
		OC	11284	8948	10225	12634	9819	7052	7969	6621	9309.1	
		TC	33250	36890	26770	30546	52910	31191	18223	7777	28990.05	
	% OC in TC		33.9	24.3	38.2	41.4	18.6	22.6	43.7	85.1	39.5	Average
	EC % change from LSD		-2.8	9.3	-12.4	26.9	31.6	0.3	-37.0	4.6		3.9
	OC % change from LSD		-1.6	-19.4	0.3	-7.9	-26.4	-27.1	-16.2	-13.1		-12.9
	TC % change from LSD		-2.4	0.6	-8.0	9.8	14.8	-7.6	-29.4	-10.8		-2.2
4	**Stepan SB-W**	EC	11039	14446	8586	5776	18845	9164	6920		9161.15	
	biodiesel	OC	14971	18924	20382	17186	14225	16967	18635	12244	16679.45	
		TC	26009	33370	28968	22962	33070	26132	25556	12584	25908.45	
	% OC in TC		57.6	56.7	70.4	74.8	43.0	64.9	72.9	97.5	67.2	Average
	EC % change from LSD		-51.2	-43.5	-54.5	-59.1	-42.5	-61.9	-57.5	na		-51.5
	OC % change from LSD		30.5	70.4	99.9	25.3	6.6	75.4	96.0	60.8		56.1
	TC % change from LSD		-23.7	-9.0	-0.4	-17.5	-28.2	-22.6	-0.9	44.0		-12.6
5	**IRE REG-9000-10**	EC	9131	11127	7260	4080	17239	6968	5059		7462.3	
	biodiesel	OC	17269	21786	19500	19116	14717	20843	20049	13562	18290.05	
		TC	26400	32913	26760	23195	31956	27819	25107	14260	25857.65	
	% OC in TC		65.4	66.2	72.9	82.4	46.1	74.9	79.9	95.1	72.9	Average
	EC % change from LSD		-59.6	-56.5	-61.6	-71.1	-47.4	-71.1	-68.9	na		-60.6
	OC % change from LSD		50.6	96.2	91.2	39.3	10.3	115.6	110.8	78.1		71.2
	TC % change from LSD		-22.6	-10.2	-8.0	-16.7	-30.7	-17.6	-2.7	63.5		-12.7
6	**IRE REG-9000-5**	EC	10012	11820	6667	4619	14017	6727	5055		7316.65	
	biodiesel	OC	17185	23246	19896	19683	14530	18524	20301	13352	18355.65	
		TC	27204	35066	26563	24302	28546	25259	25355	13886	25751.05	
	% OC in TC		63.2	66.3	74.9	81.0	50.9	73.3	80.1	96.3	73.2	Average
	EC % change from LSD		-55.7	-53.7	-64.7	-67.3	-57.2	-72.1	-69.0	na		-61.4
	OC % change from LSD		49.9	109.3	96.1	43.6	8.9	91.5	113.5	75.3		71.8
	TC % change from LSD		-20.2	-4.3	-8.7	-12.7	-38.1	-25.2	-1.7	59.0		-13.1
7	**B50 Mix***	EC	14096	14681	8603	8452	17302	14494	6398		10271.4	
		OC	12374	14089	14668	14807	13744	13724	15885	10437	13551.2	
		TC	26470	28770	23271	23259	31045	28225	22281	11163	23932.1	
	% OC in TC		46.7	49.0	63.0	63.7	44.3	48.6	71.3	93.5	60.0	Average
	EC % change from LSD		-37.7	-42.5	-54.5	-40.1	-47.2	-39.8	-60.7	na		-45.8
	OC % change from LSD		7.9	26.9	43.8	7.9	3.0	41.9	67.0	37.0		26.9
	TC % change from LSD		-22.3	-21.5	-20.0	-16.4	-32.6	-16.4	-13.6	28.0		-19.2
8	**PetroSA Fischer-Tropsch**	EC	24423	18580	9290	8775	24354	16964	8871		13740.35	
	synthetic	OC	8359	8650	7853	7144	6948	4935	5203	4213	6784.25	
		TC	32783	27222	17136	15926	31302	21900	14081	4437	20557.6	
	% OC in TC		25.5	31.8	45.8	44.9	22.2	22.5	37.0	95.0	40.6	Average
	EC % change from LSD		8.0	-27.3	-50.8	-37.8	-25.6	-29.5	-45.5	na		-27.5
	OC % change from LSD		-27.1	-22.1	-23.0	-47.9	-47.9	-49.0	-45.3	-44.7		-36.5
	TC % change from LSD		-3.8	-26.7	-41.1	-42.8	-32.1	-35.1	-45.4	-49.1		-30.6
			Weight Factors: 0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD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30000
25000
20000
15000
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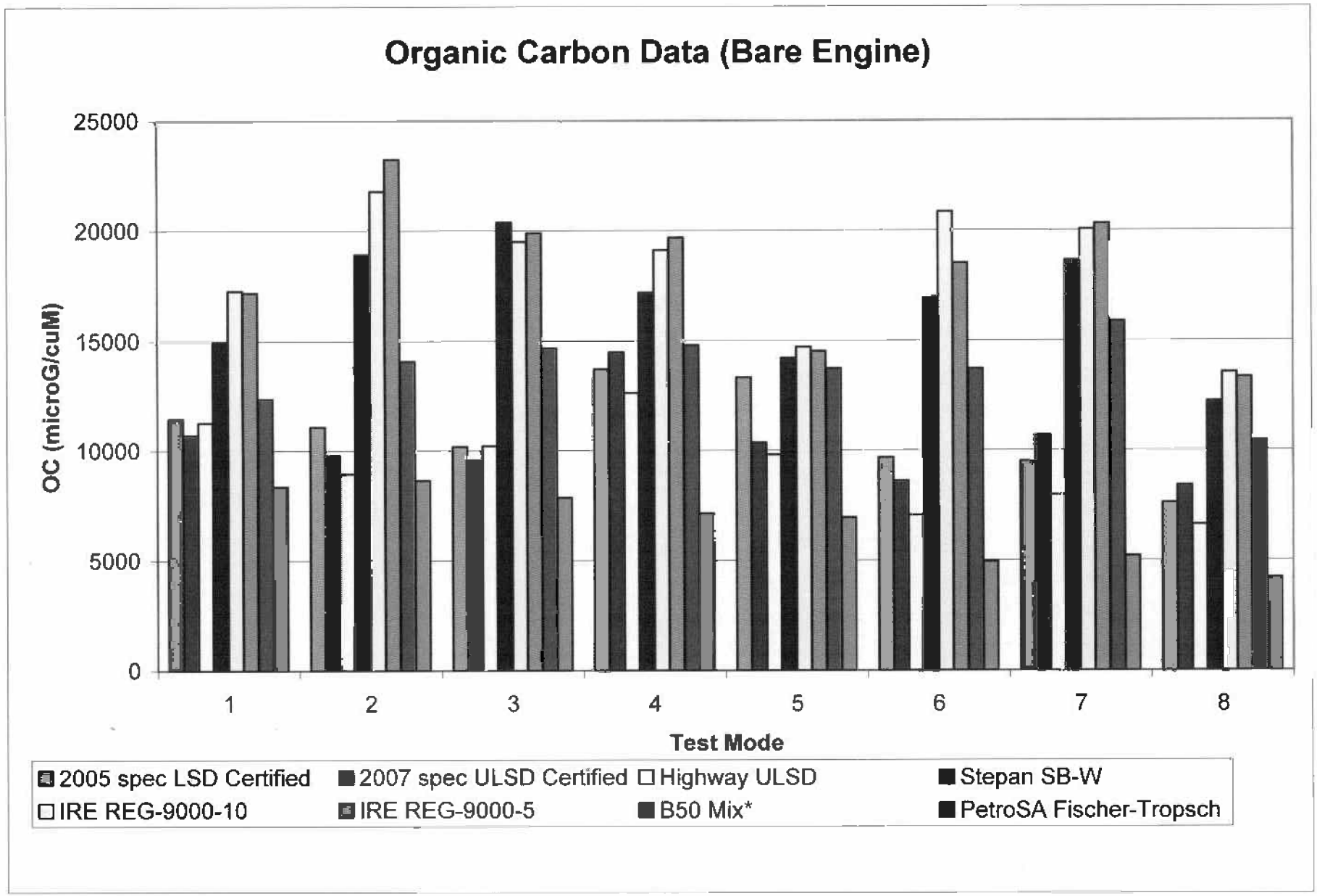
5000
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch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OC (microG/cuM)
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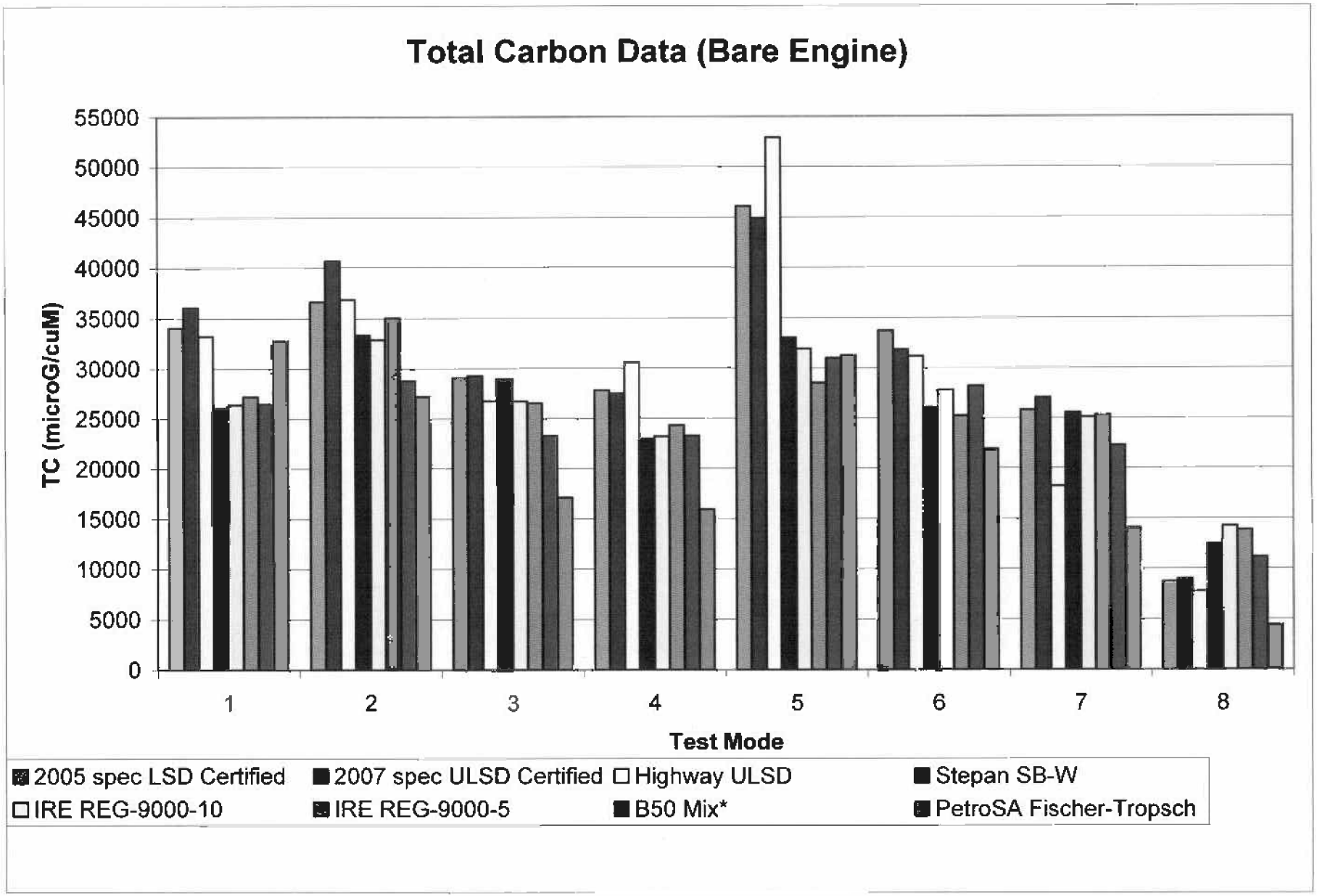
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch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TC (microG/cuM)
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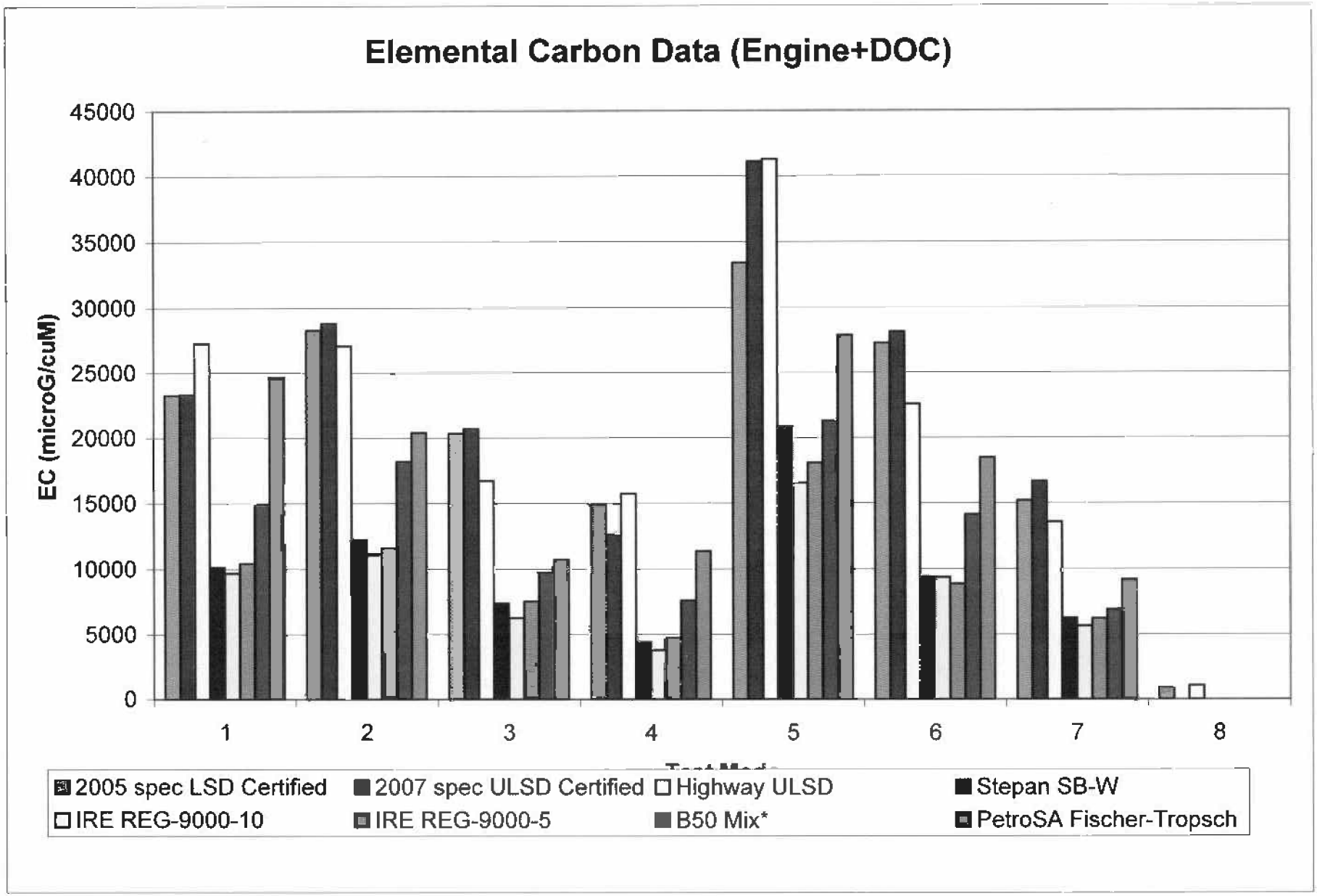
40000
35000
30000
25000
20000
15000
10000
5000
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch

FUEL TESTING on Isuzu 4JG1T Diesel Engine
EC/OC Carbon DPM Data for Engine+DOC Combination
Engine + DOC Test

Fuel No.	FUEL		Test Mode 1 (ug/m3)	2 (ug/m3)	3 (ug/m3)	4 (ug/m3)	5 (ug/m3)	6 (ug/m3)	7 (ug/m3)	8 (ug/m3)	Weighted Average	Weighted Average %Difference
1	**2005 spec LSD Certified**	EC	23274	26299	20332	14895	33431	27289	15217	908	20004.85	
		OC	8756	8078	6988	7329	6427	4867	4387	1878	6158	
		TC	32037	34377	27320	22224	39857	32156	19604	2791	26162.85	
	% OC in TC		27.3	22.2	25.6	33.0	16.1	15.1	22.4	67.3	23.6	Average
	EC % change from bare engine		2.9	10.7	7.7	5.6	2.1	13.3	-6.5	-18.1		5.6
	OC % change from bare engine		-23.6	-27.3	-34.5	-46.6	-51.8	-49.7	-53.9	-75.3		-42.4
	TC % change from bare engine		-6.0	-0.8	-6.1	-20.1	-13.5	-4.7	-24.0	-68.0		-11.7
2	**2007 spec ULSD Certified**	EC	23341	28821	20707	12638	41127	28157	16610		20791.65	
		OC	5637	6704	6048	5926	5472	3935	4622	2422	4976.15	
		TC	28978	34585	26754	18563	46600	32099	21312	3147	25877	
	% OC in TC		19.5	16.7	22.6	31.9	11.7	12.3	21.7	77.0	26.7	Average
	EC % change from bare engine		-7.1	-8.8	5.0	2.9	19.1	21.1	2.0	na		3.5
	OC % change from bare engine		-47.4	-41.1	-36.8	-59.1	-47.1	-54.3	-56.8	-71.2		-51.1
	TC % change from bare engine		-19.7	-15.1	-9.7	-32.5	3.9	0.7	-21.2	-65.0		-14.9
	EC % change from LSD w/ DOC		0.3	1.8	1.8	-15.2	23.0	3.2	9.7	na		3.9
	OC % change from LSD w/ DOC		-35.6	-28.6	-13.5	-19.1	-14.9	-19.1	5.4	29.0		-19.2
	TC % change from LSD w/ DOC		-9.6	-4.9	-2.1	-16.5	16.9	-0.2	8.7	12.8		-1.1
3	**Highway ULSD**	EC	27260	27093	16735	15755	41303	22586	13569	1059	20143.35	
		OC	5591	5416	9679	4998	4464	4179	4976	2693	5278.55	
		TC	33851	32501	25814	20752	45774	26764	18544	3752	25421.1	
	% OC in TC		17.0	16.7	35.2	24.1	9.8	15.6	26.8	71.8	27.1	Average
	EC % change from bare engine		24.1	-3.0	1.1	-12.0	-4.1	-8.4	32.3	-8.4		2.3
	OC % change from bare engine		-50.5	-39.5	-11.2	-60.4	-54.5	-40.7	-37.6	-59.3		-43.3
	TC % change from bare engine		-1.2	-11.9	-3.6	-32.1	-13.5	-14.2	1.8	-51.8		-12.3
	EC % change from LSD w/ DOC		17.1	-4.3	-17.7	5.8	23.5	-17.2	-10.8	15.8		0.7
	OC % change from LSD w/ DOC		-36.1	-33.0	29.8	-31.8	-30.5	-14.1	13.4	43.4		-14.3
	TC % change from LSD w/ DOC		2.5	-10.7	-5.5	-8.5	14.8	-16.8	-5.4	34.4		-2.8
4	**Stepan SB-W**	EC	10149	12256	7379	4425	20853	9489	6261		8668.4	
	biodiesel	OC	5278	6291	7180	7084	4812	7429	6645	3986	6027.25	
		TC	15427	18548	14559	11509	25667	16898	13098	4244	14632.8	
	% OC in TC		34.2	33.9	49.3	61.6	18.8	44.0	52.3	93.9	48.5	Average
	EC % change from bare engine		-8.1	-15.2	-14.1	-23.4	10.7	3.3	-9.6	na		-8.7
	OC % change from bare engine		-64.7	-66.8	-64.8	-58.8	-66.2	-56.2	-63.3	-57.4		-63.9
	TC % change from bare engine		-40.7	-44.4	-49.7	-49.9	-22.4	-35.3	-48.7	-68.2		-43.5
	EC % change from LSD w/ DOC		-58.4	-56.7	-63.7	-70.3	-37.6	-65.3	-58.9	na		-57.2
	OC % change from LSD w/ DOC		-39.7	-22.1	2.7	-3.3	-25.1	52.5	58.0	112.2		-2.1
	TC % change from LSD w/ DOC		-51.8	-49.0	-46.7	-48.2	-35.6	-47.4	-33.2	52.1		-44.1
5	**IRE REG-9000-10**	EC	9692	11151	6277	3789	16583	9371	5647		7607	
	biodiesel	OC	7563	9439	7790	7124	6057	6510	5781	3474	6787.1	
		TC	17255	20590	14074	10906	22640	15881	11428	4107	14489.4	
	% OC in TC		43.8	45.8	55.4	65.3	26.8	41.0	50.6	84.6	51.7	Average
	EC % change from bare engine		6.1	0.2	-13.5	-7.1	-3.8	34.5	11.8	na		1.9
	OC % change from bare engine		-56.2	-56.7	-60.1	-62.7	-58.8	-68.8	-71.2	-74.4		-62.9
	TC % change from bare engine		-34.6	-37.4	-47.4	-53.0	-29.2	-42.9	-54.5	-71.2		-44.0
	EC % change from LSD w/ DOC		-58.4	-60.6	-69.1	-74.6	-50.4	-65.7	-62.9	na		-62.0
	OC % change from LSD w/ DOC		-13.6	18.8	11.5	-2.8	-5.8	33.8	31.8	85.0		10.3
	TC % change from LSD w/ DOC		-46.1	-43.4	-48.5	-50.9	-43.2	-50.6	-41.7	47.2		-44.6
6	**IRE REG-9000-5**	EC	10428	11094	7550	4770	18110	6876	8223		8233.7	
	biodiesel	OC	6333	7799	8021	7614	6255	6017	6140	3603	6486	
		TC	16762	18892	15571	12384	24365	14892	12363	4178	14786	
	% OC in TC		37.8	40.2	51.5	61.5	25.7	40.4	49.7	86.2	49.1	Average
	EC % change from bare engine		4.2	-1.9	13.2	3.3	29.2	31.9	23.1	na		12.5
	OC % change from bare engine		-63.1	-68.5	-59.7	-61.3	-57.0	-67.8	-69.8	-73.0		-64.8
	TC % change from bare engine		-38.4	-44.7	-41.4	-49.0	-14.6	-41.0	-51.2	-69.9		-42.8
	EC % change from LSD w/ DOC		-55.2	-59.0	-62.9	-68.0	-45.8	-67.5	-59.1	na		-58.8
	OC % change from LSD w/ DOC		-27.7	-3.5	14.8	3.9	-2.7	23.6	40.0	91.9		5.0
	TC % change from LSD w/ DOC		-47.7	-46.7	-43.0	-44.3	-38.9	-53.7	-36.9	49.7		-43.6
7	**B50 Mix***	EC	14940	18215	9723	7617	21289	14151	6910		11429.4	
		OC	5977	6915	6415	5973	5657	5064	4577	2605	5415.9	
		TC	20910	25130	16138	13583	26947	19245	11487	3298	16947.6	
	% OC in TC		28.6	27.5	39.8	44.0	21.0	26.4	39.8	79.0	38.3	Average
	EC % change from bare engine		6.0	24.1	13.0	-9.9	23.0	-2.3	8.0	na		11.3
	OC % change from bare engine		-51.7	-50.9	-56.3	-59.7	-58.8	-63.0	-71.2	-75.0		-60.0
	TC % change from bare engine		-21.0	-12.7	-30.7	-47.6	-13.2	-31.8	-48.4	-70.5		-29.2
	EC % change from LSD w/ DOC		-35.8	-35.6	-52.2	-48.9	-36.3	-48.1	-54.6	na		-42.9
	OC % change from LSD w/ DOC		-31.7	-14.4	-8.2	-18.5	-12.0	4.5	4.3	38.7		-12.0
	TC % change from LSD w/ DOC		-34.7	-30.9	-40.9	-38.9	-32.4	-40.2	-41.4	19.2		-36.2
8	**PetroSA Fischer-Tropsch**	EC	24669	20418	10726	11380	27878	18509	9185		15068.15	
	synthetic	OC	8425	5501	4653	4885	4497	3598	2460	4617.65		
		TC	33094	25919	15380	16023	32773	23006	12785	2776	19734.05	
	% OC in TC		20.7	21.2	30.3	29.0	14.9	19.5	28.1	88.3	31.5	Average
	EC % change from bare engine		1.0	9.8	15.5	29.7	14.5	9.1	3.7	na		9.7
	OC % change from bare engine		-23.1	-36.4	-40.7	-35.0	-29.5	-8.9	-30.8	-41.8		-31.9
	TC % change from bare engine		-5.2	-4.8	-10.2	0.6	4.7	5.1	-9.2	-37.4		-4.0
	EC % change from LSD w/ DOC		6.8	-27.8	-47.2	-23.6	-16.6	-32.2	-39.6	na		-24.7
	OC % change from LSD w/ DOC		-26.8	-31.9	-33.4	-36.6	-23.8	-7.6	-18.0	30.5		-26.0
	TC % change from LSD w/ DOC		-2.9	-28.7	-43.7	-27.9	-17.8	-28.5	-34.8	-0.5		-24.6
			0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD Weight Factors.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25000
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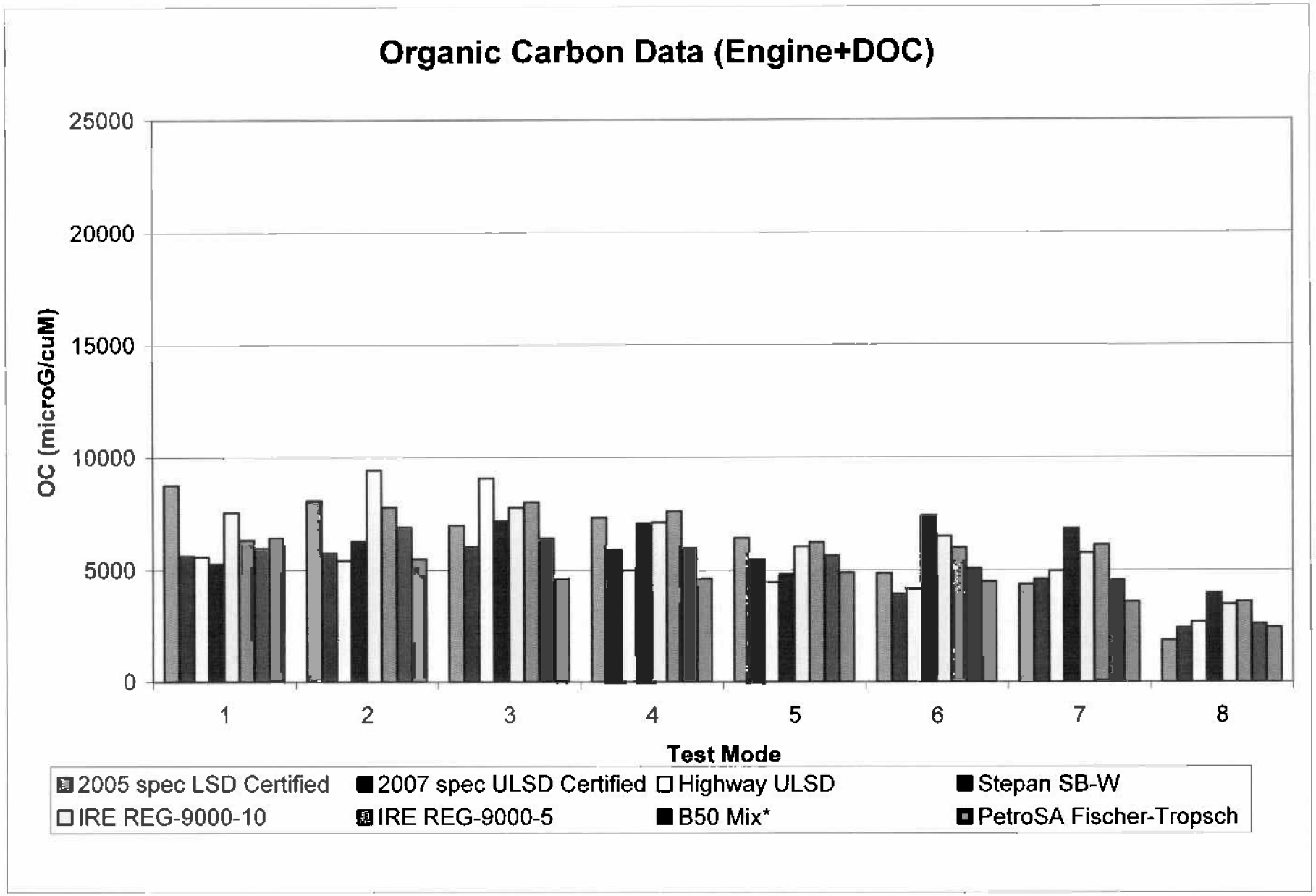
1
2
3
4
5
6
7
8
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch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7
8
Test Mode
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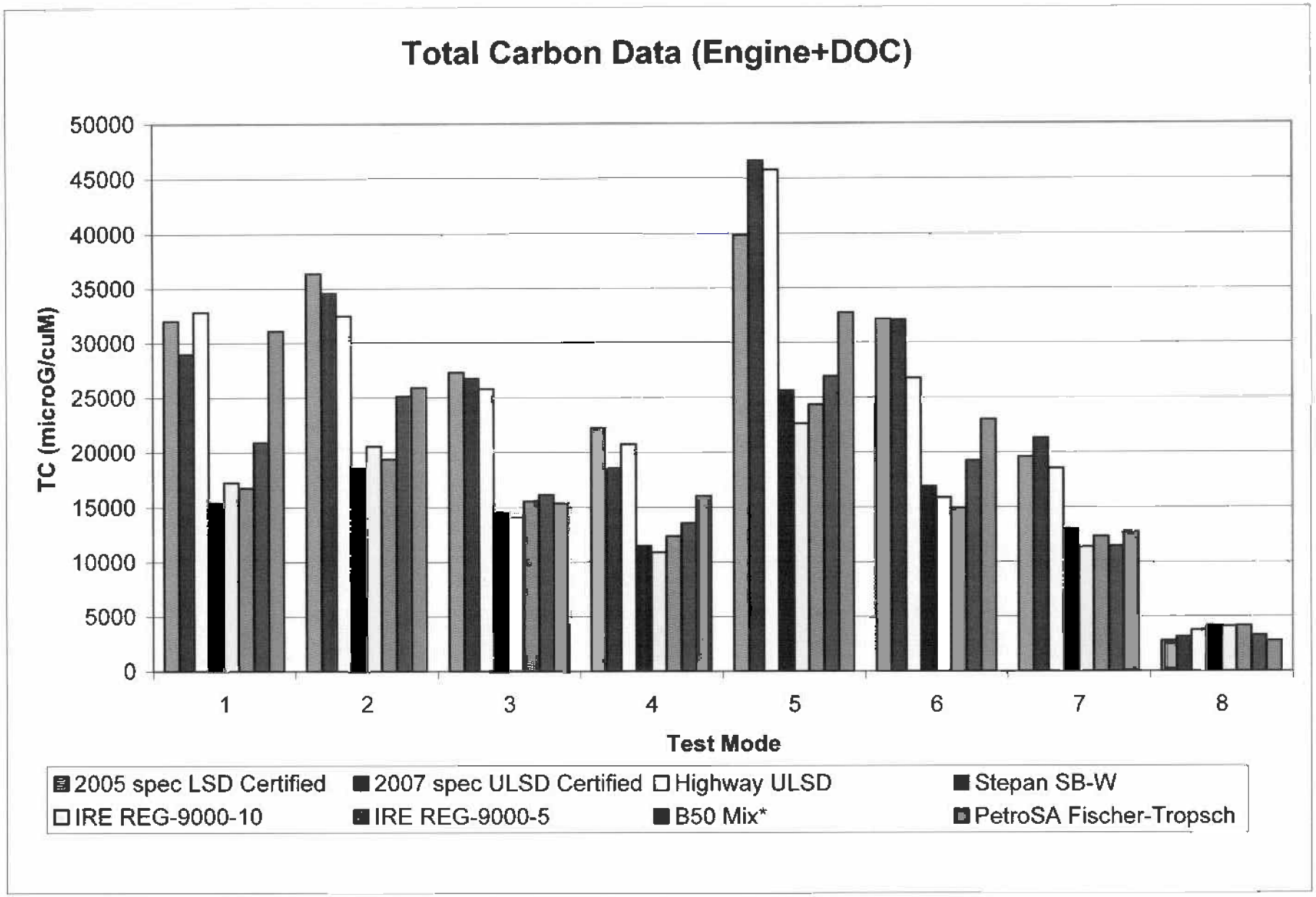
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch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2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W
IRE REG-9000-10
IRE REG-9000-5
B50 Mix*
PetroSA Fischer-Tropsch

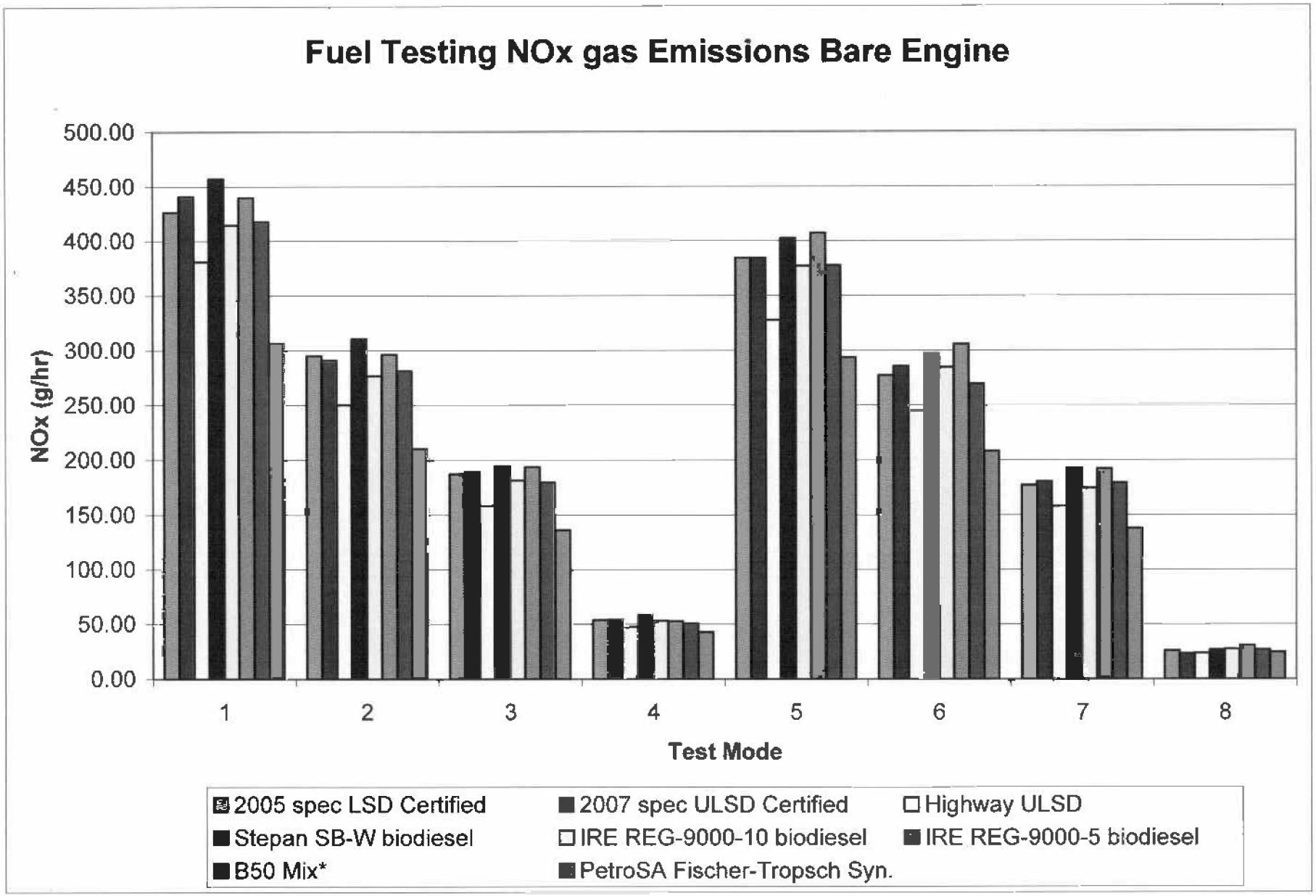
FUEL TESTING on Isuzu 4JG1T Diesel Engine
NOX Emissions Data, g/hr

Fuel No.	Bare Engine Test / FUEL	Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average % Difference
1	2005 spec LSD Certified	426.53	295.03	187.39	53.78	384.39	277.39	177.50	26.04	225.2	
2	2007 spec ULSD Certified	441.16	291.16	188.97	54.39	384.50	285.85	180.59	23.18	228.3	
	% change from LSD	3.4	-1.3	0.8	1.1	0.0	3.0	1.7	-11.0		1.4
3	Highway ULSD	381.07	250.07	158.49	47.66	327.86	245.10	157.91	23.74	196.3	
	% change from LSD	-10.7	-15.2	-15.4	-11.4	-14.7	-11.6	-11.0	-8.9		-12.8
4	Stepan SB-W biodiesel	457.30	310.75	194.67	58.54	402.64	297.46	193.15	26.90	239.5	
	% change from LSD	7.2	5.3	3.9	8.9	4.7	7.2	8.8	3.3		6.4
5	IRE REG-9000-10 biodiesel	414.80	276.74	181.69	53.24	377.34	284.93	174.85	27.45	219.7	
	% change from LSD	-2.7	-6.2	-3.0	-1.0	-1.8	2.7	-1.5	5.4		-2.4
6	IRE REG-9000-5 biodiesel	440.00	296.47	193.83	52.84	407.44	305.98	192.38	30.56	235.3	
	% change from LSD	3.2	0.5	3.4	-1.8	6.0	10.3	8.4	17.3		4.5
7	B50 Mix*	418.05	281.33	179.81	50.61	377.97	269.80	179.63	26.85	219.7	
	% change from LSD	-2.0	-4.6	-4.0	-5.9	-1.7	-2.7	1.2	3.1		-2.4
8	PetroSA Fischer-Tropsch Syn.	306.57	210.23	136.24	42.84	293.87	208.20	137.85	24.47	166.3	
	% change from LSD	-28.1	-28.7	-27.3	-20.3	-23.5	-24.9	-22.3	-6.1		-25.1

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

Fuel No.	Engine +DOC Test / FUEL	Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average % Difference
1	2005 spec LSD Certified	408.21	272.01	181.84	55.72	356.62	250.73	173.49	27.30	212.5	
	% change from bare engine	-4.3	-7.8	-3.0	3.6	-7.2	-9.6	-2.3	4.8		-5.6
2	2007 spec ULSD Certified	426.82	277.85	181.94	55.25	365.90	261.62	168.93	28.38	217.5	
	% change from bare engine	-3.2	-4.6	-3.7	1.6	-4.8	-8.5	-6.5	22.4		-4.7
3	Highway ULSD	361.03	231.70	156.46	47.36	316.06	221.56	150.56	24.47	185.6	
	% change from bare engine	-5.3	-7.3	-1.3	-0.6	-3.6	-9.6	-4.7	3.1		-6.4
4	Stepan SB-W biodiesel	415.27	271.67	185.27	57.67	367.30	254.08	172.45	26.85	215.3	
	% change from bare engine	-9.2	-12.6	-4.8	-1.5	-8.8	-14.6	-10.7	-0.2		-10.1
5	IRE REG-9000-10 biodiesel	391.64	253.53	171.92	50.73	332.81	240.96	155.22	27.20	199.7	
	% change from bare engine	-5.6	-8.4	-5.4	-4.7	-11.8	-15.4	-11.2	-0.9		-9.1
6	IRE REG-9000-5 biodiesel	404.73	261.90	179.37	54.49	362.45	260.18	172.27	30.28	211.5	
	% change from bare engine	-8.0	-11.7	-7.5	3.1	-11.0	-15.0	-10.5	-0.9		-10.1
7	B50 Mix*	390.74	253.27	165.24	50.10	338.81	236.76	158.28	28.02	199.4	
	% change from bare engine	-6.5	-10.0	-8.1	-1.0	-10.4	-12.2	-11.9	4.4		-9.2
8	PetroSA Fischer-Tropsch Syn.	304.27	200.37	137.93	41.49	272.20	188.09	130.72	23.73	159.3	
	% change from bare engine	-0.7	-4.7	1.2	-3.2	-7.4	-9.7	-5.2	-3.0		-4.2
	Weight Factors:	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD


Fuel Testing NOx gas Emissions Bare Engine
NOx (g/hr)
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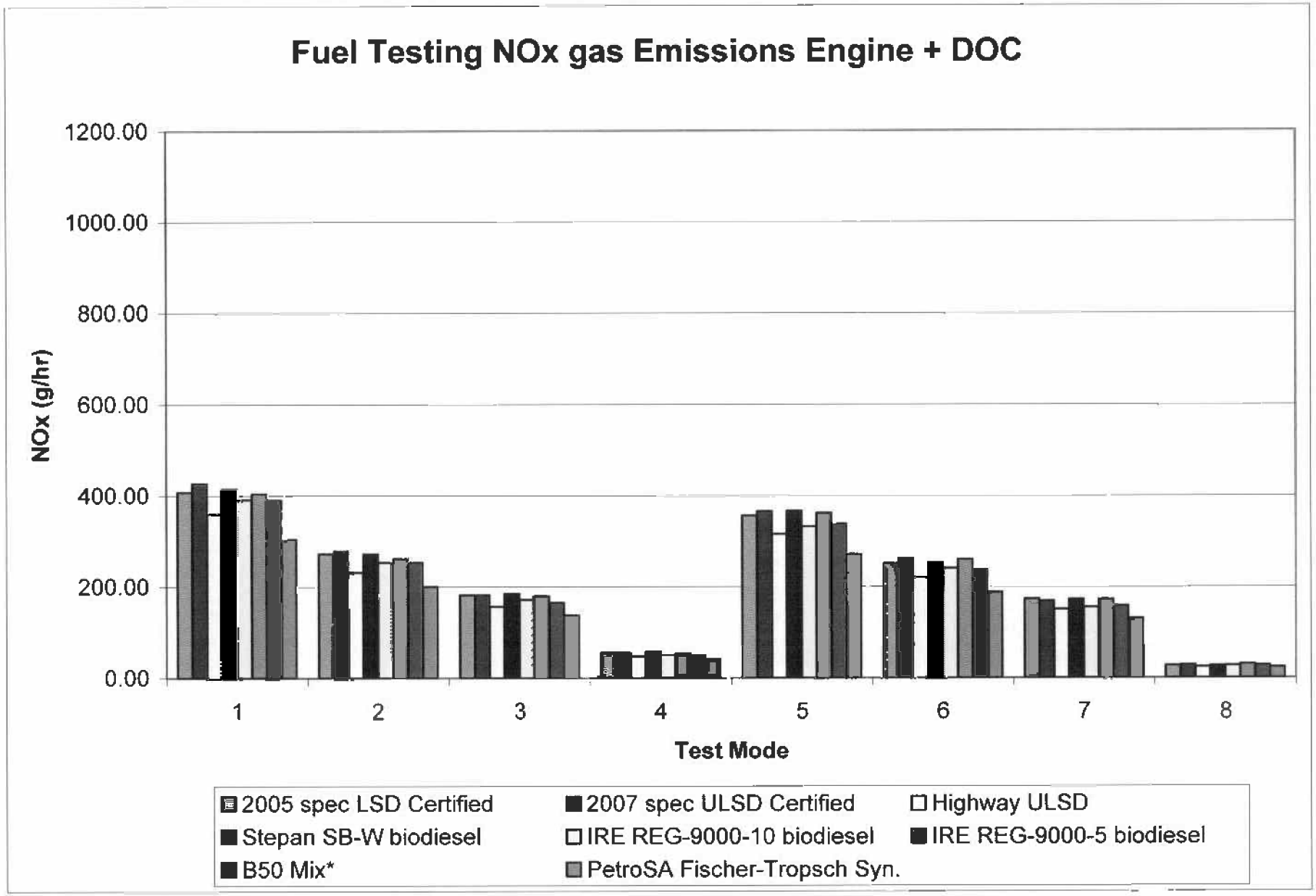
300.00
250.00
200.00
150.00
100.00
50.00
0.00
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing NOx gas Emissions Engine + DOC
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
NOx (g/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
NO Emissions Data, gr/hr
with ventilation rates

Bare Engine Test

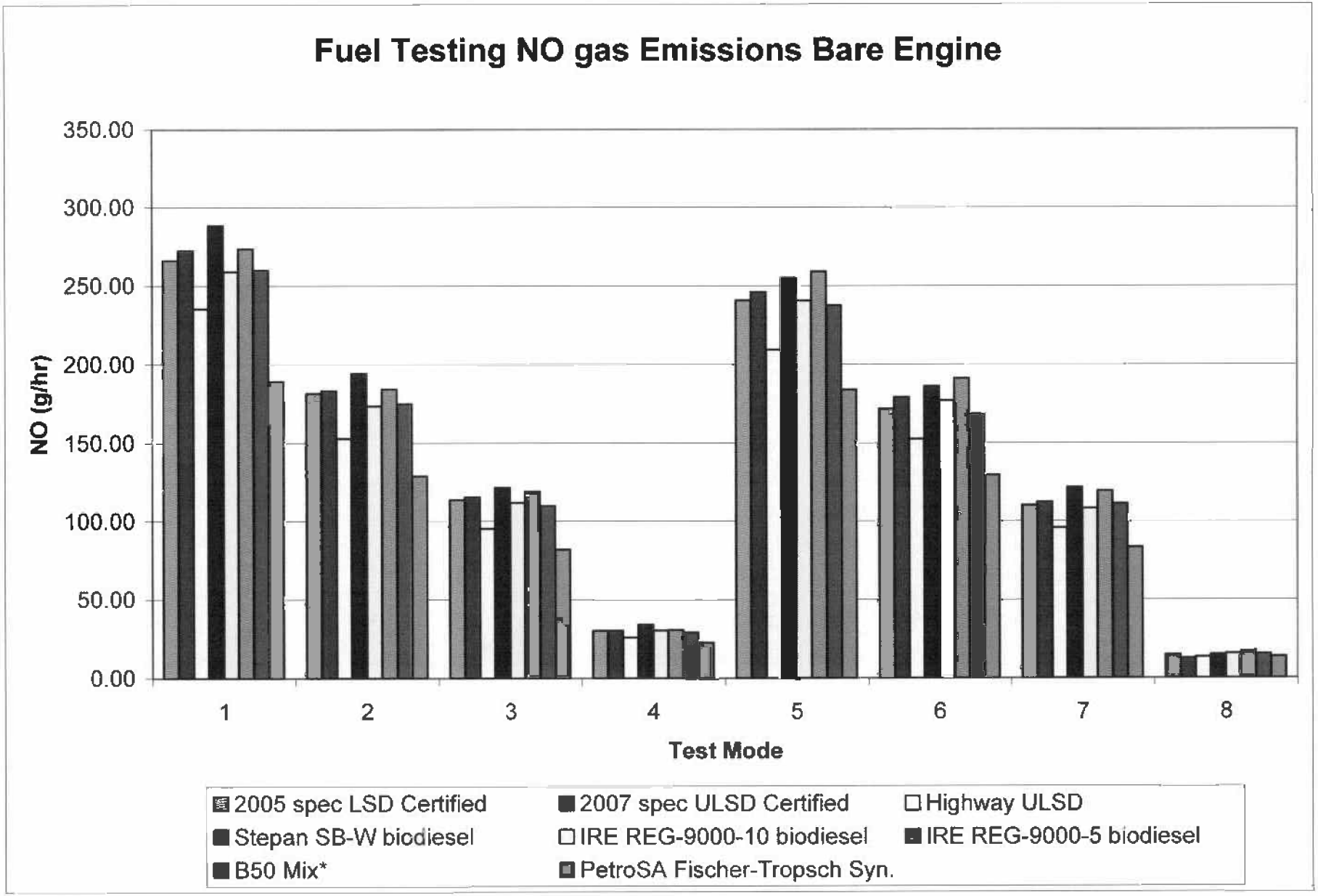
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average % Diff
1	2005 spec LSD Certified	g/hr	266.19	181.75	113.60	30.09	240.84	171.80	110.14	14.72	141.7	
		CFM Vent	4936	3371	2107	558	4468	3187	2043	273		
2	2007 spec ULSD Certified	g/hr	272.52	183.40	115.27	30.21	246.15	179.24	112.04	12.57	144.3	
		CFM Vent	5055	3402	2138	560	4566	3325	2078	233		1.8
	% change from LSD		2.4	0.9	1.5	0.4	2.2	4.3	1.7	-14.6		
3	Highway ULSD	g/hr	235.47	152.95	95.16	25.83	209.60	152.62	95.69	13.25	122.9	
		CFM Vent	4368	2837	1765	479	3888	2831	1775	248		-13.3
	% change from LSD		-11.5	-15.8	-16.2	-14.1	-13.0	-11.2	-13.1	-10.0		
4	Stepan SB-W biodiesel	g/hr	288.52	194.50	121.47	34.08	255.29	186.30	121.57	14.93	152.6	
		CFM Vent	5352	3608	2253	632	4736	3456	2255	277		7.7
	% change from LSD		8.4	7.0	6.9	13.3	6.0	8.4	10.4	1.4		
5	IRE REG-9000-10 biodiesel	g/hr	259.27	173.66	111.74	30.25	240.79	177.17	108.20	15.55	139.7	
		CFM Vent	4809	3221	2073	561	4467	3298	2007	288		-1.4
	% change from LSD		-2.6	-4.5	-1.6	0.5	0.0	3.1	-1.8	5.6		
6	IRE REG-9000-5 biodiesel	g/hr	273.66	184.34	118.89	30.54	259.38	191.76	119.34	17.52	149.2	
		CFM Vent	5076	3419	2205	566	4811	3546	2214	325		5.3
	% change from LSD		2.8	1.4	4.7	1.5	7.7	11.3	8.4	19.0		
7	B50 Mix*	g/hr	260.03	175.05	109.68	28.93	237.75	168.69	111.20	15.27	138.7	
		CFM Vent	4823	3247	2035	537	4410	3129	2063	283		-2.2
	% change from LSD		-2.3	-3.7	-3.4	-3.8	-1.3	-1.8	1.0	3.7		
8	PetroSA Fischer-Tropsch Syn.	g/hr	189.28	128.80	81.90	22.50	184.05	129.58	83.41	13.66	104.0	
		CFM Vent	3511	2389	1519	417	3414	2404	1547	253		-26.6
	% change from LSD		-28.9	-29.1	-27.9	-25.2	-23.6	-24.6	-24.3	-7.2		

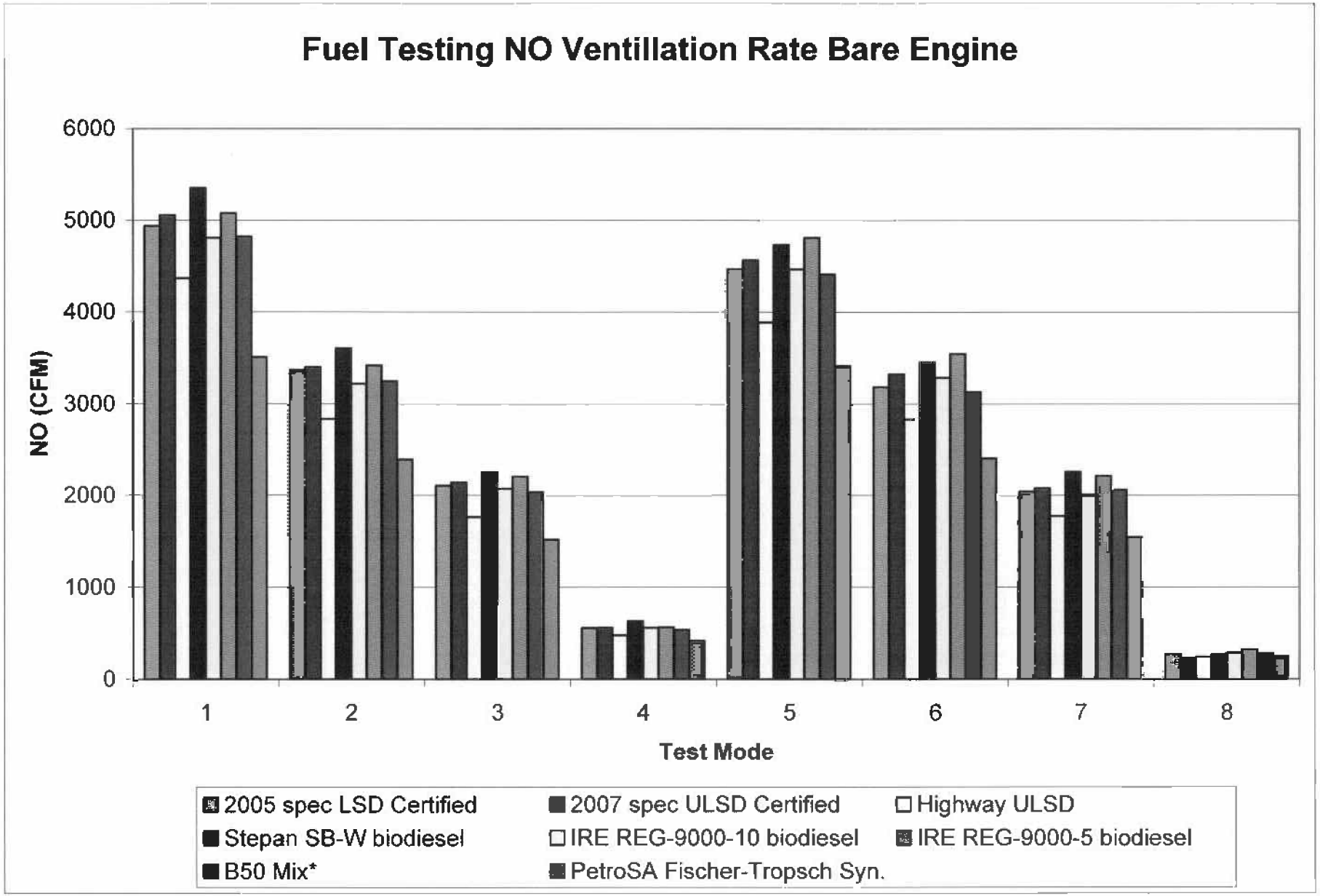
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

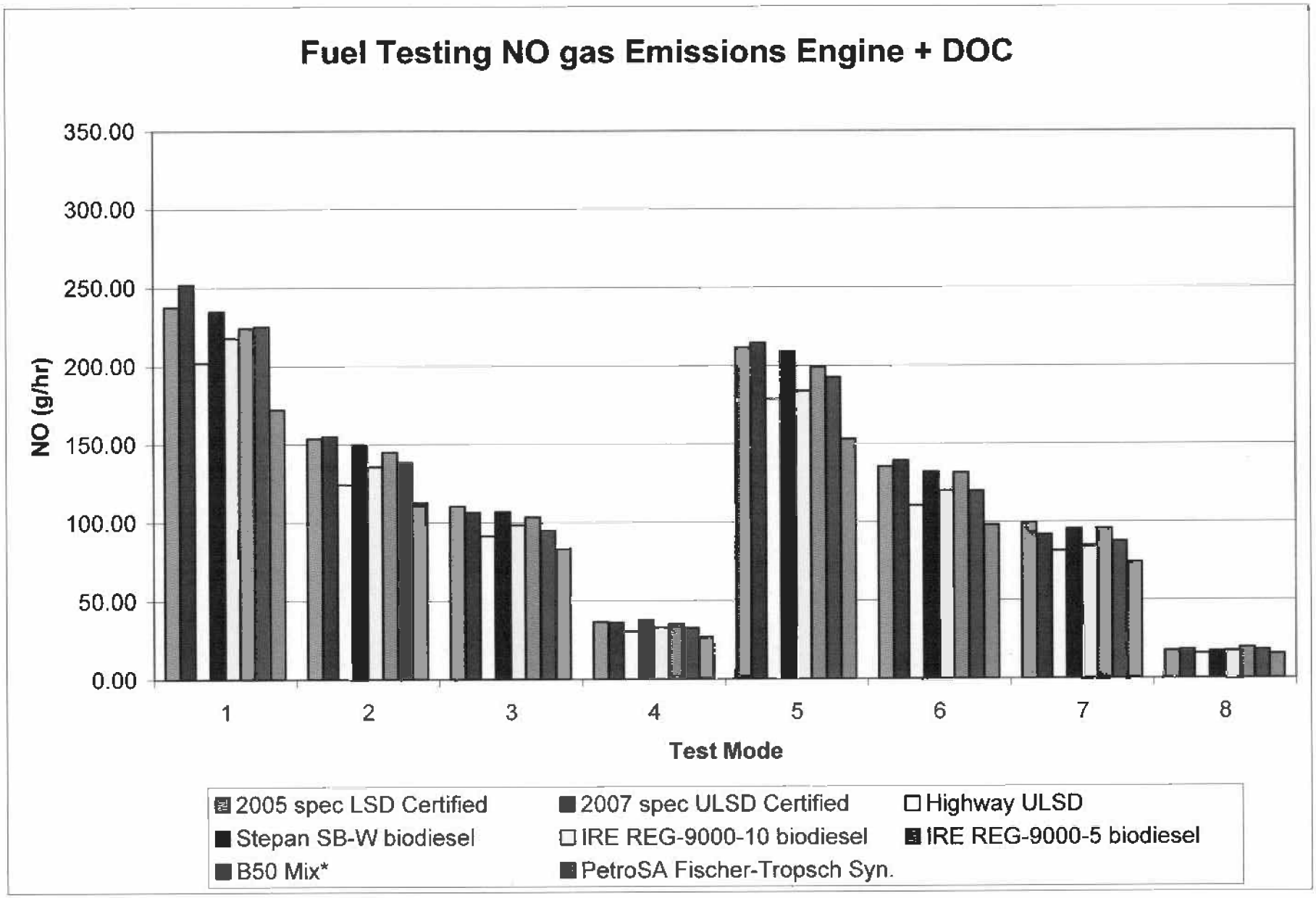
Engine +DOC Test

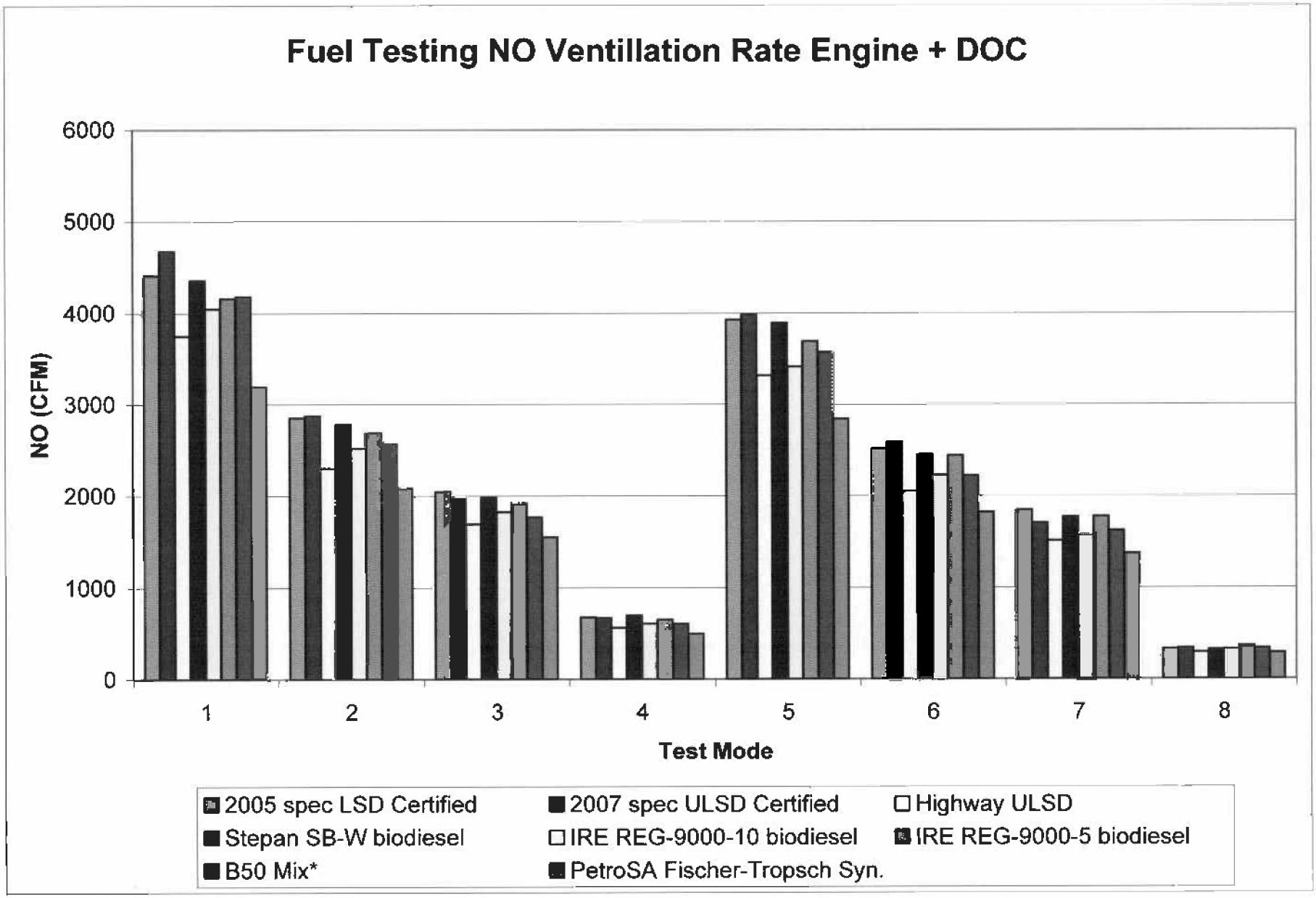
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average % Diff
1	2005 spec LSD Certified	g/hr	237.80	153.69	110.25	36.66	211.93	135.22	99.45	17.76	126.2	
		CFM Vent	4411	2851	2045	660	3931	2508	1845	329		-10.9
	% change from bare engine		-10.7	-15.4	-3.0	21.8	-12.0	-21.3	9.7	20.6		
2	2007 spec ULSD Certified	g/hr	251.93	154.86	106.47	36.21	214.79	139.21	91.88	18.28	127.9	
		CFM Vent	4673	2873	1975	672	3984	2582	1704	339		-11.4
	% change from bare engine		-7.6	-15.6	-7.8	19.8	-12.7	-22.3	-18.0	45.4		
3	Highway ULSD	g/hr	202.25	124.14	91.33	30.41	178.94	110.44	81.45	15.78	105.1	
		CFM Vent	3752	2303	1694	564	3319	2049	1511	293		-14.4
	% change from bare engine		-14.1	-18.8	-4.0	17.7	-14.6	-27.6	-14.9	19.1		
4	Stepan SB-W biodiesel	g/hr	235.08	149.81	106.88	37.74	210.06	131.91	95.39	17.32	123.9	
		CFM Vent	4361	2779	1983	700	3897	2447	1769	321		-18.8
	% change from bare engine		-18.5	-23.0	-12.0	10.7	-17.7	-29.2	-21.5	16.0		
5	IRE REG-9000-10 biodiesel	g/hr	218.32	135.63	98.32	32.91	184.01	119.93	84.85	17.56	112.6	
		CFM Vent	4050	2516	1824	610	3413	2225	1574	326		-19.4
	% change from bare engine		-15.8	-21.9	-12.0	9.8	-23.6	-32.3	-21.6	11.9		
6	IRE REG-9000-5 biodiesel	g/hr	224.45	144.90	103.52	35.20	199.28	131.39	95.71	19.61	120.0	
		CFM Vent	4163	2686	1920	653	3697	2437	1775	364		-19.6
	% change from bare engine		-18.0	-21.4	-12.9	15.3	-23.2	-31.3	-19.8	11.9		
7	B50 Mix*	g/hr	225.48	138.45	95.32	32.74	192.85	119.76	87.48	18.23	114.9	
		CFM Vent	4183	2569	1768	607	3574	2222	1623	336		-17.1
	% change from bare engine		-13.3	-20.9	-13.1	13.2	-19.0	-29.0	-21.3	19.4		
8	PetroSA Fischer-Tropsch Syn.	g/hr	172.19	112.50	83.57	26.97	153.10	98.08	74.08	15.49	92.8	
		CFM Vent	3194	2087	1550	500	2840	1819	1374	287		-10.8
	% change from bare engine		-9.0	-12.7	2.0	18.9	-16.8	-24.3	-11.2	13.3		
		Weight Factors	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD


Fuel Testing NO gas Emissions Bare Engine
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
NO (g/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing NO Ventillation Rate Bare Engine
NO (CFM)
6000
5000
4000
3000
2000
1000
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing NO gas Emissions Engine + DOC
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
NO (g/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing NO Ventillation Rate Engine + DOC
NO (CFM)
6000
5000
4000
3000
2000
1000
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
NO2 Emissions Data, gr/hr
with ventilation rates

Bare Engine Test

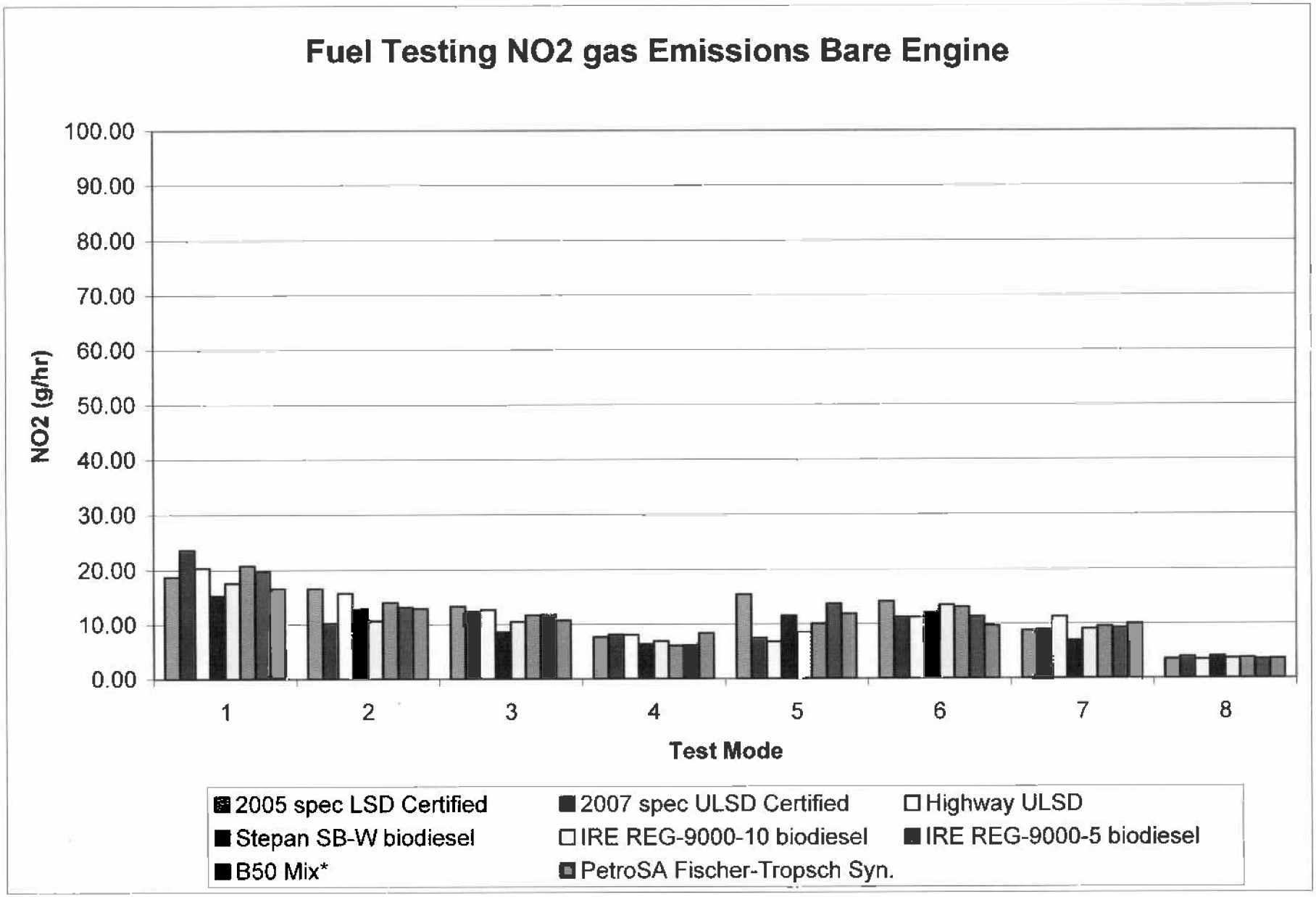
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	18.75	16.80	13.36	7.68	15.45	14.21	8.78	3.49	12.4	
		CFM Vent	1134	1004	808	465	935	860	531	211		
2	2007 spec ULSD Certified	g/hr	23.67	10.21	12.37	8.10	7.43	11.27	8.96	3.93	11.1	
		CFM Vent	1432	617	748	490	449	682	542	238		-10.8
	% change from LSD		26.3	-38.5	-7.4	5.5	-51.9	-20.7	2.1	12.5		
3	Highway ULSD	g/hr	20.35	15.77	12.71	8.09	6.77	11.30	11.32	3.44	11.6	
		CFM Vent	1231	954	769	489	410	683	685	2.6		-6.9
	% change from LSD		8.6	-5.0	-4.6	5.3	-56.2	-20.5	28.9	-1.5		
4	Stepan SB-W biodiesel	g/hr	15.31	12.80	8.59	6.33	11.56	12.07	6.91	4.03	9.8	
		CFM Vent	926	774	520	383	699	730	418	244		-21.3
	% change from LSD		-18.3	-22.9	-35.7	-17.5	-25.2	-15.1	-21.3	15.3		
5	IRE REG-9000-10 biodiesel	g/hr	17.62	10.71	10.52	6.90	8.46	13.52	9.09	3.63	10.2	
		CFM Vent	1066	648	636	418	512	818	550	219		-19.3
	% change from LSD		-6.0	-35.5	-21.3	-10.1	-45.2	-4.9	3.6	3.9		
6	IRE REG-9000-5 biodiesel	g/hr	20.78	14.09	11.70	6.06	10.09	13.14	9.55	3.71	11.4	
		CFM Vent	1257	852	708	366	611	795	578	225		-8.2
	% change from LSD		10.8	-15.1	-12.4	-21.2	-34.7	-7.5	8.9	6.4		
7	B50 Mix*	g/hr	19.74	13.18	11.79	6.29	13.76	11.39	9.28	3.46	11.3	
		CFM Vent	1194	797	713	380	833	689	561	209		-9.2
	% change from LSD		5.3	-20.6	-11.8	-18.2	-10.9	-19.9	5.7	-1.0		
8	PetroSA Fischer-Tropsch Syn.	g/hr	16.61	12.92	10.78	6.38	11.92	9.70	10.06	3.53	10.6	
		CFM Vent	1005	782	652	507	721	587	609	214		-14.9
	% change from LSD		-11.4	-22.1	-19.3	9.1	-22.9	-31.8	14.7	1.2		

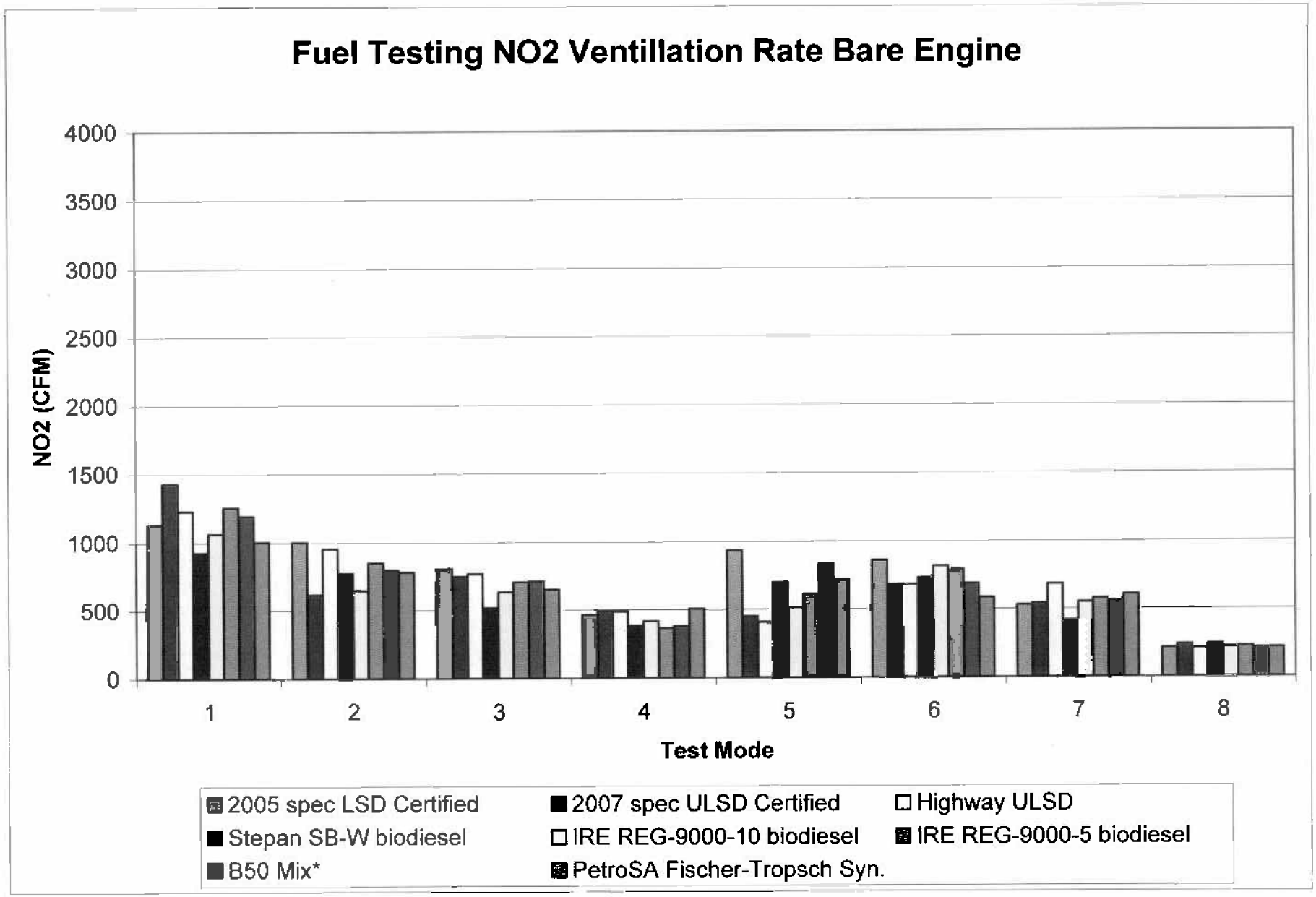
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

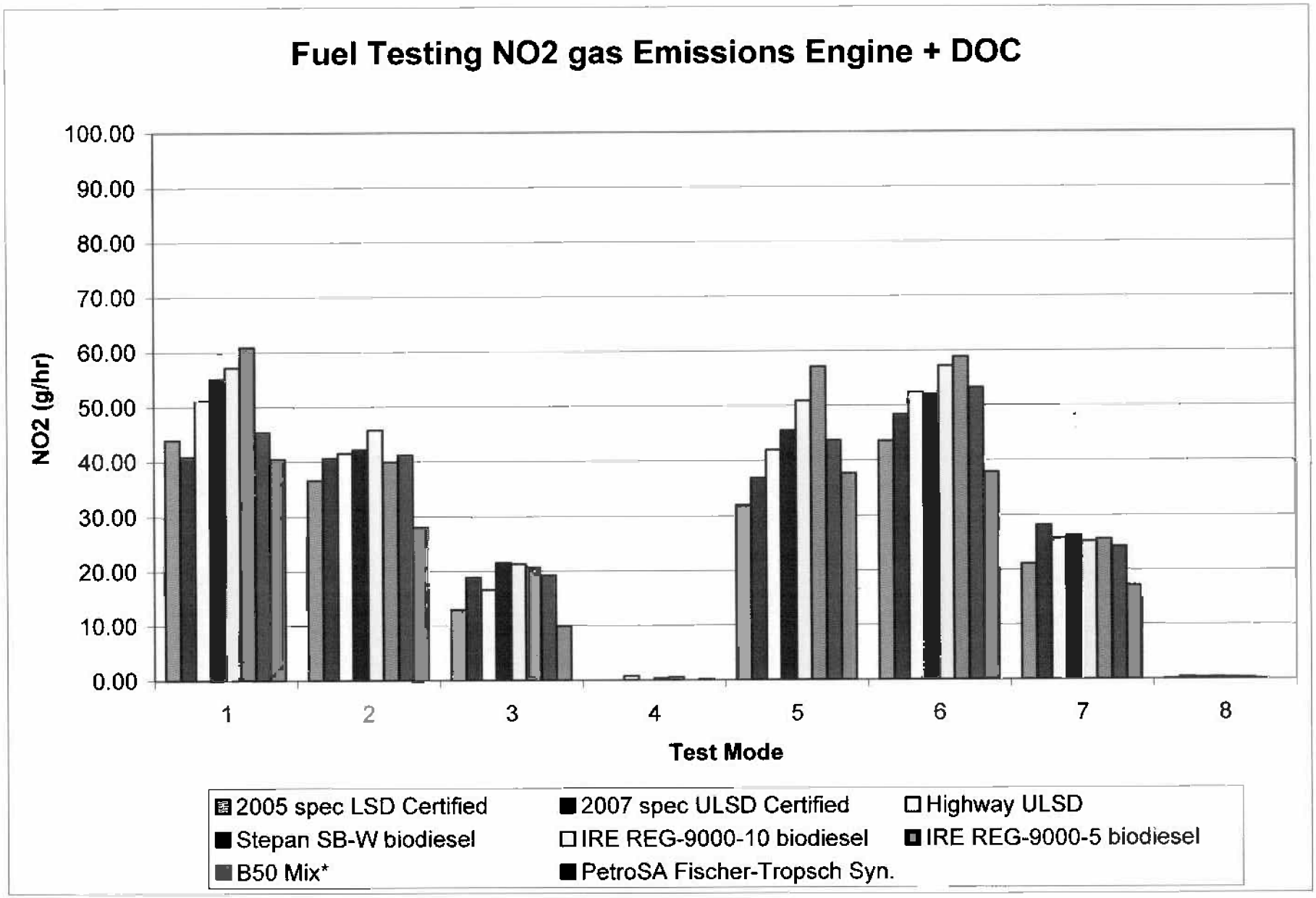
Engine +DOC Test

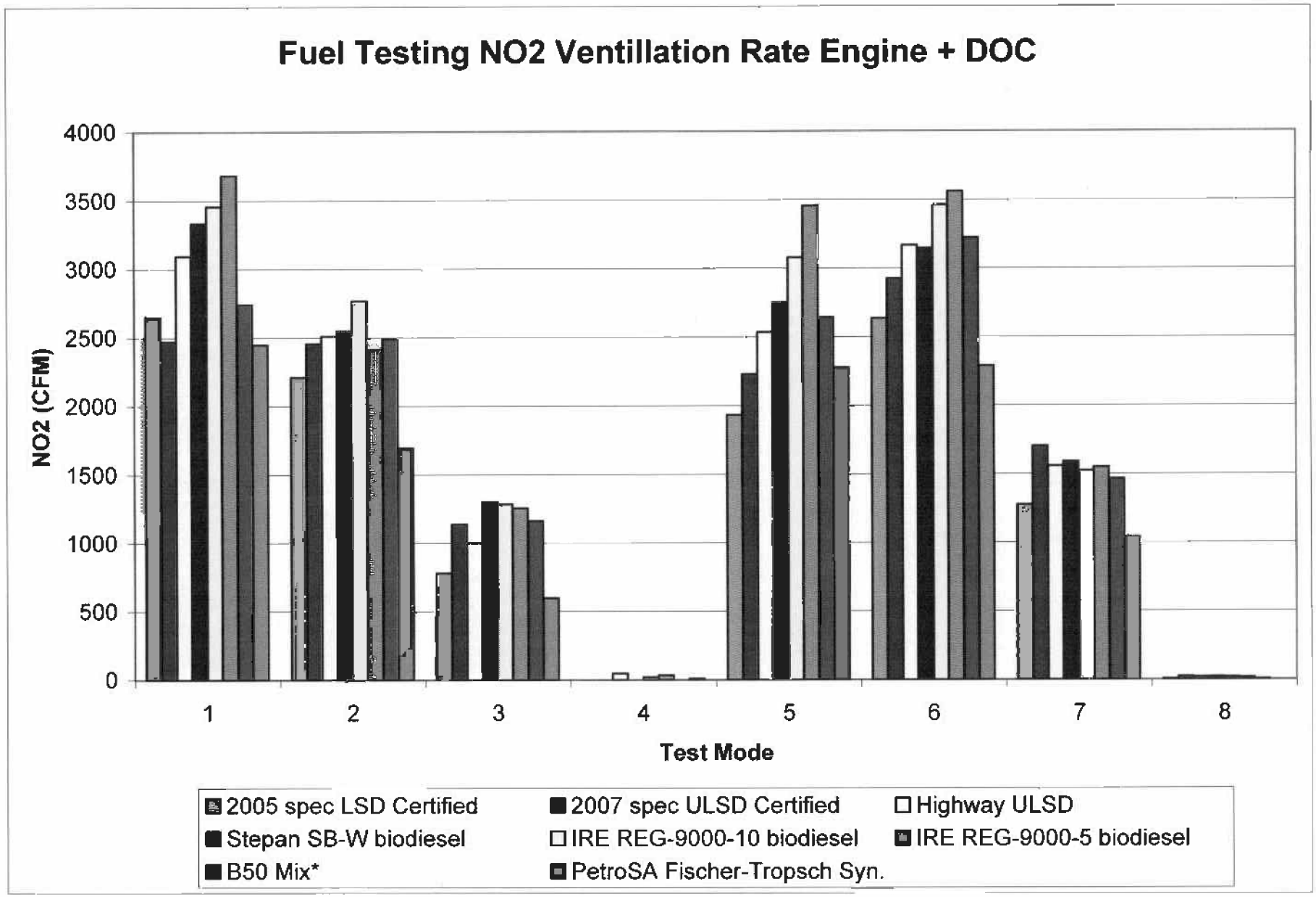
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	43.92	36.58	12.95	0.00	31.95	43.58	21.14	0.09	23.7	
		CFM Vent	2857	2213	783	0	1933	2636	1278	5		90.5
	% change from bare engine		134.3	120.4	-3.1	-100.0	106.8	206.6	140.9	-97.5		
2	2007 spec ULSD Certified	g/hr	40.88	40.62	18.84	0.00	36.86	48.36	28.18	0.37	26.4	
		CFM Vent	2473	2457	1140	0	2229	2925	1705	22		138.2
	% change from bare engine		72.7	298.0	52.3	-100.0	386.3	329.1	214.5	-90.6		
3	Highway ULSD	g/hr	51.19	41.52	16.55	0.77	41.93	52.37	25.78	0.30	28.6	
		CFM Vent	3096	2512	1002	47	2536	3168	1560	18		146.1
	% change from bare engine		151.5	163.2	30.3	-90.5	519.3	363.6	127.8	-91.2		
4	Stepan SB-W biodiesel	g/hr	55.14	42.17	21.56	0.00	45.51	52.01	26.33	0.33	30.3	
		CFM Vent	3336	2551	1303	0	2753	3146	1593	20		208.9
	% change from bare engine		260.1	229.5	150.8	-100.0	283.7	330.7	281.0	-91.9		
5	IRE REG-9000-10 biodiesel	g/hr	57.19	45.76	21.30	0.32	50.92	57.24	25.24	0.30	32.1	
		CFM Vent	3460	2768	1288	20	3080	3463	1527	18		215.2
	% change from bare engine		224.8	327.2	102.5	-95.3	501.6	323.3	177.5	-91.6		
6	IRE REG-9000-5 biodiesel	g/hr	60.89	39.93	20.78	0.57	57.17	58.90	25.65	0.25	32.5	
		CFM Vent	3684	2415	1257	34	3458	3563	1552	15		184.5
	% change from bare engine		193.1	183.5	77.8	-90.6	466.3	348.1	188.5	-93.3		
7	B50 Mix*	g/hr	45.32	41.18	19.22	0.00	43.69	53.29	24.26	0.09	28.0	
		CFM Vent	2742	2491	1163	0	2643	3224	1468	6		147.9
	% change from bare engine		129.6	212.5	63.1	-100.0	217.4	388.1	181.4	-97.3		
8	PetroSA Fischer-Tropsch Syn.	g/hr	40.48	28.04	9.90	0.16	37.67	37.85	17.24	0.05	21.1	
		CFM Vent	2449	1696	599	10	2278	2289	1043	0		99.0
	% change from bare engine		143.7	117.0	-8.1	98.1	216.0	290.2	71.3	-99.9		
		Weight Factors:	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD


Fuel Testing NO2 gas Emissions Bare Engine
NO2 (g/hr)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing NO2 Ventillation Rate Bare Engine
NO2 (CFM)
4000
3500
3000
2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing NO2 gas Emissions Engine + DOC
NO2 (g/hr)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing NO2 Ventillation Rate Engine + DOC
NO2 (CFM)
4000
3500
3000
2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
CO Emissions Data, gr/hr
with ventilation rates

Bare Engine Test

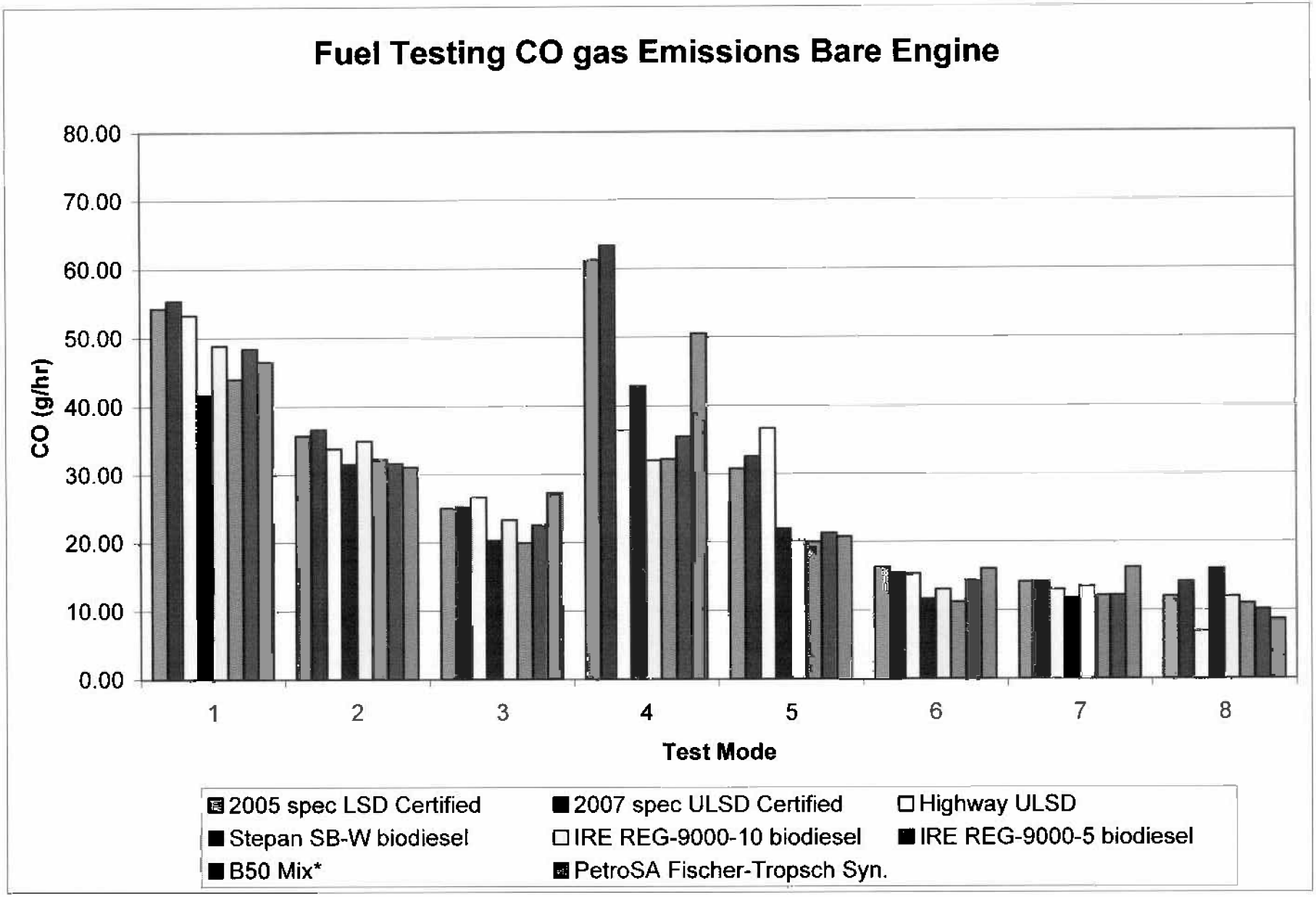
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	54.29	35.72	25.04	61.23	30.81	16.39	14.18	12.03	31.3	
		CFM Vent	539	355	249	609	306	163	141	120		
2	2007 spec ULSD Certified	g/hr	55.40	36.63	25.31	63.34	32.60	15.55	14.22	14.19	32.3	
		CFM Vent	551	364	252	630	324	155	141	141		3.1
	% change from LSD		2.0	2.6	1.1	3.4	5.8	-5.1	0.2	17.9		
3	Highway ULSD	g/hr	53.29	33.82	26.66	36.42	36.72	15.39	13.06	6.95	28.3	
		CFM Vent	530	336	265	362	365	153	130	69		-9.8
	% change from LSD		-1.8	-5.3	6.5	-40.5	19.2	-6.1	-7.9	-42.2		
4	Stepan SB-W biodiesel	g/hr	41.65	31.54	20.28	42.86	21.96	11.67	11.93	16.06	25.3	
		CFM Vent	414	313	202	426	218	116	119	160		-19.3
	% change from LSD		-23.3	-10.7	-19.0	-30.0	-28.7	-28.8	-15.9	33.5		
5	IRE REG-9000-10 biodiesel	g/hr	48.84	34.97	23.31	32.04	20.25	13.09	13.46	12.01	25.8	
		CFM Vent	485	348	232	318	201	130	134	119		-17.8
	% change from LSD		-10.0	-2.1	-6.9	-47.7	-34.3	-20.2	-5.1	-0.2		
6	IRE REG-9000-5 biodiesel	g/hr	43.97	32.24	19.95	32.22	20.05	11.20	12.17	10.98	23.6	
		CFM Vent	437	320	198	320	199	111	121	109		-24.5
	% change from LSD		-19.0	-9.7	-20.3	-47.4	-34.9	-31.6	-14.2	-8.8		
7	B50 Mix*	g/hr	48.38	31.65	22.53	35.53	21.32	14.35	12.20	10.14	26.2	
		CFM Vent	481	315	224	353	212	143	121	101		-19.4
	% change from LSD		-10.9	-11.4	-10.0	-42.0	-30.8	-12.5	-14.0	-15.7		
8	PetroSA Fischer-Tropsch Syn.	g/hr	46.46	31.13	27.31	50.54	20.80	16.10	16.26	8.67	27.4	
		CFM Vent	462	309	271	502	207	160	162	86		-12.5
	% change from LSD		-14.4	-12.8	9.1	-17.5	-32.5	-1.8	14.6	-27.9		

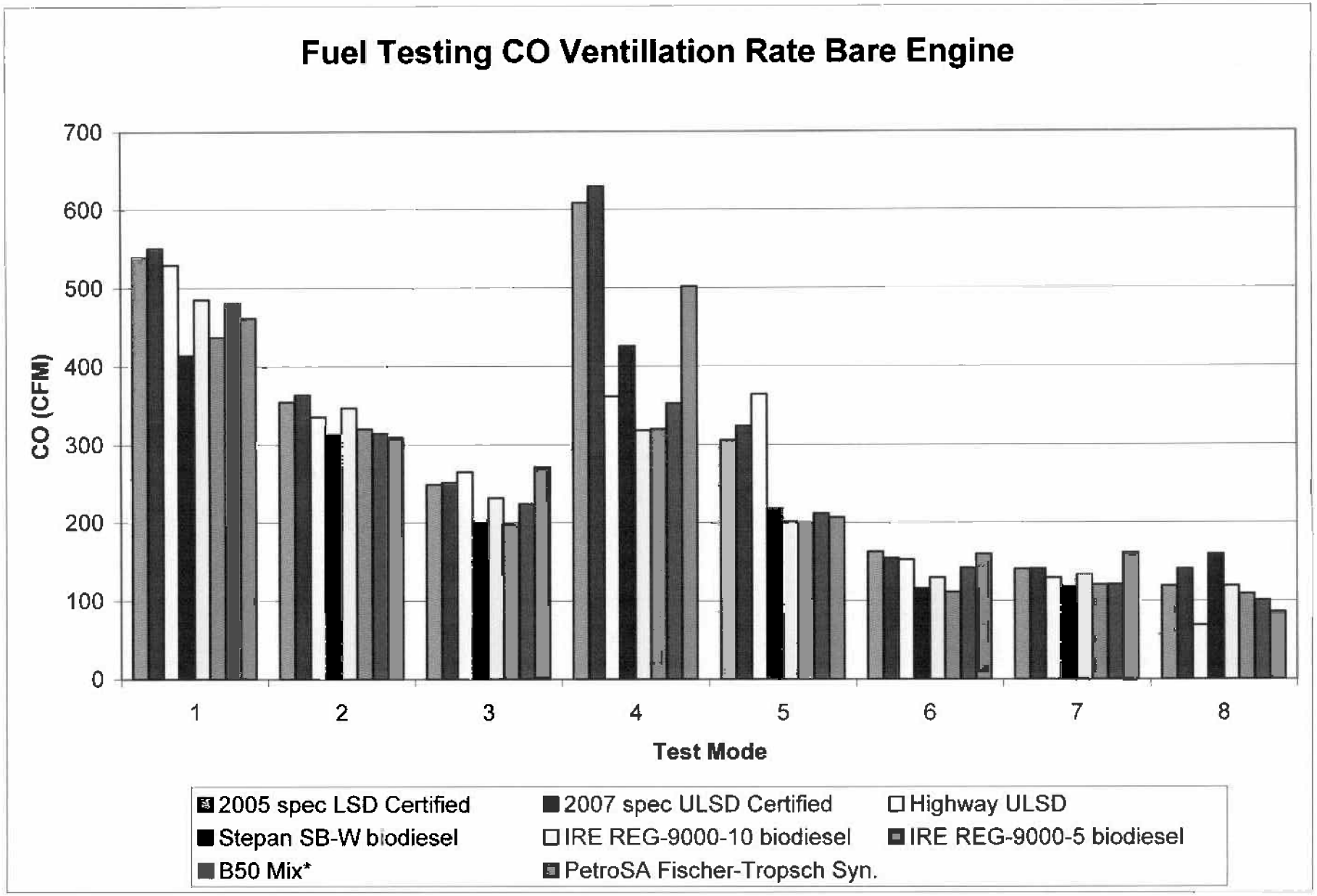
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

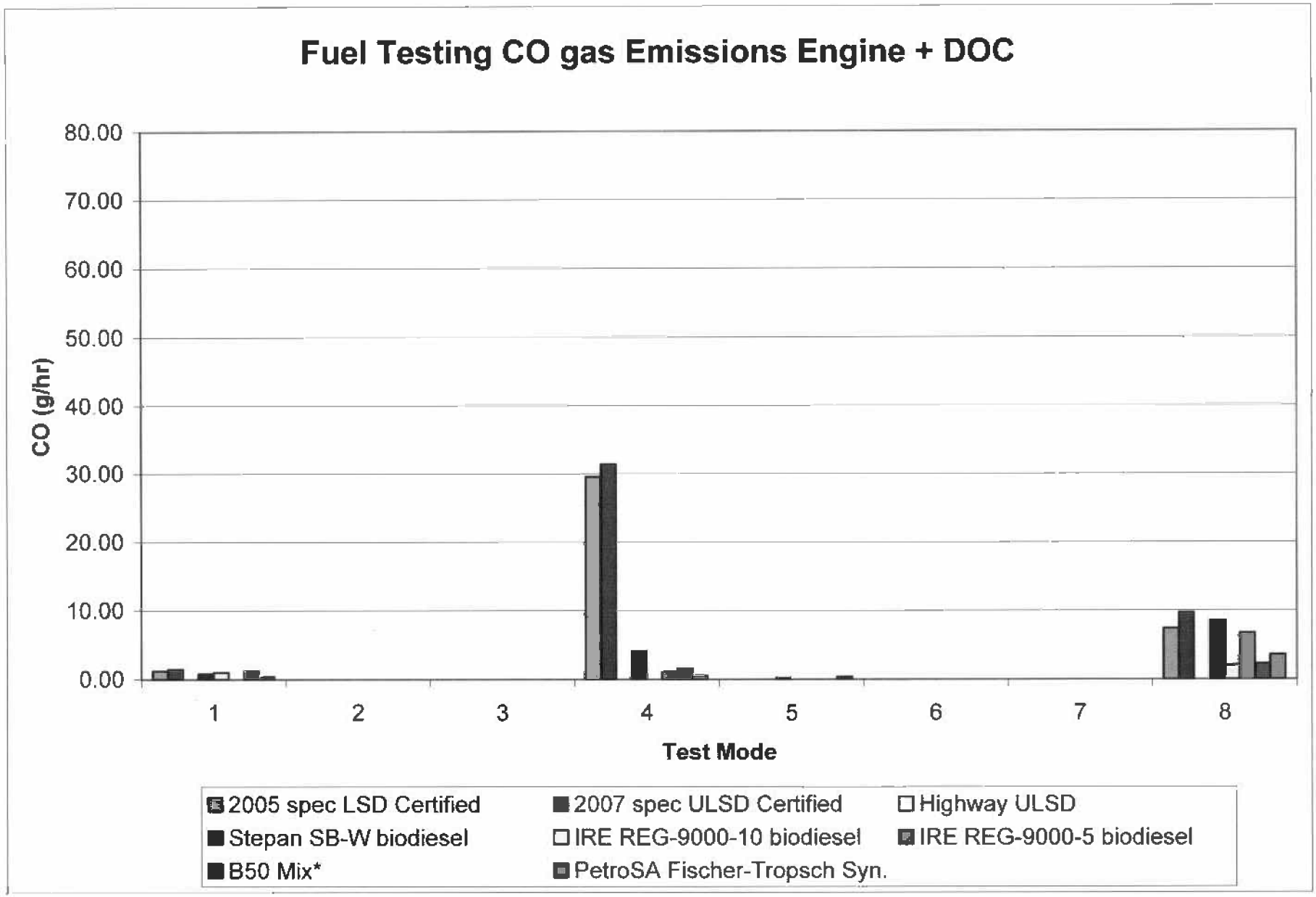
Engine +DOC Test

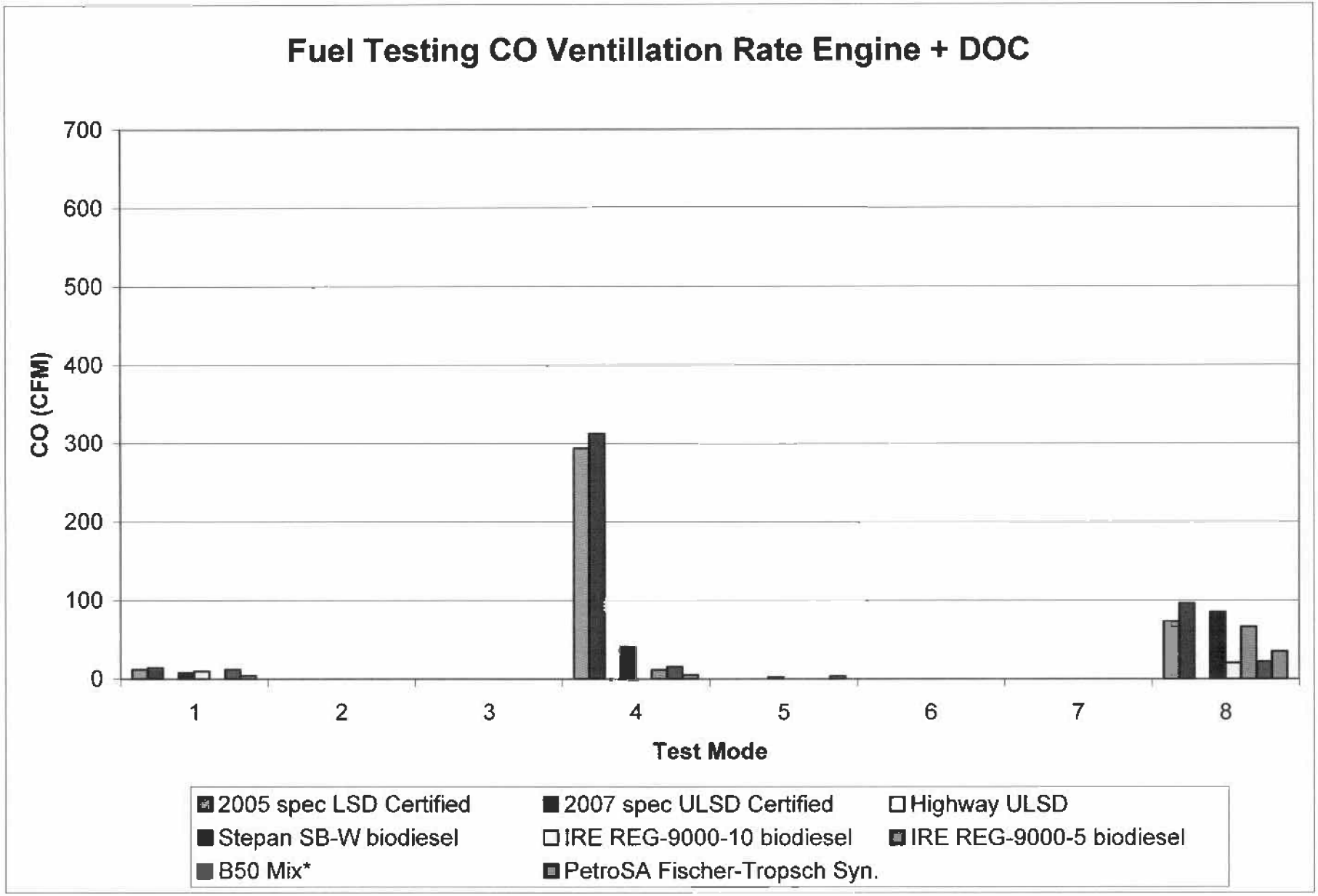
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	1.22	0.00	0.00	29.56	0.00	0.00	0.00	7.40	4.2	
		CFM Vent	12	0	0	284	0	0	0	74		-96.4
	% change from bare engine		-97.8	-100.0	-100.0	-51.7	-100.0	-100.0	-100.0	-38.5		
2	2007 spec ULSD Certified	g/hr	1.44	0.00	0.00	31.41	0.00	0.00	0.00	9.69	4.8	
		CFM Vent	14	0	0	312	0	0	0	96		-85.1
	% change from bare engine		-97.4	-100.0	-100.0	-50.4	-100.0	-100.0	-100.0	-31.7		
3	Highway ULSD	g/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
		CFM Vent	0	0	0	0	0	0	0	0		-100.0
	% change from bare engine		-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0		
4	Stepan SB-W biodiesel	g/hr	0.80	0.00	0.00	4.20	0.23	0.00	0.00	8.59	1.9	
		CFM Vent	8	0	0	42	2	0	0	85		-92.7
	% change from bare engine		-98.1	-100.0	-100.0	-90.2	-98.9	-100.0	-100.0	-46.5		
5	IRE REG-9000-10 biodiesel	g/hr	1.01	0.00	0.00	0.00	0.00	0.00	0.00	2.15	0.5	
		CFM Vent	10	0	0	0	0	0	0	21		-98.2
	% change from bare engine		-97.9	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-82.5		
6	IRE REG-9000-5 biodiesel	g/hr	0.00	0.00	0.00	1.19	0.00	0.00	0.00	6.72	1.1	
		CFM Vent	0	0	0	12	0	0	0	67		-95.2
	% change from bare engine		-100.0	-100.0	-100.0	-96.3	-100.0	-100.0	-100.0	-38.8		
7	B50 Mix*	g/hr	1.23	0.00	0.00	1.58	0.00	0.00	0.00	2.28	0.7	
		CFM Vent	12	0	0	16	0	0	0	22		-97.3
	% change from bare engine		-97.6	-100.0	-100.0	-95.6	-100.0	-100.0	-100.0	-77.7		
8	PetroSA Fischer-Tropsch Syn.	g/hr	0.41	0.00	0.00	0.53	0.36	0.00	0.00	3.57	0.7	
		CFM Vent	4	0	0	5	4	0	0	35		-97.5
	% change from bare engine		-99.1	-100.0	-100.0	-98.9	-98.3	-100.0	-100.0	-58.9		
		Weight Factors:	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15		

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD


Fuel Testing CO gas Emissions Bare Engine
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
CO (g/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing CO Ventillation Rate Bare Engine
CO (CFM)
700
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing CO gas Emissions Engine + DOC
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
CO (g/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing CO Ventillation Rate Engine + DOC
CO (CFM)
700
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
CO2 Emissions Data, gr/hr
with ventilation rates

Bare Engine Test

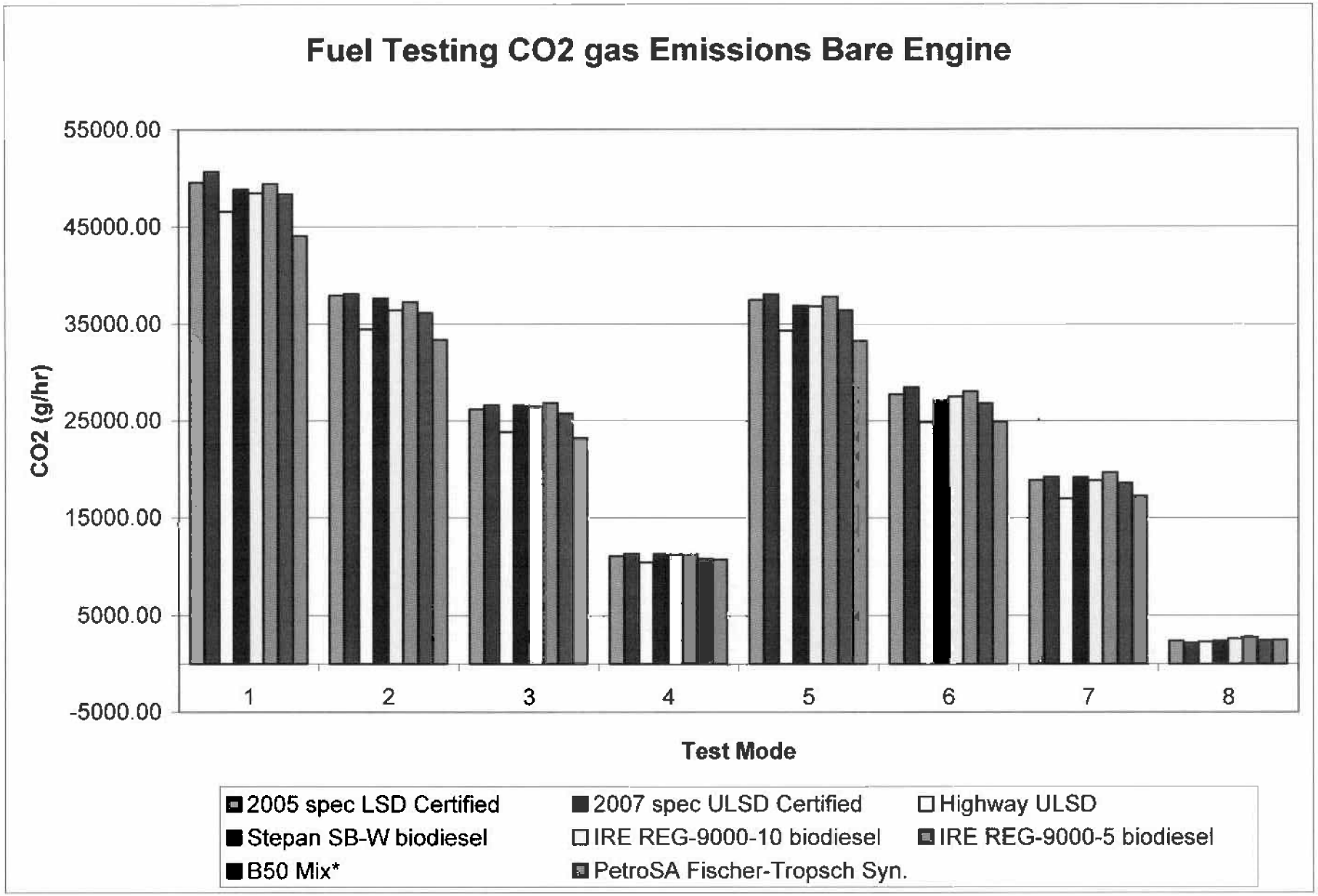
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	49561.67	37960.34	26179.77	11112.84	37466.47	27730.09	18918.68	2393.43	26937.1	
		CFM Vent	3122	2392	1649	700	2360	1747	1192	151		
2	2007 spec ULSD Certified	g/hr	50682.10	38116.28	26611.30	11348.76	38054.78	28444.86	19246.04	2188.60	27349.2	
		CFM Vent	3193	2401	1677	715	2397	1792	1213	138		1.6
	% change from LSD		2.3	0.4	1.6	2.1	1.6	2.6	1.7	-8.8		
3	Highway ULSD	g/hr	46572.34	34456.06	23842.35	10470.32	34330.64	24874.17	17012.15	2306.15	24745.1	
		CFM Vent	2934	2171	1502	660	2163	1567	1072	145		-8.1
	% change from LSD		-6.0	-9.2	-8.9	-5.8	-8.4	-10.3	-10.1	-3.6		
4	Stepan SB-W biodiesel	g/hr	48871.44	37659.48	26619.19	11359.65	36894.17	27162.13	19241.14	2406.26	26799.2	
		CFM Vent	3079	2373	1677	716	2324	1711	1212	152		-0.5
	% change from LSD		-1.4	-0.8	1.7	2.2	-1.5	-2.0	1.7	0.5		
5	IRE REG-9000-10 biodiesel	g/hr	48449.12	36452.19	26498.33	11261.61	36824.16	27484.58	18932.16	2638.30	26551.9	
		CFM Vent	3052	2296	1569	709	2320	1732	1190	166		-1.4
	% change from LSD		-2.2	-4.0	1.2	1.3	-1.7	-0.9	-0.1	10.2		
6	IRE REG-9000-5 biodiesel	g/hr	49406.47	37287.40	26836.36	11328.75	37799.52	28038.41	19721.28	2817.31	27140.9	
		CFM Vent	3113	2349	1691	714	2381	1766	1242	177		0.8
	% change from LSD		-0.3	-1.8	2.5	1.9	0.9	1.1	4.2	17.7		
7	B50 Mix*	g/hr	48341.96	36168.07	25755.46	10842.00	36426.12	26809.15	18645.03	2464.28	26180.2	
		CFM Vent	3046	2279	1623	683	2295	1689	1175	155		-2.8
	% change from LSD		-2.5	-4.7	-1.5	-2.4	-2.8	-3.3	-1.4	2.5		
8	PetroSA Fischer-Tropsch Syn.	g/hr	44068.42	33373.94	23250.68	10758.95	33257.19	24930.60	17291.59	2488.12	24101.0	
		CFM Vent	2776	2103	1465	678	2095	1571	1089	157		-10.5
	% change from LSD		-11.1	-12.1	-11.2	-3.2	-11.2	-10.1	-8.6	4.0		

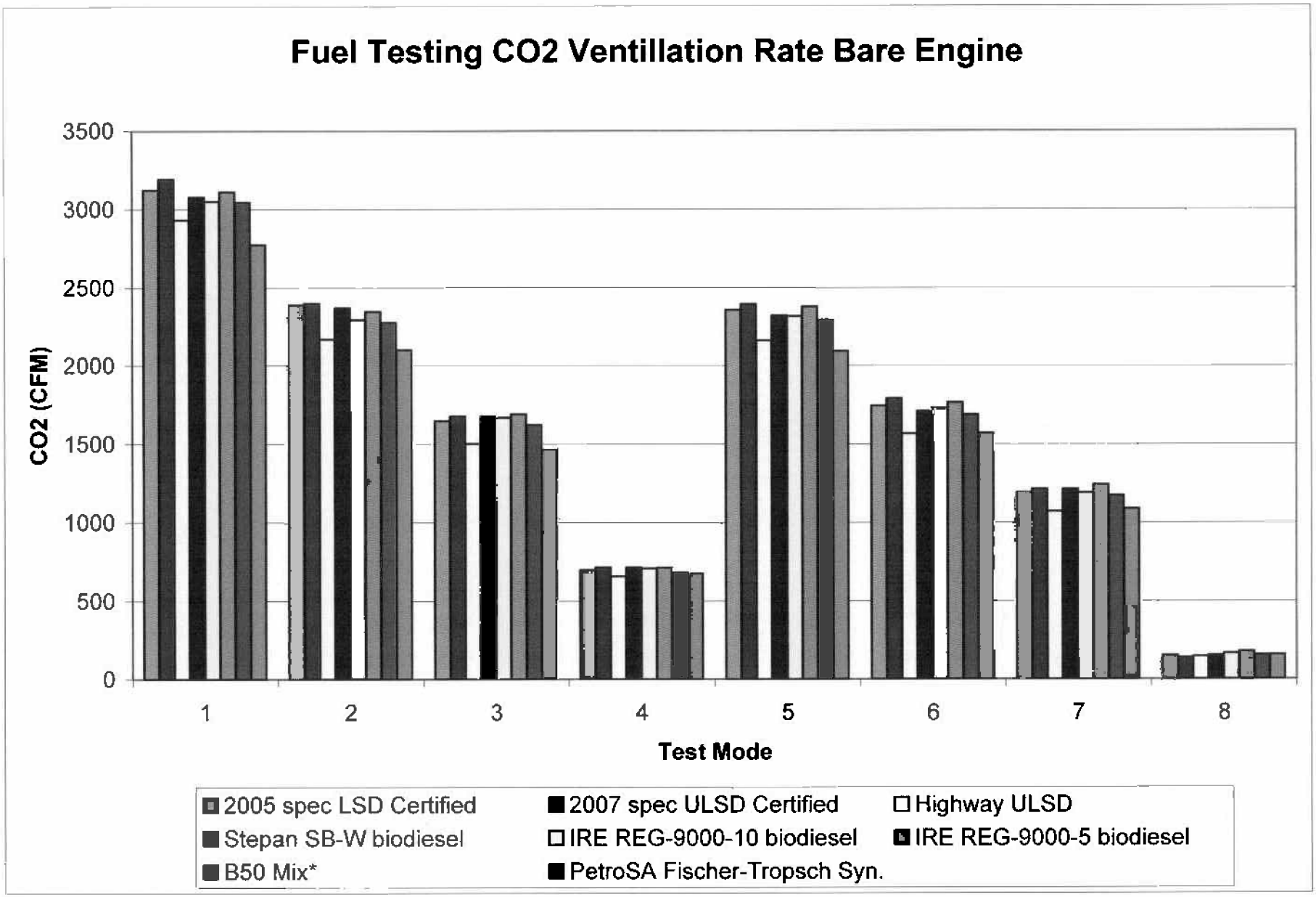
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD

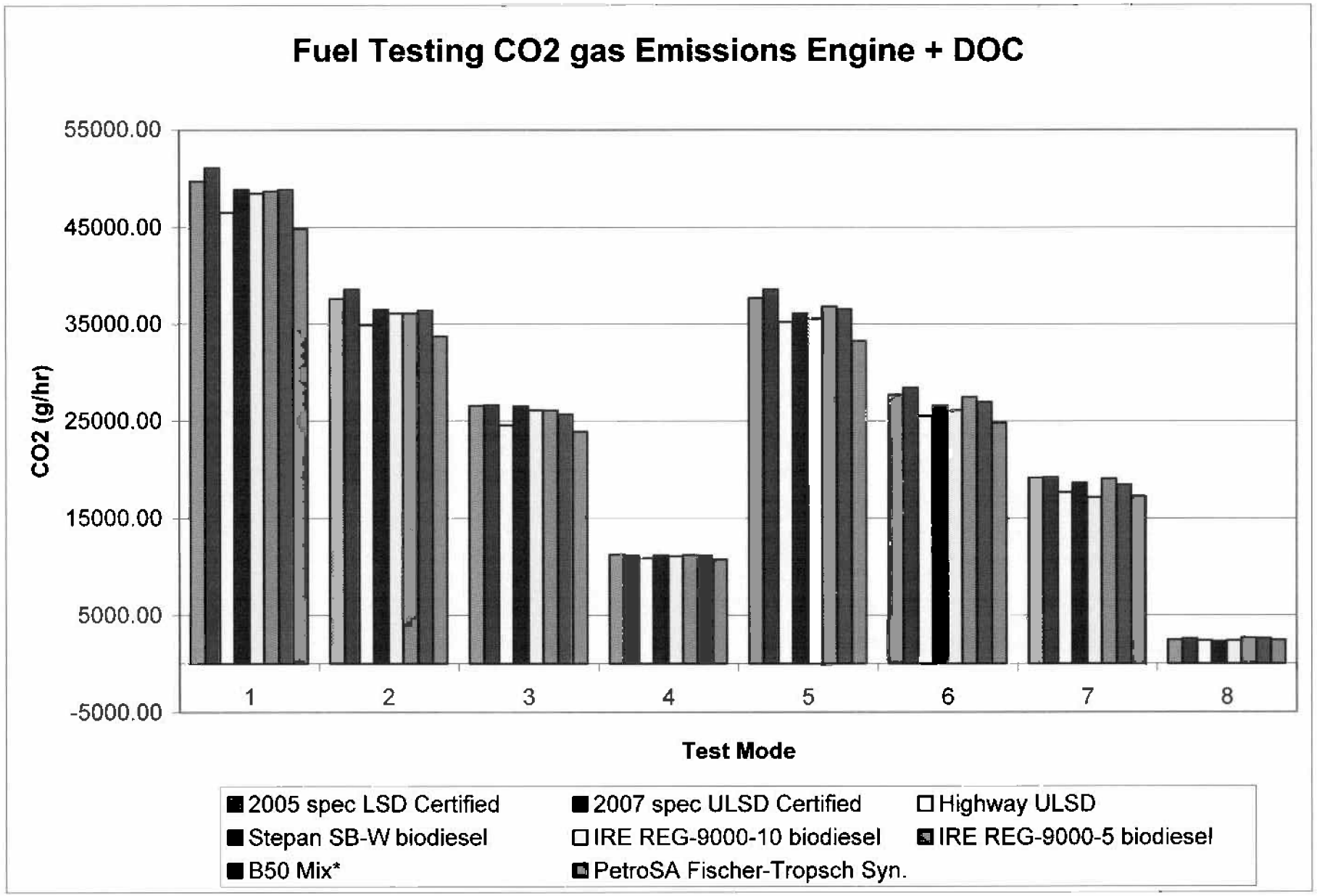
Engine +DOC Test

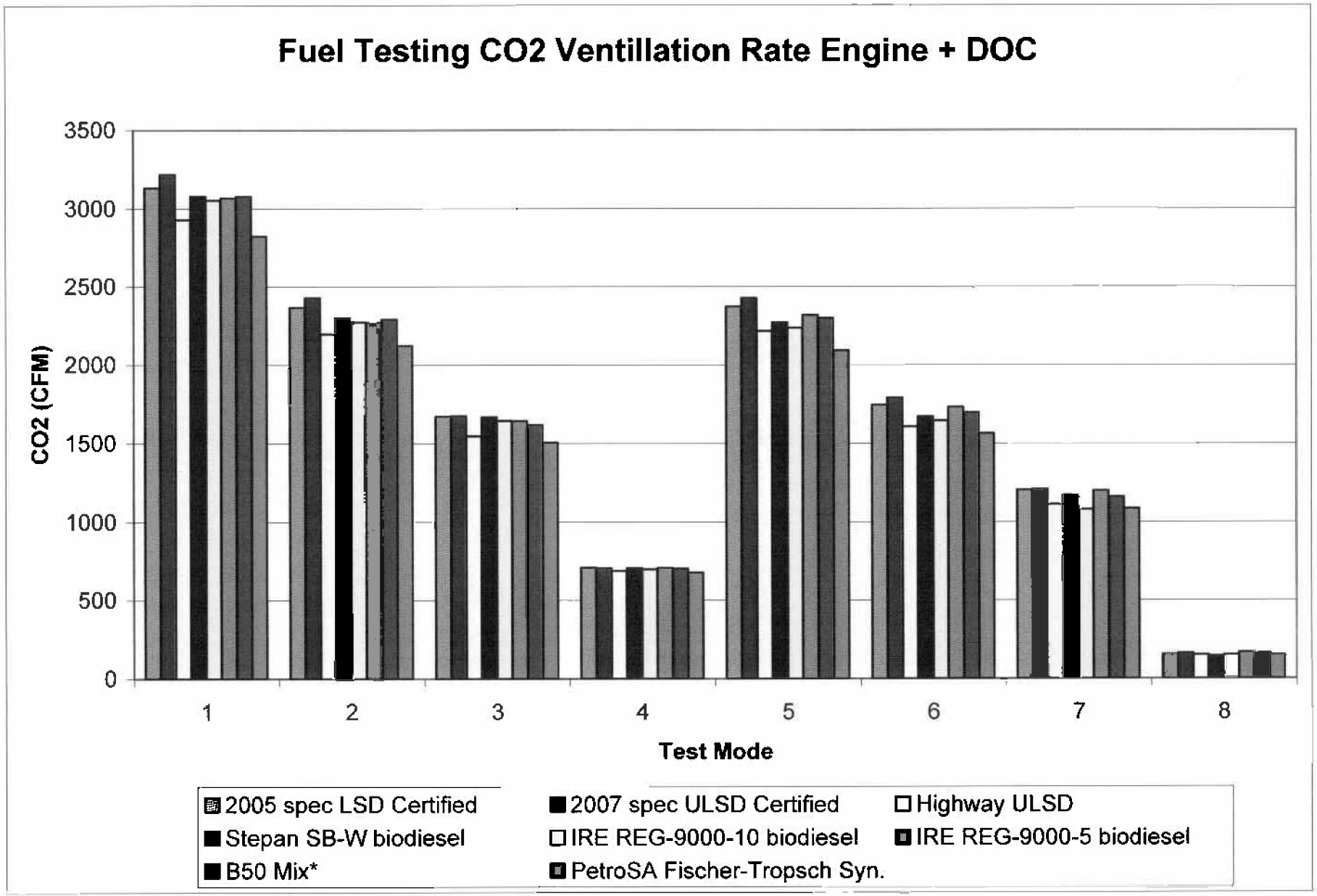
Fuel No.	FUEL		Test Mode 1	2	3	4	5	6	7	8	Weighted Average	Weighted Average %Difference
1	2005 spec LSD Certified	g/hr	49730.22	37583.95	26545.83	11275.04	37690.64	27711.02	19128.31	2445.84	27026.4	
		CFM Vent	3133	2368	1672	710	2375	1746	1205	154		0.3
	% change from bare engine		0.3	-1.0	1.4	1.5	0.6	-0.1	1.1	2.2		
2	2007 spec ULSD Certified	g/hr	51105.09	38565.46	26600.15	11196.67	38569.78	28451.18	19203.65	2567.94	27567.8	
		CFM Vent	3220	2430	1676	705	2430	1792	1210	162		0.8
	% change from bare engine		0.8	1.2	0.0	-1.3	1.4	0.0	-0.2	17.3		
3	Highway ULSD	g/hr	46524.75	34872.78	24552.80	10927.97	35197.91	25525.75	17690.55	2383.74	25184.3	
		CFM Vent	2931	2197	1547	688	2217	1603	1115	150		1.8
	% change from bare engine		-0.1	1.2	3.0	4.4	2.5	2.6	4.0	3.4		
4	Stepan SB-W biodiesel	g/hr	48882.10	36478.06	26482.98	11210.55	36078.39	26545.49	18642.61	2280.63	26366.3	
		CFM Vent	3080	2298	1668	706	2273	1672	1174	144		-1.6
	% change from bare engine		0.0	-3.1	-0.5	-1.3	-2.2	-2.3	-3.1	-5.2		
5	IRE REG-9000-10 biodiesel	g/hr	48483.31	36089.99	26109.38	11106.74	35535.06	26124.89	17192.09	2389.28	26956.7	
		CFM Vent	3054	2274	1645	700	2239	1646	1083	151		-2.2
	% change from bare engine		0.1	-1.0	-1.5	-1.4	-3.5	-4.9	-9.0	-9.4		
6	IRE REG-9000-5 biodiesel	g/hr	48692.86	36084.91	26084.04	11236.53	36815.60	27501.28	19056.74	2661.05	26489.4	
		CFM Vent	3068	2273	1643	708	2319	1733	1201	168		-2.4
	% change from bare engine		-1.4	-3.2	-2.8	-0.8	-2.8	-1.9	-3.4	-5.5		
7	B50 Mix*	g/kr	48871.32	36386.24	25703.02	11161.90	36512.10	26976.25	18435.94	2598.84	26342.5	
		CFM Vent	3079	2292	1619	703	2300	1700	1161	164		0.6
	% change from bare engine		1.1	0.6	-0.2	3.0	0.2	0.6	-1.1	5.8		
8	PetroSA Fischer-Tropsch Syn.	g/hr	44826.11	33702.06	23906.04	10777.67	33257.31	24822.01	17274.02	2420.38	24341.3	
		CFM Vent	2824	2123	1506	679	2095	1564	1088	152		1.0
	% change from bare engine		1.7	1.0	2.8	0.2	0.0	-0.4	-0.1	-2.7		

Weight Factors:


Fuel Testing CO2 gas Emissions Bare Engine
55000.00
45000.00
35000.00
25000.00
15000.00
5000.00
-5000.00
CO2 (g/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing CO2 Ventillation Rate Bare Engine
CO2 (CFM)
3500
3000
2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing CO2 gas Emissions Engine + DOC
55000.00
45000.00
35000.00
25000.00
15000.00
5000.00
-5000.00
CO2 (g/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing CO2 Ventillation Rate Engine + DOC
CO2 (CFM)
3500
3000
2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
Engine Power (HP)

Bare Engine Test

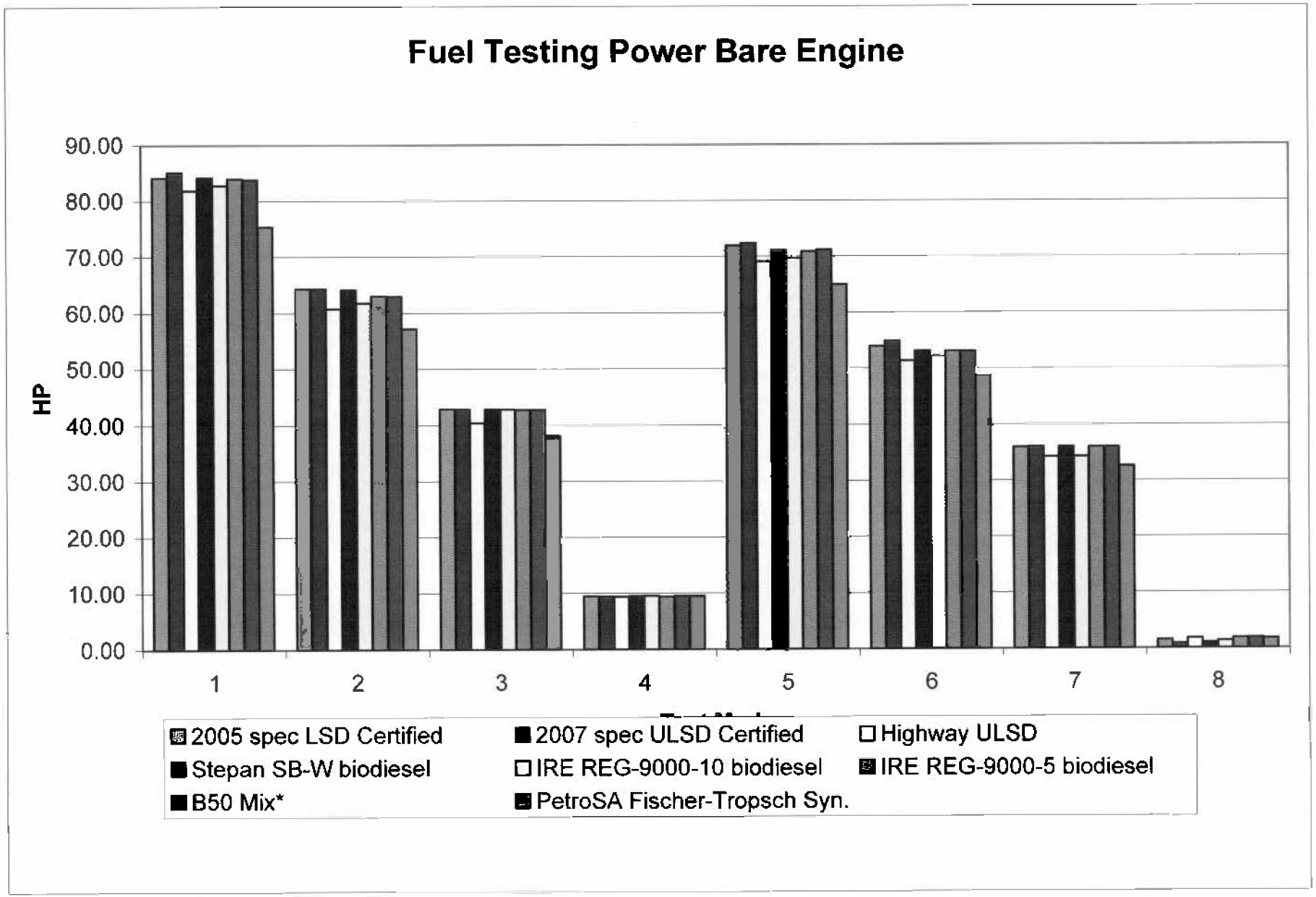
Fuel No.	FUEL	Test Mode 1	2	3	4	5	6	7	8			
1	2005 spec LSD Certified	84.16	64.31	42.88	9.48	71.96	53.98	35.95	1.52	HP		
2	2007 spec ULSD Certified	85.15	64.31	42.83	9.44	72.34	54.86	36.03	0.81	HP		
	% change from LSD	1.2	0.0	-0.1	-0.4	0.5	1.6	0.2	-46.3		0.4	AVE CHANGE**
3	Highway ULSD	81.89	60.79	40.43	9.40	69.11	51.38	34.26	1.82	HP		
	% change from LSD	-2.7	-5.5	-5.7	-0.8	-4.0	-4.8	-4.7	20.0		-4.0	AVE CHANGE
4	Stepan SB-W biodiesel	84.18	64.15	42.87	9.53	71.11	53.12	36.02	1.05	HP		
	% change from LSD	0.0	-0.2	0.0	0.5	-1.2	-1.6	0.2	-30.8		-0.3	AVE CHANGE
5	IRE REG-9000-10 biodiesel	82.77	61.80	42.83	9.55	69.67	52.22	34.29	1.35	HP		
	% change from LSD	-1.7	-3.9	-0.1	0.8	-3.2	-3.3	-4.6	-11.0		-2.3	AVE CHANGE
6	IRE REG-9000-5 biodiesel	83.98	63.04	42.73	9.40	70.90	53.12	35.98	1.84	HP		
	% change from LSD	-0.2	-2.0	-0.3	-0.9	-1.5	-1.6	0.1	21.3		-0.9	AVE CHANGE
7	B50 Mix*	83.82	62.94	42.74	9.53	71.22	53.10	35.97	1.90	HP		
	% change from LSD	-0.4	-2.1	-0.3	0.5	-1.0	-1.6	0.1	25.2		-0.7	AVE CHANGE
8	PetroSA Fischer-Tropsch Syn.	75.37	57.17	38.12	9.53	65.01	48.81	32.62	1.78	HP		
	% change from LSD	-10.4	-11.1	-11.1	0.5	-9.7	-9.6	-9.3	17.4		-8.7	AVE CHANGE

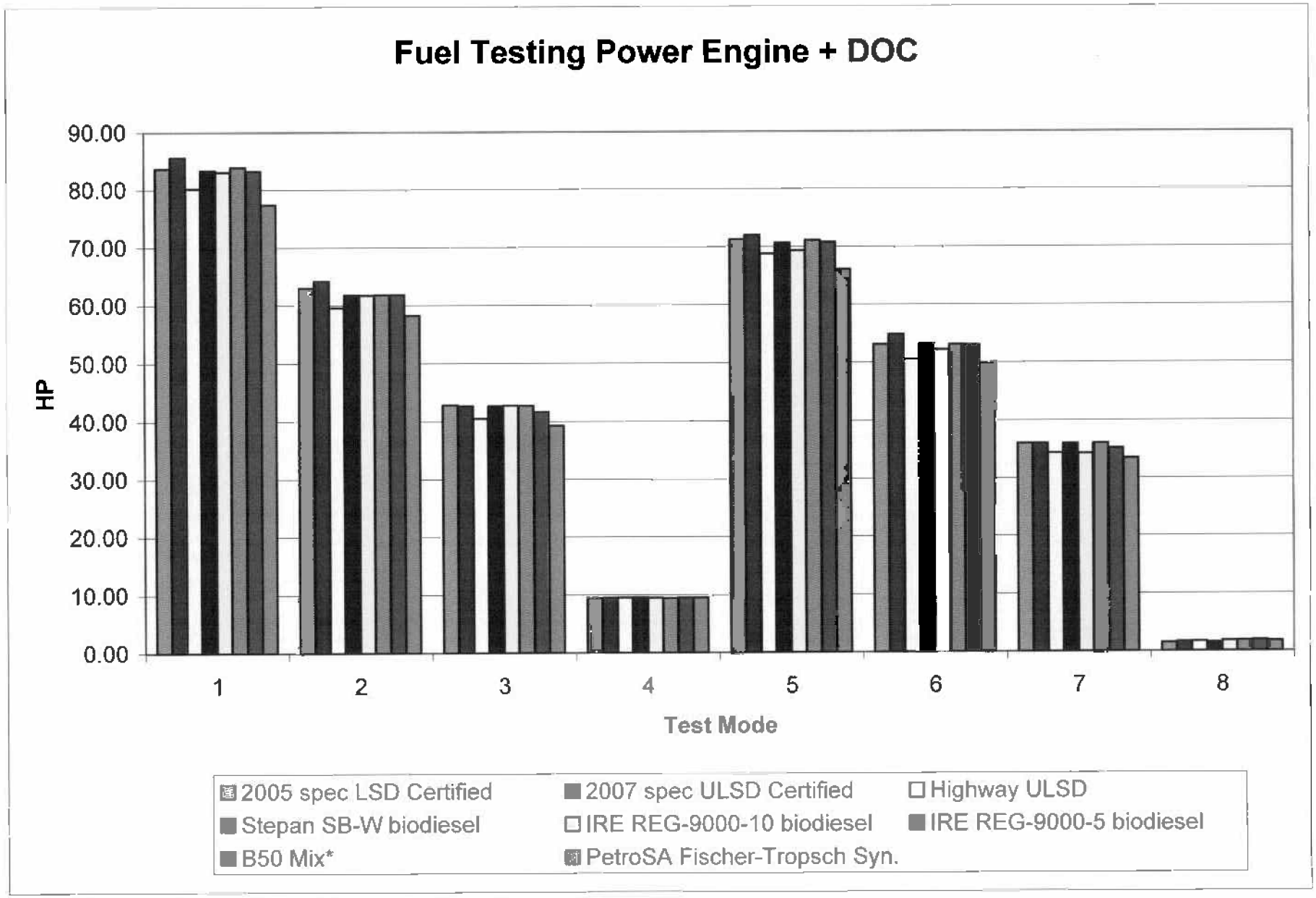
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD ** mode 8 discounted in average change

Engine +DOC Test

	FUEL	Test Mode 1	2	3	4	5	6	7	8			
1	2005 spec LSD Certified	83.68	63.06	42.88	9.51	71.28	53.16	36.03	1.48	HP		
	% change from bare engine	-0.6	-1.9	0.0	0.3	-0.9	-1.5	0.2	-2.5		-0.6	AVE CHANGE**
2	2007 spec ULSD Certified	85.66	64.20	42.74	9.49	72.02	54.85	36.01	1.63	HP		
	% change from bare engine	0.60	-0.17	-0.21	0.47	-0.44	-0.02	-0.07	100.76		0.0	AVE CHANGE
3	Highway ULSD	80.22	59.62	40.55	9.56	68.80	50.56	34.34	1.67	HP		
	% change from bare engine	-2.04	-1.92	0.30	1.65	-0.45	-1.61	0.23	-8.11		-0.5	AVE CHANGE
4	Stepan SB-W biodiesel	83.39	61.86	42.72	9.60	70.67	53.17	35.99	1.52	HP		
	% change from bare engine	-0.94	-3.57	-0.34	0.75	-0.62	0.08	-0.09	44.79		-0.7	AVE CHANGE
5	IRE REG-9000-10 biodiesel	83.07	61.82	42.80	9.48	69.35	52.23	34.27	1.79	HP		
	% change from bare engine	0.37	0.03	-0.06	-0.72	-0.46	0.01	-0.05	32.49		-0.1	AVE CHANGE
6	IRE REG-9000-5 biodiesel	83.93	61.89	42.77	9.42	71.09	53.11	36.00	1.84	HP		
	% change from bare engine	-0.07	-1.82	0.08	0.20	0.27	-0.02	0.06	0.03		-0.2	AVE CHANGE
8	B50 Mix*	83.24	61.88	41.65	9.51	70.81	53.05	35.17	1.91	HP		
	% change from bare engine	-0.69	-1.68	-2.55	-0.18	-0.57	-0.10	-2.23	0.50		-1.1	AVE CHANGE
8	PetroSA Fischer-Tropsch Syn.	77.41	58.29	39.31	9.52	66.11	49.73	33.41	1.74	HP		
	% change from bare engine	2.71	1.97	3.13	-0.08	1.70	1.89	2.41	-2.40		2.0	AVE CHANGE

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD ** mode 8 discounted in average change


Fuel Testing Power Bare Engine
HP
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1
2
3
4
5
6
7
8
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing Power Engine + DOC
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
HP
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.

FUEL TESTING on Isuzu 4JG1T Diesel Engine
Fuel Consumption (lb/hr)

Bare Engine Test

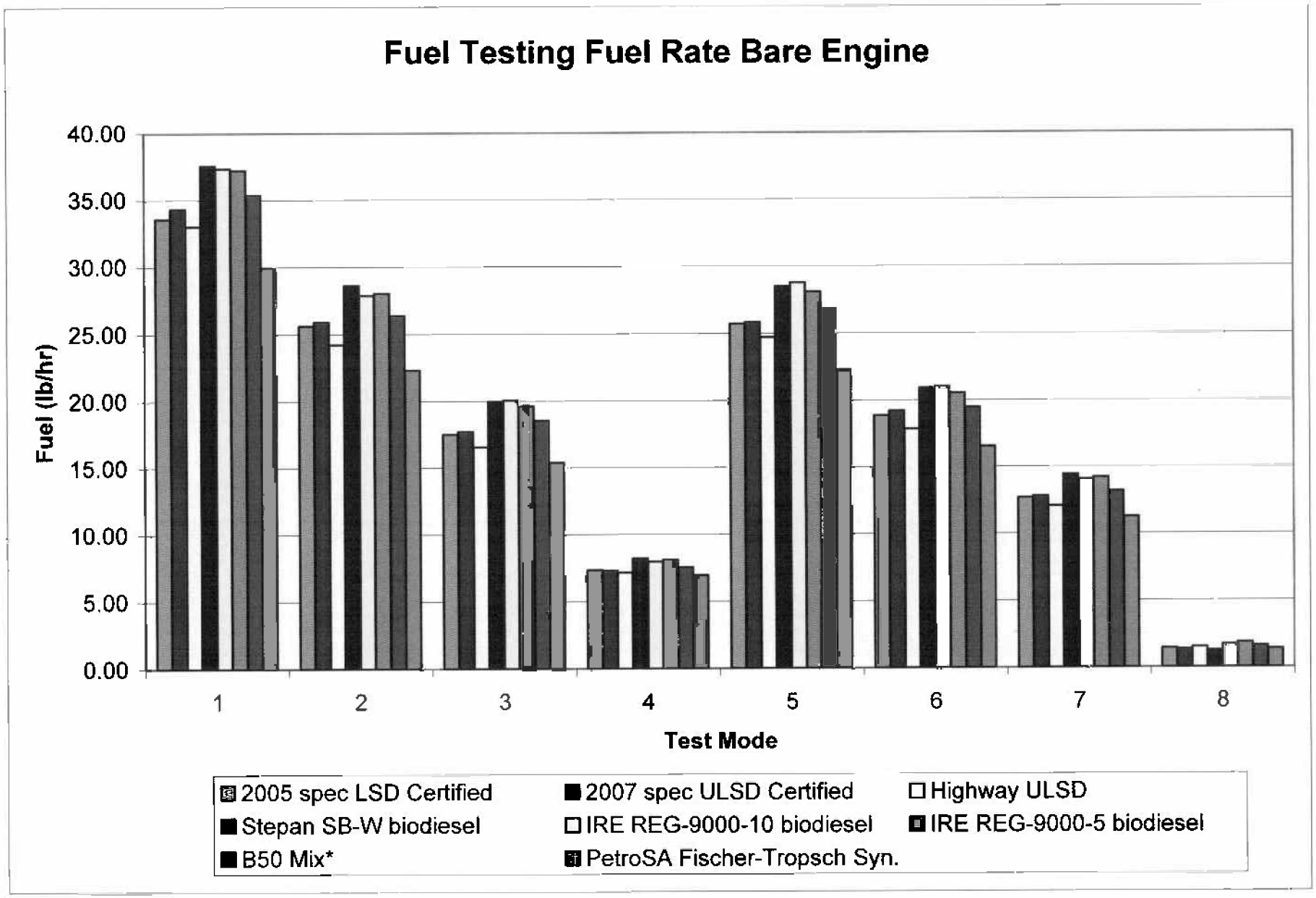
Fuel No.	FUEL	Test Mode 1	2	3	4	5	6	7	8		
1	2005 spec LSD Certified	33.60	25.61	17.51	7.35	25.72	18.88	12.68	1.44	lb/hr	
2	2007 spec ULSD Certified	34.34	25.90	17.72	7.30	25.84	19.20	12.79	1.34	lb/hr	
	% change from LSD	2.2	1.1	1.2	-0.7	0.5	1.7	0.8	-6.5	1.0	AVE CHANGE**
3	Highway ULSD	33.05	24.23	16.57	7.16	24.72	17.85	12.05	1.52	lb/hr	
	% change from LSD	-1.6	-5.4	-5.4	-2.6	-3.9	-5.5	-5.0	5.9	-4.2	AVE CHANGE
4	Stepan SB-W biodiesel	37.57	28.62	19.98	8.21	28.50	20.92	14.41	1.25	lb/hr	
	% change from LSD	11.8	11.7	14.1	11.7	10.8	10.8	13.6	-12.9	12.1	AVE CHANGE
5	IRE REG-9000-10 biodiesel	37.36	27.88	20.06	7.98	28.77	21.03	14.05	1.71	lb/hr	
	% change from LSD	11.2	8.8	14.6	8.5	11.8	11.4	10.8	19.2	11.0	AVE CHANGE
6	IRE REG-9000-5 biodiesel	37.22	28.03	19.62	8.12	28.10	20.54	14.19	1.84	lb/hr	
	% change from LSD	10.8	9.4	12.1	10.4	9.2	8.7	11.9	27.9	10.4	AVE CHANGE
7	B50 Mix*	35.36	26.37	18.54	7.55	26.81	19.47	13.16	1.60	lb/hr	
	% change from LSD	5.3	3.0	5.9	2.7	4.2	3.1	3.8	11.3	4.0	AVE CHANGE
8	PetroSA Fischer-Tropsch Syn.	29.91	22.31	15.40	6.97	22.30	16.54	11.24	1.37	lb/hr	
	% change from LSD	-11.0	-12.9	-12.1	-5.2	-13.3	-12.4	-11.4	-4.5	-11.2	AVE CHANGE

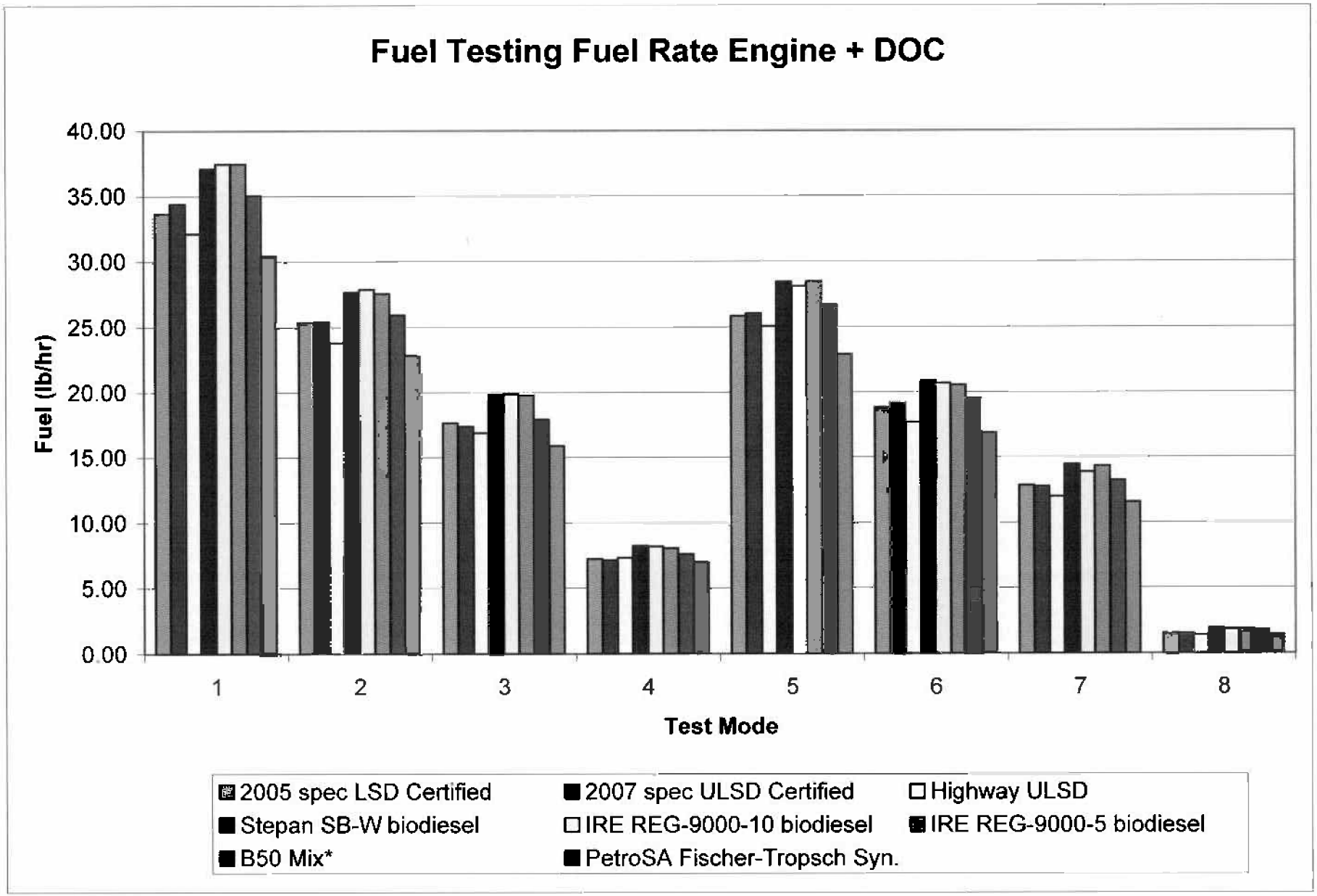
*B50: 50/50 Mix of Stepan SB-W and Highway ULSD ** mode 8 discounted in average change

Engine +DOC Test

	FUEL	Test Mode 1	2	3	4	5	6	7	8		
1	2005 spec LSD Certified	33.66	25.38	17.64	7.24	25.83	18.85	12.84	1.55	lb/hr	
	% change from bare engine	0.2	-0.9	0.7	-1.6	0.4	-0.2	1.2	7.6	0.0	AVE CHANGE
2	2007 spec ULSD Certified	34.41	25.45	17.37	7.14	26.04	19.18	12.74	1.50	lb/hr	
	% change from bare engine	0.21	-1.74	-1.96	-2.27	0.78	-0.09	-0.33	11.62	-0.8	AVE CHANGE
3	Highway ULSD	32.14	23.83	16.88	7.33	25.07	17.69	11.98	1.41	lb/hr	
	% change from bare engine	-2.74	-1.63	1.90	2.29	1.42	-0.92	-0.56	-7.54	0.0	AVE CHANGE
4	Stepan SB-W biodiesel	37.10	27.66	19.82	8.25	28.45	20.90	14.45	1.92	lb/hr	
	% change from bare engine	-1.26	-3.34	-0.81	0.48	-0.19	-0.11	0.24	53.65	-0.7	AVE CHANGE
5	IRE REG-9000-10 biodiesel	37.46	27.87	19.89	8.21	28.09	20.70	13.85	1.84	lb/hr	
	% change from bare engine	0.27	-0.02	-0.84	2.81	-2.37	-1.59	-1.40	7.29	-0.4	AVE CHANGE
6	IRE REG-9000-5 biodiesel	37.47	27.56	19.81	8.06	28.46	20.56	14.30	1.84	lb/hr	
	% change from bare engine	0.67	-1.69	0.94	-0.78	1.30	0.11	0.79	0.21	0.2	AVE CHANGE
8	B50 Mix*	35.06	25.93	17.93	7.62	26.70	19.49	13.20	1.77	lb/hr	
	% change from bare engine	-0.87	-1.66	-3.32	0.84	-0.41	0.10	0.28	10.30	-0.7	AVE CHANGE
8	PetroSA Fischer-Tropsch Syn.	30.43	22.86	15.89	6.97	22.93	16.87	11.54	1.42	lb/hr	
	% change from bare engine	1.73	2.46	3.19	0.07	2.83	1.99	2.70	3.08	2.1	AVE CHANGE

*B50: 50/50 Mix of Stepan SB-W and Highway ULSD ** mode 8 discounted in average change


Fuel Testing Fuel Rate Bare Engine
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Fuel (lb/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.


Fuel Testing Fuel Rate Engine + DOC
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Fuel (lb/hr)
1
2
3
4
5
6
7
8
Test Mode
2005 spec LSD Certified
2007 spec ULSD Certified
Highway ULSD
Stepan SB-W biodiesel
IRE REG-9000-10 biodiesel
IRE REG-9000-5 biodiesel
B50 Mix*
PetroSA Fischer-Tropsch Syn.

Appendix C-2:

Test Data Sheets

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: B50: 50/50 Mix of Stepan SB-W and Highway ULSD
Engine: Isuzu 4JG1T
DOC: ECS Purifier A16-0119

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.1	2500.1	2499.9	2497.6	1800.1	1800.0	1799.8	986.4
TORQUE lbft	174.86	130.00	87.49	20.00	206.60	154.80	102.64	10.16
HORSEPOWER	83.24	61.88	41.65	9.51	70.81	53.05	35.17	1.91
Barometric Pressure INHG	28.85	28.85	28.85	28.85	28.85	28.84	28.84	28.84
Laminar flow air temp DEG F	59.92	60.22	60.68	61.15	60.33	60.63	60.66	60.64
Laminar flow diff pressure in. of H2O	4.39	3.89	3.36	2.73	2.63	2.31	2.05	0.89
Laminar Flow cfm	223.27	198.28	171.91	140.19	134.88	118.44	105.23	46.16
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	69.00	69.05	69.75	70.00	71.40	72.50	72.50	75.50
Boost/Air In Manifold (degF)	305.80	247.65	192.84	132.13	224.85	180.57	141.42	94.09
Altitude Barrel Pressure (inHg)	28.78	28.78	28.78	28.77	28.77	28.77	28.77	28.77
Altitude (ft)	1071.14	1069.27	1072.71	1077.07	1077.63	1079.71	1079.82	1078.71
Intake AIR Consumption lbs/hr	981.54	870.74	753.85	613.82	592.10	519.35	461.38	202.40
LAB FACTOR-NA	1.014	1.015	1.016	1.016	1.018	1.020	1.020	1.024
LAB FACTOR-TURBO	0.995	0.996	0.997	0.998	1.002	1.006	1.006	1.014
Intake Air Temperature DEG F	69.00	69.05	69.75	70.00	71.40	72.50	72.50	75.50
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	305.80	247.65	192.84	132.13	224.85	180.57	141.42	94.09
Boost air Pressure (@manifold) psi	21.04	15.08	9.59	3.84	12.42	8.09	4.65	0.30
FUEL Temperature DEG F	93.72	94.16	94.16	93.66	93.50	92.94	92.49	90.61
FUEL Cunsumption lbs/hr	35.06	25.93	17.93	7.62	26.70	19.49	13.20	1.77
DEW Point DEG F	47.85	48.09	48.14	48.31	48.02	48.20	48.06	48.36
Grains Water (H2O) per lb dry air	50.43	50.86	51.00	51.30	50.77	51.11	50.84	51.41
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	920.48	776.60	630.11	388.02	959.11	828.47	633.98	281.55
FINAL EXHAUST TEMP	426.31	732.08	600.39	388.40	837.95	753.50	595.91	303.85
Coolant Temperature IN DEG F	168.50	160.22	162.75	164.20	159.23	159.65	162.90	164.47
Coolant Temperature OUT DEG F	181.25	170.83	170.38	168.78	172.30	170.23	170.26	168.46
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.56	13.00	10.49	7.76	7.50	6.26	5.36	2.01
Exhaust Restriction (mmHg)	13.89	13.68	11.93	9.45	11.71	11.87	10.64	7.89
Exhaust Restriction (inH2O)	7.44	7.32	6.39	5.06	6.27	6.35	5.69	4.22
EXHAUST FLOW LB/HR	1016.59	896.68	771.78	621.44	618.79	538.84	474.58	204.16
FUEL /AIR RATIO	0.04	0.03	0.02	0.01	0.05	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.97	0.90	0.92	0.94	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.57	6.31	5.12	2.70	9.47	7.91	6.03	1.90
CO PPM DRY	3.00	0.00	0.00	6.00	0.00	0.00	0.00	26.00
NOX PPM DRY	605.22	439.50	329.83	121.77	877.39	695.58	521.16	210.55
NO PPM DRY	534.94	368.03	291.47	121.90	764.23	539.02	441.26	209.86
NO2 PPM DRY	70.28	71.47	38.36	-0.13	113.15	156.56	79.90	0.69
%O2								
NO WET	493.27	343.42	275.24	117.69	691.27	495.13	412.71	204.07
NO2 WET	64.81	66.69	36.22	-0.12	102.35	143.82	74.74	0.67
CO2 WET	6.98	5.89	4.83	2.61	8.56	7.27	5.64	1.85
CO WET	0.0003	0.0000	0.0000	0.0006	0.0000	0.0000	0.0000	0.0025
G	0.0012	0.0018	0.0025	0.0039	0.0001	0.0009	0.0020	0.0043
R	-0.0022	-0.0025	-0.0028	-0.0033	-0.0018	-0.0021	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0455	1.0454	1.0477	1.0501	1.0436	1.0471	1.0525	1.0741
NO CORR	471.82	328.51	262.72	112.09	662.39	472.88	392.14	189.99
NO2 CORR	61.97	63.79	34.57	-0.12	98.07	137.35	71.01	0.63
GAS EMISSIONS								
NO GR/HR	225.48	138.45	95.32	32.74	192.65	119.76	87.48	18.23
NO2 GR/HR	45.32	41.18	19.22	-0.05	43.69	53.29	24.26	0.09
CO2 GR/HR	48871.32	36386.24	25703.02	11161.90	36512.10	26976.25	18435.94	2598.84
CO GR/HR	1.23	0.00	0.00	1.58	0.00	0.00	0.00	2.26
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4183	2568	1768	607	3574	2222	1623	338
NO2 CFM 5 ppm	2742	2491	1163	-3	2643	3224	1468	6
CO2 CFM 5000 ppm	3079	2292	1619	703	2300	1700	1161	164
CO CFM 50 ppm	12	0	0	16	0	0	0	22
NOX ppm - wet EURO, EPA, ISO	558.1	410.1	311.5	117.6	793.6	638.9	487.4	204.7
NOX ppm(corr) EURO,EPA,ISO	533.8	392.3	297.3	112.0	760.5	610.2	463.1	190.6
NOX GR/HR EURO, EPA, ISO	390.7	253.3	165.2	50.1	338.8	236.8	158.3	28.0
NOX cfm EURO, EPA, ISO	4727.4	3064.3	1999.2	606.1	4099.2	2864.4	1915.0	339.0

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

COMPANY NAME Isuzu
DATE 9/17/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: B50 Bend of Stepan SB-W biodiesel and HWULSD, Engine with ECS DOC, gravimetric sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2501.0	2501.1	2500.5	2498.9	1799.9	1799.7	1799.1	986.0
TORQUE lbft	176.4	130.2	90.1	20.1	206.3	154.7	105.2	9.8
HORSEPOWER	84.0	62.0	42.9	9.5	70.7	53.0	36.0	1.8
Barometric Pressure INHG	28.86	28.86	28.86	28.86	28.86	28.86	28.86	28.85
Laminar flow air temp DEG F	59.60	59.71	60.15	60.63	60.26	60.20	60.80	61.13
Laminar flow diff pressure in. of H2O	4.41	3.89	3.39	2.74	2.63	2.31	2.06	0.89
Laminar Flow cfm	224.44	198.30	173.13	140.47	134.99	118.47	105.89	46.19
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.00	68.09	69.00	69.00	71.00	72.00	72.00	75.00
Boost/Air In Manifold (degF)	307.14	246.00	194.56	131.50	224.64	180.28	142.38	92.50
Altitude Barrel Pressure (inHg)	28.79	28.79	28.79	28.79	28.78	28.78	28.78	28.78
Altitude (ft)	1060	1056	1056	1063	1065	1064	1067	1070
Intake AIR Consumption lbs/hr	987.90	872.62	760.72	616.27	592.90	520.46	464.26	202.30
LAB FACTOR-NA	1.013	1.014	1.014	1.015	1.017	1.018	1.019	1.023
LAB FACTOR-TURBO	0.993	0.993	0.995	0.995	1.000	1.004	1.004	1.012
Intake Air Temperature DEG F	68.00	68.09	69.00	69.00	71.00	72.00	72.00	75.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	307.14	246.00	194.56	131.50	224.64	180.28	142.38	92.50
Boost air Pressure (@manifold) psi	21.31	15.07	9.90	3.89	12.48	8.14	4.83	0.31
FUEL Temperature DEG F	93.06	93.27	93.41	93.09	93.00	92.00	91.98	89.52
FUEL Cunsumption lbs/hr	35.44	25.89	18.40	7.70	26.56	19.32	13.46	1.70
DEW Point DEG F	47.99	47.90	48.17	48.40	48.17	47.99	48.21	48.35
Grains Water (H2O) per lb dry air	50.65	50.50	51.00	51.46	51.02	50.69	51.11	51.36
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	925.55	771.63	636.23	388.00	962.05	830.39	641.69	269.53
FINAL EXHAUST TEMP	0.00	724.56	603.73	388.27	842.30	756.16	600.42	289.77
Coolant Temperature IN DEG F	169	160	162.5	164	159	159.14063	162.35938	164
Coolant Temperature OUT DEG F	162	170.76563	170.25	168.51563	172.14063	169.8125	170	167.92188
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.62	12.97	10.60	7.73	7.49	6.22	5.39	2.00
Exhaust Restriction (mmHg)	12.03	12.18	10.52	7.79	10.21	10.53	9.46	6.61
Exhaust Restriction (inH2O)	6.44	6.52	5.63	4.17	5.47	5.64	5.07	3.54
EXHAUST FLOW LB/HR	1023.34	898.51	779.12	623.97	619.47	539.78	477.72	204.00
FUEL /AIR RATIO	0.0359	0.0297	0.0242	0.0125	0.0448	0.0371	0.0290	0.0084
J CONVER	0.9218	0.9334	0.9435	0.9653	0.9050	0.9194	0.9345	0.9730
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.6	6.3	5.2	2.7	9.5	7.9	6.2	1.9
CO PPM DRY	3.0	0.0	0.0	6.0	0.0	0.0	0.0	47.0
NOX PPM DRY	612.2	442.5	338.8	122.6	889.6	706.8	533.7	212.0
NO PPM DRY	551.1	371.6	298.4	123.0	777.8	541.0	454.2	210.3
NO2 PPM DRY	61.1	70.9	40.4	-0.4	111.8	165.8	79.5	1.6
%O2								
NO WET	508.0310	346.8305	281.5595	118.7619	703.8664	497.4264	424.4752	204.6646
NO2 WET	56.3029	66.2193	36.1192	-0.3680	101.1838	152.4445	74.2850	1.5873
CO2 WET	7.0055	5.8819	4.9064	2.6064	8.5522	7.2822	5.7519	1.8488
CO WET	0.0003	0.0000	0.0000	0.0006	0.0000	0.0000	0.0000	0.0046
G	0.0011	0.0019	0.0025	0.0039	0.0001	0.0010	0.0019	0.0043
R	-0.0022	-0.0025	-0.0027	-0.0033	-0.0018	-0.0022	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0438	1.0446	1.0457	1.0457	1.0432	1.0477	1.0506	1.0724
NO CORR	486.6928	332.0354	269.2565	113.5724	674.6996	474.7771	404.0220	190.8386
NO2 CORR	53.9381	63.3946	36.4535	-0.3519	96.9910	145.5032	70.7056	1.4800
GAS EMISSIONS								
NO GR/HR	234.08	140.22	98.60	33.31	196.44	120.45	90.71	18.30
NO2 GR/HR	39.74	41.01	20.45	-0.16	43.26	56.55	24.32	0.22
CO2 GR/HR	49393.95	36413.31	26338.31	11205.22	36501.74	27082.87	18932.28	2598.53
CO GR/HR	1.24	0.00	0.00	1.58	0.00	0.00	0.00	4.09
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4342	2601	1829	618	3644	2234	1683	339
NO2 CFM 5 ppm	2404	2481	1237	-10	2617	3421	1471	13
CO2 CFM 5000 ppm	3112	2294	1659	706	2300	1706	1193	164
CO CFM 50 ppm	12	0	0	16	0	0	0	41
NOX ppm - wet EURO, EPA, ISO	564.33	413.05	319.68	118.39	805.05	649.87	498.76	206.25
NOX ppm(corr) EURO,EPA,ISO	540.63	395.43	305.71	113.22	771.69	620.28	474.73	192.32
NOX GR/HR EURO, EPA, ISO	398.34	255.81	171.49	50.87	344.19	241.07	163.29	28.25
NOX cfm EURO, EPA, ISO	4819	3095	2075	615	4164	2917	1976	342
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	11.30	8.52	5.44	3.94	7.62	4.55	2.52	0.25
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.70	1.28	0.82	0.39	0.76	0.46	0.25	0.04
Weighted HP	12.603	9.301	6.434	0.954	7.071	5.302	3.604	0.275
Weighted Average HP	45.543 HP							
Weighted Average PARTICULATE	5.690 GR/HR							
	0.125 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	3348.406							

COMPANY NAME Isuzu
DATE 9/17/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: B50 Bend of Stepan SB-W biodiesel and HWULSD, Engine with ECS DOC, EC/OC sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.2	2499.2	2499.3	2496.4	1800.3	1800.3	1800.4	986.8
TORQUE lbft	173.3	129.8	84.9	19.9	206.9	154.9	100.1	10.5
HORSEPOWER	82.5	61.8	40.4	9.5	70.9	53.1	34.3	2.0
Barometric Pressure INHG	28.84	28.84	28.84	28.84	28.83	28.83	28.83	28.83
Laminar flow air temp DEG F	60.24	60.74	61.22	61.67	60.39	61.05	60.52	60.15
Laminar flow diff pressure in. of H2O	4.36	3.89	3.34	2.73	2.63	2.30	2.03	0.89
Laminar Flow cfm	222.10	198.26	170.69	139.90	134.78	118.40	104.56	46.13
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entenng Manifold/Turbo (degF)	70.00	70.00	70.50	71.00	71.80	73.00	73.00	76.00
Boost/Air In Manifold (degF)	304.47	249.30	191.13	132.75	225.06	180.86	140.47	95.67
Altitude Barrel Pressure (inHg)	28.77	28.76	28.76	28.76	28.76	28.75	28.75	28.76
Altitude (ft)	1082	1083	1090	1091	1090	1095	1093	1087
Intake AIR Consumption lbs/hr	975.18	868.87	746.99	611.37	591.29	518.25	458.50	202.49
LAB FACTOR-NA	1.016	1.017	1.017	1.018	1.019	1.021	1.021	1.025
LAB FACTOR-TURBO	0.997	0.999	1.000	1.001	1.003	1.008	1.007	1.016
Intake Air Temperature DEG F	70.00	70.00	70.50	71.00	71.80	73.00	73.00	76.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.47	249.30	191.13	132.75	225.06	180.86	140.47	95.67
Boost air Pressure (@manifold) psi	20.78	15.08	9.27	3.80	12.36	8.04	4.47	0.30
FUEL Temperature DEG F	94.38	95.05	94.92	94.22	94.00	93.88	93.00	91.70
FUEL Cunsumption lbs/hr	34.67	25.98	17.45	7.53	26.83	19.66	12.94	1.84
DEW Point DEG F	47.72	48.28	48.12	48.21	47.88	48.40	47.91	48.38
Grains Water (H2O) per lb dry air	50.20	51.22	51.00	51.14	50.51	51.53	50.57	51.47
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	915.41	781.58	623.98	388.03	956.17	826.55	626.27	293.58
FINAL EXHAUST TEMP	852.63	739.59	597.05	388.53	833.59	750.84	591.41	317.94
Coolant Temperature IN DEG F	168	160.4375	163	164.40625	159.46875	160.15625	163.4375	164.9375
Coolant Temperature OUT DEG F	180.5	170.89063	170.5	169.04688	172.46875	170.65625	170.51563	169
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.50	13.03	10.38	7.79	7.50	6.30	5.34	2.03
Exhaust Restriction (mmHg)	15.76	15.19	13.35	11.11	13.21	13.20	11.81	9.16
Exhaust Restriction (inH2O)	8.44	8.13	7.14	5.95	7.07	7.07	6.32	4.90
EXHAUST FLOW LB/HR	1009.85	894.85	764.44	618.90	618.12	537.91	471.44	204.32
FUEL /AIR RATIO	0.0356	0.0299	0.0234	0.0123	0.0454	0.0379	0.0282	0.0091
J CONVER	0.9225	0.9328	0.9451	0.9657	0.9040	0.9177	0.9361	0.9717
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.5	6.3	5.0	2.7	9.5	7.9	5.9	1.9
CO PPM DRY	3.0	0.0	0.0	6.0	0.0	0.0	0.0	5.0
NOX PPM DRY	598.2	436.5	320.9	120.9	865.2	684.3	508.6	209.1
NO PPM DRY	518.7	364.5	284.5	120.8	750.7	537.0	428.3	209.4
NO2 PPM DRY	79.5	72.0	36.3	0.1	114.5	147.3	80.3	-0.3
%O2								
NO WET	478.5148	340.0055	268.9120	116.6267	678.6738	492.8352	400.9358	203.4665
NO2 WET	73.3159	67.1575	34.3184	0.1207	103.5134	135.1928	75.1855	-0.2429
CO2 WET	6.9488	5.8972	4.7594	2.6074	8.5757	7.2499	5.5229	1.8463
CO WET	0.0003	0.0000	0.0000	0.0006	0.0000	0.0000	0.0000	0.0005
G	0.0012	0.0018	0.0026	0.0039	0.0000	0.0009	0.0020	0.0042
R	-0.0022	-0.0025	-0.0028	-0.0033	-0.0018	-0.0021	-0.0026	-0.0034
HUM&TEM CORR FACTOR	1.0472	1.0462	1.0497	1.0545	1.0440	1.0464	1.0544	1.0758
NO CORR	456.9432	324.9755	256.1798	110.5994	650.0804	470.9814	380.2539	189.1322
NO2 CORR	70.0108	64.1888	32.6935	0.1145	99.1522	129.1979	71.3071	-0.2258
GAS EMISSIONS								
NO GR/HR	216.88	136.68	92.04	32.17	188.86	119.07	84.26	18.16
NO2 GR/HR	50.90	41.36	17.99	0.05	44.13	50.04	24.20	-0.03
CO2 GR/HR	48348.68	36359.18	25067.73	11118.58	36522.46	26869.63	17939.61	2599.15
CO GR/HR	1.22	0.00	0.00	1.57	0.00	0.00	0.00	0.43
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4023	2535	1707	597	3503	2209	1563	337
NO2 CFM 5 ppm	3079	2502	1088	3	2669	3027	1464	-2
CO2 CFM 5000 ppm	3046	2291	1579	700	2301	1693	1130	164
CO CFM 50 ppm	12	0	0	16	0	0	0	4
NOX ppm - wet EURO, EPA, ISO	551.83	407.16	303.23	116.75	782.19	628.03	476.12	203.22
NOX ppm(corr) EURO,EPA,ISO	526.95	389.16	288.87	110.71	749.23	600.18	451.56	188.91
NOX GR/HR EURO, EPA, ISO	383.14	250.73	159.00	49.34	333.44	232.45	153.28	27.79
NOX cfm EURO, EPA, ISO	4636	3034	1924	597	4034	2812	1854	336

DPM EC/OC DATA

EC	TWA (ug/m3)	14940	18215	9723	7617	21289	14161	6910	---
OC	TWA (ug/m3)	5977	6915	6415	5973	5657	5084	4577	2605
TC	TWA (ug/m3)	20910	25130	16138	13583	26947	19245	11487	3298

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: B50: 50/50 Mix of Stepan SB-W and Highway ULSD
Engine: Isuzu 4JG1T
DOC: NONE

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.2	2499.0	2499.3	2497.6	1800.4	1800.1	1800.2	987.3
TORQUE lbft	176.15	132.28	89.81	20.04	207.76	154.94	104.95	10.10
HORSEPOWER	83.82	62.94	42.74	9.53	71.22	53.10	35.97	1.90
Barometric Pressure INHG	28.87	28.87	28.86	28.86	28.86	28.86	28.86	28.85
Laminar flow air temp DEG F	60.21	60.30	60.33	60.43	60.41	60.12	60.09	60.20
Laminar flow diff pressure in. of H2O	4.37	3.89	3.37	2.72	2.65	2.31	2.05	0.88
Laminar Flow cfm	222.75	198.54	172.38	139.47	136.03	118.88	105.48	45.68
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.08	68.98	69.25	68.65	70.00	71.44	70.75	73.50
Boost/Air In Manifold (degF)	308.83	252.31	196.01	132.12	226.58	179.73	140.65	91.69
Altitude Barrel Pressure (inHg)	28.86	28.86	28.86	28.85	28.85	28.84	28.84	28.84
Altitude (ft)	990.45	992.29	997.01	1003.07	1003.14	1006.90	1007.38	1010.98
Intake AIR Consumption lbs/hr	979.65	872.79	757.67	612.79	597.66	522.80	463.90	200.77
LAB FACTOR-NA	1.012	1.013	1.014	1.013	1.015	1.017	1.016	1.020
LAB FACTOR-TURBO	0.992	0.994	0.995	0.994	0.997	1.001	1.000	1.007
Intake Air Temperature DEG F	68.08	68.98	69.25	68.65	70.00	71.44	70.75	73.50
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	308.83	252.31	196.01	132.12	226.58	179.73	140.65	91.69
Boost air Pressure (@manifold) psi	21.43	15.63	9.93	3.93	12.77	8.25	4.78	0.27
FUEL Temperature DEG F	92.53	92.56	93.44	92.88	92.08	91.49	90.80	88.88
FUEL Cunsumption lbs/hr	35.36	26.37	18.54	7.55	26.81	19.47	13.16	1.60
DEW Point DEG F	46.55	46.75	46.50	46.58	46.70	46.46	46.44	46.57
Grains Water (H2O) per lb dry air	47.95	48.35	47.88	48.02	48.21	47.83	47.75	48.05
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	917.34	776.58	635.87	394.02	950.98	816.16	640.61	282.61
FINAL EXHAUST TEMP	824.96	715.19	590.29	388.42	801.01	715.00	580.62	295.82
Coolant Temperature IN DEG F	168.52	160.80	161.17	162.74	157.73	158.70	160.56	160.08
Coolant Temperature OUT DEG F	180.99	171.28	169.27	167.20	171.05	169.46	168.23	164.10
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.81	13.26	10.68	7.81	7.62	6.32	5.42	2.00
Exhaust Restriction (mmHg)	2.85	3.20	2.81	1.55	2.62	2.75	2.57	0.88
Exhaust Restriction (inH2O)	1.52	1.71	1.50	0.83	1.40	1.47	1.38	0.47
EXHAUST FLOW LB/HR	1015.02	899.16	776.21	620.34	624.46	542.28	477.06	202.37
FUEL /AIR RATIO	0.04	0.03	0.02	0.01	0.04	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.97	0.91	0.92	0.94	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.50	6.26	5.10	2.63	9.35	7.80	6.06	1.81
CO PPM DRY	118.03	86.14	70.23	135.32	86.09	65.68	62.34	117.54
NOX PPM DRY	651.47	489.75	359.60	123.77	973.32	791.35	590.33	203.73
NO PPM DRY	620.70	466.78	336.03	108.40	937.76	757.84	559.81	177.49
NO2 PPM DRY	30.77	22.96	23.57	15.37	35.56	33.51	30.52	26.25
%O2								
NO WET	572.25	435.44	317.11	104.76	849.15	697.08	524.22	172.96
NO2 WET	28.37	21.42	22.24	14.85	32.19	30.81	28.58	25.58
CO2 WET	6.91	5.84	4.82	2.54	8.47	7.18	5.67	1.76
CO WET	0.0109	0.0080	0.0066	0.0131	0.0078	0.0060	0.0058	0.0115
G	0.0011	0.0018	0.0025	0.0039	0.0001	0.0010	0.0020	0.0044
R	-0.0022	-0.0025	-0.0027	-0.0033	-0.0018	-0.0022	-0.0026	-0.0034
HUM&TEM CORR FACTOR	1.0499	1.0515	1.0548	1.0555	1.0483	1.0533	1.0570	1.0776
NO CORR	545.06	414.14	300.65	99.24	810.06	661.80	495.95	160.50
NO2 CORR	27.02	20.37	21.09	14.07	30.71	29.26	27.04	23.73
GAS EMISSIONS								
NO GR/HR	260.03	175.05	109.68	28.93	237.75	168.69	111.20	15.27
NO2 GR/HR	19.74	13.18	11.79	6.29	13.76	11.39	9.28	3.46
CO2 GR/HR	48341.96	36168.07	25755.45	10842.00	36426.12	26809.15	18645.03	2454.28
CO GR/HR	48.38	31.65	22.53	35.53	21.32	14.35	12.20	10.14
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4823	3247	2035	537	4410	3129	2063	283
NO2 CFM 5 ppm	1194	797	713	380	833	689	561	209
CO2 CFM 5000 ppm	3046	2279	1623	683	2295	1689	1175	155
CO CFM 50 ppm	481	315	224	353	212	143	121	101
NOX ppm - wet EURO, EPA, ISO	600.6	456.9	339.4	119.6	881.3	727.9	552.8	198.5
NOX ppm(corr) EURO,EPA,ISO	572.1	434.5	321.7	113.3	840.8	691.1	523.0	184.2
NOX GR/HR EURO, EPA, ISO	418.1	281.3	179.8	50.6	378.0	269.8	179.6	26.8
NOX cfm EURO, EPA, ISO	5058.2	3403.7	2175.5	612.3	4572.9	3264.2	2173.3	324.8

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 9/16/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: B50 Bend of Stepan SB-W biodiesel and HWULSD, Engine Only, gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	**2498.8**	**2498.5**	**2498.7**	**2496.2**	**1800.4**	**1800.2**	**1800.2**	**986.4**
TORQUE lbft	**176.7**	**135.0**	**89.7**	**20.1**	**208.4**	**154.8**	**105.0**	**9.7**
HORSEPOWER	**84.1**	**64.2**	**42.7**	**9.6**	**71.4**	**53.1**	**36.0**	**1.8**
Barometric Pressure INHG	**28.89**	**28.88**	**28.88**	**28.88**	**28.88**	**28.87**	**28.87**	**28.86**
Laminar flow air temp DEG F	**60.48**	**60.73**	**60.76**	**60.74**	**60.45**	**60.14**	**60.08**	**60.08**
Laminar flow diff pressure in. of H2O	**4.38**	**3.92**	**3.36**	**2.71**	**2.62**	**2.29**	**2.02**	**0.86**
Laminar Flow cfm	**223.03**	**200.19**	**171.88**	**138.86**	**134.58**	**117.43**	**104.18**	**44.55**
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.16	69.00	70.00	69.00	70.00	71.00	70.50	73.00
Boost/Air In Manifold (degF)	310.03	255.75	196.42	132.38	227.66	179.50	140.48	90.95
Altitude Barrel Pressure (inHg)	28.88	28.87	28.87	28.87	28.87	28.86	28.86	28.85
Altitude (ft)	977	978	985	986	984	992	995	1000
Intake AIR Consumption lbs/hr	**980.51**	**879.32**	**754.88**	**609.92**	**591.51**	**516.64**	**458.34**	**195.98**
LAB FACTOR-NA	**1.012**	**1.013**	**1.014**	**1.013**	**1.015**	**1.016**	**1.015**	**1.018**
LAB FACTOR-TURBO	**0.992**	**0.994**	**0.996**	**0.994**	**0.998**	**1.000**	**0.999**	**1.005**
Intake Air Temperature DEG F	**68.16**	**69.00**	**70.00**	**69.00**	**70.00**	**71.00**	**70.50**	**73.00**
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	**310.03**	**255.75**	**196.42**	**132.38**	**227.66**	**179.50**	**140.48**	**90.95**
Boost air Pressure (@manifold) psi	**21.53**	**15.99**	**9.92**	**3.93**	**12.82**	**8.28**	**4.77**	**0.30**
FUEL Temperature DEG F	**92.23**	**92.00**	**92.98**	**92.77**	**91.55**	**90.98**	**90.00**	**88.39**
FUEL Cunsumption lbs/hr	**35.43**	**26.92**	**18.59**	**7.68**	**26.82**	**19.58**	**13.25**	**1.65**
DEW Point DEG F	**46.94**	**46.90**	**46.60**	**46.65**	**46.79**	**46.49**	**46.50**	**46.50**
Grains Water (H2O) per lb dry air	**48.64**	**48.61**	**48.04**	**48.11**	**48.35**	**47.85**	**47.83**	**47.93**
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	921.91	783.52	636.97	394.11	957.41	815.28	640.03	283.56
FINAL EXHAUST TEMP	832.33	721.25	592.94	388.42	811.98	716.05	580.09	295.91
Coolant Temperature IN DEG F	170	160.8125	160.34375	161.48438	158.46875	157.10938	159.54688	158.34375
Coolant Temperature OUT DEG F	182.35938	171.39063	168.546875	166	172	167.96875	167	162.78125
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.82	13.40	10.64	7.79	7.62	6.35	5.41	1.99
Exhaust Restriction (mmHg)	2.77	2.90	3.01	1.60	2.60	2.21	1.78	0.00
Exhaust Restriction (inH2O)	1.48	1.55	1.61	0.85	1.39	1.18	0.95	0.00
EXHAUST FLOW LB/HR	1015.94	906.24	773.48	617.60	618.33	536.21	471.59	197.63
FUEL /AIR RATIO	0.0361	0.0306	0.0246	0.0126	0.0453	0.0379	0.0289	0.0084
J CONVER	0.9217	0.9321	0.9434	0.9659	0.9046	0.9186	0.9354	0.9737
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	**7.5**	**6.3**	**5.1**	**2.7**	**9.4**	**7.8**	**6.1**	**1.8**
CO PPM DRY	**120.2**	**88.2**	**71.8**	**135.3**	**87.9**	**65.2**	**63.0**	**122.9**
NOX PPM DRY	**652.2**	**496.3**	**360.2**	**125.2**	**988.3**	**795.7**	**592.0**	**202.8**
NO PPM DRY	**623.6**	**476.1**	**337.2**	**110.3**	**941.3**	**752.4**	**559.2**	**175.8**
NO2 PPM DRY	28.6	20.1	23.0	14.9	47.0	43.3	32.8	27.0
%O2								
NO WET	574.7494	443.7926	318.1079	106.5214	851.4662	691.2061	523.0989	171.1416
NO2 WET	26.3819	18.7781	21.6563	14.3765	42.4987	39.7588	30.6784	26.3150
CO2 WET	6.9130	5.8866	4.8171	2.5596	8.5031	7.1666	5.6914	1.7588
CO WET	0.0111	0.0082	0.0068	0.0131	0.0080	0.0060	0.0059	0.0120
G	0.0011	0.0017	0.0024	0.0038	0.0000	0.0009	0.0019	0.0043
R	-0.0022	-0.0025	-0.0027	-0.0032	-0.0018	-0.0021	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0485	1.0507	1.0561	1.0566	1.0478	1.0525	1.0560	1.0756
NO CORR	548.1884	422.3632	301.1977	100.8190	812.6086	656.7389	495.3466	159.1191
NO2 CORR	25.1627	17.8714	20.5051	13.6069	40.5592	37.7762	29.0508	24.4664
GAS EMISSIONS								
NO GR/HR	261.76	179.90	109.50	29.26	236.16	165.51	109.79	14.78
NO2 GR/HR	18.41	11.66	11.42	6.05	18.06	14.58	9.86	3.48
CO2 GR/HR	48389.94	36755.63	25671.52	10891.71	36225.82	26477.21	18492.73	2394.86
CO GR/HR	49.29	32.64	22.94	35.35	21.54	14.07	12.17	10.36
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	**4856**	**3337**	**2031**	**543**	**4381**	**3070**	**2037**	**274**
NO2 CFM 5 ppm	**1113**	**705**	**691**	**366**	**1092**	**882**	**597**	**211**
CO2 CFM 5000 ppm	**3049**	**2316**	**1617**	**686**	**2282**	**1668**	**1165**	**151**
CO CFM 50 ppm	**490**	**324**	**228**	**351**	**214**	**140**	**121**	**103**
NOX ppm - wet EURO, EPA, ISO	601.13	462.57	339.76	120.90	893.96	730.96	553.78	197.46
NOX ppm(corr) EURO,EPA,ISO	573.35	440.23	321.70	114.43	853.17	694.52	524.40	183.59
NOX GR/HR EURO, EPA, ISO	419.39	287.25	179.16	50.88	379.83	268.13	178.06	26.12
NOX cfm EURO, EPA, ISO	5074	3475	2168	616	4595	3244	2154	316
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	12.85	11.95	8.68	7.00	8.35	6.16	4.58	0.99
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.93	1.79	1.30	0.70	0.83	0.62	0.46	0.15
Weighted HP	12.609	9.637	6.400	0.957	7.142	5.307	3.599	0.274
Weighted Average HP	45.925 HP							
Weighted Average PARTICULATE	7.778 GR/HR							
	0.169 **(GR/HP-HR)**							
PARTICULATE INDEX (PI) CFM	4577.630							

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 9/16/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: B50 Bend of Stepan SB-W biodiesel and HWULSD, Engine Only, EC/OC sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.7	2499.5	2499.8	2498.9	1800.4	1800.1	1800.1	988.1
TORQUE lbft	175.6	129.5	89.9	19.9	207.2	155.0	104.9	10.5
HORSEPOWER	83.6	61.6	42.8	9.5	71.0	53.1	36.0	2.0
Barometric Pressure INHG	28.85	28.85	28.85	28.84	28.85	28.85	28.85	28.84
Laminar flow air temp DEG F	59.93	59.87	59.91	60.11	60.38	60.10	60.10	60.32
Laminar flow diff pressure in. of H2O	4.37	3.86	3.38	2.73	2.68	2.34	2.08	0.90
Laminar Flow cfm	222.47	196.90	172.87	140.07	137.48	120.33	106.79	46.81
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.00	68.95	68.50	68.30	70.00	71.88	71.00	74.00
Boost/Air In Manifold (degF)	307.63	248.88	195.59	131.86	225.50	179.97	140.81	92.42
Altitude Barrel Pressure (inHg)	28.85	28.85	28.84	28.83	28.83	28.83	28.83	28.83
Altitude (ft)	1004	1006	1009	1021	1023	1022	1020	1022
Intake AIR Consumption lbs/hr	978.79	866.26	760.46	615.65	603.80	528.97	469.46	205.55
LAB FACTOR-NA	1.013	1.014	1.013	1.014	1.015	1.017	1.017	1.021
LAB FACTOR-TURBO	0.992	0.994	0.993	0.994	0.997	1.002	1.001	1.009
Intake Air Temperature DEG F	68.00	68.95	68.50	68.30	70.00	71.88	71.00	74.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	307.63	248.88	195.59	131.86	225.50	179.97	140.81	92.42
Boost air Pressure (@manifold) psi	21.33	15.27	9.95	3.94	12.73	8.21	4.78	0.24
FUEL Temperature DEG F	92.83	93.13	93.89	93.00	92.61	92.00	91.59	89.36
FUEL Cunsumption lbs/hr	35.30	25.83	18.49	7.43	26.80	19.37	13.07	1.55
DEW Point DEG F	46.15	46.60	46.40	46.50	46.60	46.43	46.37	46.64
Grains Water (H2O) per lb dry air	47.26	48.08	47.73	47.94	48.07	47.80	47.66	48.18
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	912.77	769.64	634.77	393.92	944.55	817.03	641.19	281.66
FINAL EXHAUST TEMP	817.59	709.13	587.64	388.42	790.03	713.95	581.14	295.73
Coolant Temperature IN DEG F	167.04688	160.79688	162	164	157	160.29688	161.57813	161.8125
Coolant Temperature OUT DEG F	179.625	171.17188	170	168.39063	170.09375	170.95313	169.45313	165.42188
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.80	13.12	10.71	7.82	7.62	6.30	5.42	2.01
Exhaust Restriction (mmHg)	2.93	3.50	2.60	1.50	2.64	3.30	3.36	1.75
Exhaust Restriction (inH2O)	1.57	1.87	1.39	0.80	1.42	1.76	1.80	0.94
EXHAUST FLOW LB/HR	1014.09	892.08	778.95	623.08	630.60	548.34	482.53	207.11
FUEL /AIR RATIO	0.0361	0.0298	0.0243	0.0121	0.0444	0.0366	0.0278	0.0076
J CONVER	0.9222	0.9337	0.9440	0.9669	0.9064	0.9210	0.9374	0.9753
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.5	6.2	5.1	2.6	9.3	7.8	6.0	1.8
CO PPM DRY	115.9	84.1	68.7	135.3	84.3	66.1	61.7	112.2
NOX PPM DRY	650.8	483.2	359.0	122.4	958.4	787.0	588.6	204.7
NO PPM DRY	617.9	457.4	334.9	106.5	934.2	763.2	560.4	179.2
NO2 PPM DRY	32.9	25.8	24.2	15.9	24.1	23.7	28.2	25.5
%O2								
NO WET	569.7555	427.0887	316.1128	102.9951	846.8348	702.9561	525.3415	174.7868
NO2 WET	30.3505	24.0713	22.8307	15.3283	21.8763	21.8567	26.4799	24.8359
CO2 WET	6.9119	5.7888	4.8145	2.5139	8.4299	7.1839	5.6540	1.7616
CO WET	0.0107	0.0078	0.0065	0.0131	0.0076	0.0061	0.0058	0.0109
G	0.0011	0.0018	0.0025	0.0039	0.0002	0.0011	0.0021	0.0044
R	-0.0022	-0.0025	-0.0027	-0.0033	-0.0018	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0513	1.0522	1.0534	1.0545	1.0487	1.0541	1.0580	1.0797
NO CORR	541.9323	405.9143	300.0986	97.6691	807.5201	666.8553	496.5525	161.8805
NO2 CORR	28.8684	22.8779	21.6741	14.5356	20.8607	20.7343	25.0288	23.0020
GAS EMISSIONS								
NO GR/HR	258.30	170.19	109.87	28.60	239.33	171.86	112.61	15.76
NO2 GR/HR	21.08	14.69	12.16	6.52	9.47	8.19	8.70	3.43
CO2 GR/HR	48293.98	35580.51	25839.38	10792.29	36626.41	27141.09	18797.33	2513.71
CO GR/HR	47.47	30.67	22.12	35.71	21.10	14.63	12.23	9.93
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4791	3157	2038	531	4440	3188	2089	292
NO2 CFM 5 ppm	1275	889	735	394	573	495	526	207
CO2 CFM 5000 ppm	3043	2242	1628	680	2307	1710	1184	158
CO CFM 50 ppm	472	305	220	355	210	145	122	99
NOX ppm - wet EURO, EPA, ISO	600.11	451.16	338.94	118.32	868.71	724.81	551.82	199.62
NOX ppm(corr) EURO,EPA,ISO	570.80	428.79	321.77	112.20	828.38	687.59	521.58	184.88
NOX GR/HR EURO, EPA, ISO	416.77	275.41	180.46	50.34	376.11	271.46	181.21	27.57
NOX cfm EURO, EPA, ISO	5042	3332	2183	609	4550	3284	2192	334

DPM EC/OC DATA

EC	TWA (ug/m3)	14096	14681	8603	8452	17302	14494	6396	---
OC	TWA (ug/m3)	12374	14089	14668	14807	13744	13724	15885	10437
TC	TWA (ug/m3)	26470	28770	23271	23259	31045	28225	22281	11163

Fuel Test Data on Isuzu 4JT1T Engine

Fuel:	2005 spec LSD Certified
Engine:	Isuzu 4JG1T
DOC:	ECS Purifier A16-0119

COMPANY NAME	Isuzu
DATE	
ENGINE MODEL	Isuzu 4JG1T
COMMENTS:	AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.2	2500.3	2499.8	2499.4	1800.1	1800.1	1800.0	991.7
TORQUE lbft	175.77	132.46	90.08	19.98	207.98	155.09	105.11	7.83
HORSEPOWER	83.68	63.06	42.88	9.51	71.28	53.16	36.03	1.48
Barometric Pressure INHG	28.76	28.75	28.76	28.76	28.76	28.76	28.76	28.75
Laminar flow air temp DEG F	61.69	62.68	62.20	62.46	62.19	62.62	62.35	61.41
Laminar flow diff pressure in. of H2O	4.39	3.94	3.40	2.75	2.65	2.32	2.06	0.89
Laminar Flow cfm	223.31	201.18	173.91	140.76	135.90	119.11	105.71	46.21
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.19	74.20	74.00	74.00	75.96	77.50	77.50	80.84
Boost/Air In Manifold (degF)	315.99	261.23	202.68	137.43	236.38	187.82	148.75	98.10
Altitude Barrel Pressure (inHg)	28.68	28.68	28.68	28.69	28.69	28.68	28.68	28.68
Altitude (ft)	1161.08	1159.47	1158.29	1156.95	1154.69	1158.47	1159.89	1158.35
Intake AIR Consumption lbs/hr	970.60	871.37	754.45	610.24	589.84	516.31	458.84	201.18
LAB FACTOR-NA	1.027	1.028	1.028	1.028	1.030	1.032	1.031	1.036
LAB FACTOR-TURBO	1.012	1.014	1.014	1.014	1.019	1.023	1.023	1.032
Intake Air Temperature DEG F	73.19	74.20	74.00	74.00	75.96	77.50	77.50	80.84
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	315.99	261.23	202.68	137.43	236.38	187.82	148.75	98.10
Boost air Pressure (@manifold) psi	21.41	15.82	10.01	3.92	13.03	8.37	4.91	0.30
FUEL Temperature DEG F	95.36	95.34	94.76	94.11	93.78	93.74	93.48	92.18
FUEL Cunsumption lbs/hr	33.66	25.38	17.64	7.24	25.83	18.85	12.84	1.55
DEW Point DEG F	53.41	54.47	54.08	54.18	53.53	53.46	52.36	51.63
Grains Water (H2O) per lb dry air	62.36	64.78	63.87	64.07	62.59	62.41	59.89	58.26
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	950.48	810.70	656.01	396.00	995.93	848.24	661.69	264.43
FINAL EXHAUST TEMP	891.52	772.38	629.68	397.89	875.17	774.14	624.71	296.11
Coolant Temperature IN DEG F	158.00	160.00	162.22	164.56	156.01	158.88	161.25	165.00
Coolant Temperature OUT DEG F	172.00	170.88	170.25	169.45	169.95	169.88	169.24	168.24
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.55	13.16	10.55	7.81	7.68	6.37	5.42	2.06
Exhaust Restriction (mmHg)	21.66	16.32	10.94	5.84	10.55	9.05	5.64	1.31
Exhaust Restriction (inH2O)	11.60	8.74	5.86	3.13	5.65	4.84	3.02	0.70
EXHAUST FLOW LB/HR	1004.27	896.75	772.09	617.48	615.67	535.15	471.67	202.73
FUEL /AIR RATIO	0.03	0.03	0.02	0.01	0.04	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.90	0.92	0.93	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.80	6.53	5.30	2.75	9.83	8.19	6.30	1.80
CO PPM DRY	3.00	0.00	0.00	113.44	0.00	0.00	0.00	85.66
NOX PPM DRY	627.31	461.57	355.18	133.18	910.11	728.79	568.45	206.63
NO PPM DRY	559.76	399.50	329.87	134.21	828.56	602.18	499.18	205.96
NO2 PPM DRY	67.54	62.07	25.32	-1.03	81.55	126.61	69.28	0.66
%O2								
NO WET	515.77	372.04	310.81	129.34	749.31	552.81	466.49	200.36
NO2 WET	62.24	57.81	23.86	-0.99	73.75	116.23	64.74	0.65
CO2 WET	7.19	6.08	4.99	2.65	8.89	7.52	5.89	1.75
CO WET	0.0003	0.0000	0.0000	0.0109	0.0000	0.0000	0.0000	0.0083
G	0.0013	0.0019	0.0026	0.0039	0.0002	0.0011	0.0021	0.0044
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0239	1.0203	1.0231	1.0240	1.0230	1.0281	1.0398	1.0748
NO CORR	503.79	364.63	303.81	126.31	732.41	537.65	448.61	186.41
NO2 CORR	60.75	56.66	23.29	-0.97	72.08	113.08	62.26	0.60
GAS EMISSIONS								
NO GR/HR	237.80	153.69	110.25	36.66	211.93	135.22	99.45	17.76
NO2 GR/HR	43.92	36.58	12.95	-0.43	31.95	43.58	21.14	0.09
CO2 GR/HR	49730.22	37583.96	26545.83	11275.04	37690.64	27711.02	19128.31	2445.84
CO GR/HR	1.22	0.00	0.00	29.56	0.00	0.00	0.00	7.40
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4411	2851	2045	680	3931	2508	1845	329
NO2 CFM 5 ppm	2657	2213	783	-26	1933	2636	1279	5
CO2 CFM 5000 ppm	3133	2368	1672	710	2375	1746	1205	154
CO CFM 50 ppm	12	0	0	294	0	0	0	74
NOX ppm - wet EURO, EPA, ISO	578.0	429.8	334.7	128.4	823.1	669.0	531.2	201.0
NOX ppm(corr) EURO,EPA,ISO	564.5	421.3	327.1	125.3	804.5	650.7	510.9	187.0
NOX GR/HR EURO, EPA, ISO	408.2	272.0	181.8	55.7	356.6	250.7	173.5	27.3
NOX cfm EURO, EPA, ISO	4938.7	3291.0	2200.0	674.1	4314.5	3033.5	2099.0	330.3

PARTICULATE EMISSIONS

Modal Particulate emission (gr/hr)

weight factor

Weighted Particulate (gr/hr)

Weighted HP

Weighted Average HP

Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/19/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2005 spec. LSD Test fuel; Engine + ECS Purifier DOC

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.3	2500.6	2500.2	2499.5	1800.2	1800.1	1799.9	992.5
TORQUE lbft	176.0	130.1	89.9	20.0	208.1	155.1	105.0	7.9
HORSEPOWER	83.8	61.9	42.8	9.5	71.3	53.2	36.0	1.5
Barometric Pressure INHG	28.76	28.76	28.76	28.76	28.76	28.76	28.76	28.75
Laminar flow air temp DEG F	61.98	62.58	62.50	62.43	62.60	62.67	61.85	60.58
Laminar flow diff pressure in. of H2O	4.40	3.91	3.41	2.75	2.66	2.32	2.05	0.89
Laminar Flow cfm	223.92	199.70	174.36	141.27	136.28	119.40	105.55	46.14
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.00	74.00	74.00	74.00	75.67	77.00	77.00	80.67
Boost/Air In Manifold (degF)	316.98	257.22	202.64	137.36	236.13	187.14	148.00	97.72
Altitude Barrel Pressure (inHg)	28.69	28.69	28.69	28.69	28.69	28.69	28.69	28.68
Altitude (ft)	1154	1156	1149	1153	1151	1153	1156	1161
Intake AIR Consumption lbs/hr	971.80	864.83	755.26	612.25	590.49	517.37	458.93	201.41
LAB FACTOR-NA	1.027	1.028	1.028	1.028	1.030	1.031	1.030	1.035
LAB FACTOR-TURBO	1.012	1.014	1.014	1.013	1.018	1.022	1.021	1.032
Intake Air Temperature DEG F	73.00	74.00	74.00	74.00	75.67	77.00	77.00	80.67
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	316.98	257.22	202.64	137.36	236.13	187.14	148.00	97.72
Boost air Pressure (@manifold) psi	21.51	15.46	10.04	3.94	13.10	8.38	4.90	0.30
FUEL Temperature DEG F	95.39	95.19	94.38	93.89	93.52	93.45	93.02	91.88
FUEL Cunsumption lbs/hr	33.91	24.80	17.64	7.06	25.87	18.83	12.93	1.57
DEW Point DEG F	55.05	55.50	55.69	55.25	54.90	54.26	51.98	51.20
Grains Water (H2O) per lb dry air	66.11	67.24	67.62	66.58	65.70	64.23	59.03	57.35
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	954.28	802.94	655.36	395.69	995.48	844.58	658.42	263.28
FINAL EXHAUST TEMP	895.92	766.08	629.05	397.34	874.72	768.08	620.34	294.42
Coolant Temperature IN DEG F	158	160	162	164.125	156.5	158.01563	162	165
Coolant Temperature OUT DEG F	172	170.79688	170	169	170.3125	169.20313	170	168
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.56	12.94	10.54	7.80	7.69	6.38	5.39	2.03
Exhaust Restriction (mmHg)	21.79	15.94	10.95	5.85	10.50	8.90	5.53	1.30
Exhaust Restriction (inH2O)	11.66	8.53	5.86	3.13	5.62	4.76	2.96	0.70
EXHAUST FLOW LB/HR	1005.71	889.63	772.91	619.31	616.35	536.20	471.86	202.98
FUEL /AIR RATIO	0.0349	0.0287	0.0234	0.0115	0.0438	0.0364	0.0282	0.0078
J CONVER	0.9202	0.9316	0.9414	0.9638	0.9036	0.9178	0.9343	0.9728
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.8	6.5	5.3	2.7	9.8	8.2	6.3	1.8
CO PPM DRY	4.0	0.0	0.0	109.0	0.0	0.0	0.0	88.1
NOX PPM DRY	625.3	458.2	349.9	130.7	898.3	724.7	574.0	206.8
NO PPM DRY	563.2	395.4	327.6	132.8	818.8	589.6	506.5	207.1
NO2 PPM DRY	62.1	62.8	22.3	-2.1	79.5	135.1	67.5	-0.3
%O2								
NO WET	518.2244	368.3775	308.3915	127.9974	739.8908	541.0963	473.2178	201.4860
NO2 WET	57.1907	58.4797	20.9941	-1.9938	71.8384	123.9996	63.0556	-0.2949
CO2 WET	7.1776	6.0203	4.9623	2.6354	8.8556	7.5015	5.8775	1.7510
CO WET	0.0004	0.0000	0.0000	0.0105	0.0000	0.0000	0.0000	0.0086
G	0.0013	0.0020	0.0026	0.0040	0.0002	0.0011	0.0020	0.0044
R	-0.0023	-0.0025	-0.0026	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0151	1.0138	1.0127	1.0158	1.0171	1.0237	1.0409	1.0772
NO CORR	510.5092	363.3674	304.5297	126.0030	727.4306	528.5847	454.6236	187.0543
NO2 CORR	56.3392	57.6844	20.7312	-1.9628	70.6286	121.1324	60.5760	-0.2738
GAS EMISSIONS								
NO GR/HR	241.31	151.93	110.63	36.68	210.73	133.21	100.82	17.85
NO2 GR/HR	40.80	36.95	11.54	-0.88	31.34	46.76	20.58	-0.04
CO2 GR/HR	49735.88	36901.83	26532.23	11245.15	37606.69	27713.82	19108.64	2448.91
CO GR/HR	1.62	0.00	0.00	28.49	0.00	0.00	0.00	7.62
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4476	2818	2052	680	3909	2471	1870	331
NO2 CFM 5 ppm	2468	2235	698	-53	1896	2829	1245	-2
CO2 CFM 5000 ppm	3133	2325	1672	708	2369	1746	1204	154
CO CFM 50 ppm	16	0	0	283	0	0	0	76
NOX ppm - wet EURO, EPA, ISO	575.42	426.86	329.39	126.00	811.73	665.10	536.27	201.19
NOX ppm(corr) EURO,EPA,ISO	566.85	421.05	325.26	124.04	798.06	649.72	515.20	186.78
NOX GR/HR EURO, EPA, ISO	410.46	269.70	181.01	55.31	354.16	250.83	175.04	27.30
NOX cfm EURO, EPA, ISO	4966	3263	2190	669	4285	3035	2118	330
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	20.83	16.16	8.31	5.46	20.56	10.11	4.00	0.23
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	3.12	2.42	1.25	0.55	2.06	1.01	0.40	0.03
Weighted HP	12.571	9.291	6.421	0.953	7.133	5.316	3.599	0.223
Weighted Average HP	45.506 HP							
Weighted Average PARTICULATE	10.840 GR/HR							
	0.238 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	6379.534							

COMPANY NAME Isuzu
DATE 8/19/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2005 spedc LSD test fuel; Engine + ECS Purifier DOC, EC/OC samples

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.2	2500.1	2499.4	2499.3	1800.0	1800.0	1800.1	990.9
TORQUE lbft	175.5	134.8	90.2	19.9	207.9	155.1	105.2	7.8
HORSEPOWER	83.6	64.2	42.9	9.5	71.2	53.2	36.1	1.5
Barometric Pressure INHG	28.75	28.75	28.75	28.75	28.75	28.75	28.75	28.76
Laminar flow air temp DEG F	61.40	62.77	61.91	62.49	61.79	62.57	62.85	62.24
Laminar flow diff pressure in. of H2O	4.37	3.97	3.39	2.74	2.64	2.31	2.06	0.90
Laminar Flow cfm	222.71	202.67	173.45	140.26	135.52	118.82	105.88	46.27
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.38	74.41	74.00	74.00	76.25	78.00	78.00	81.00
Boost/Air In Manifold (degF)	315.00	265.25	202.72	137.50	236.64	188.50	149.50	98.48
Altitude Barrel Pressure (inHg)	28.67	28.68	28.68	28.68	28.68	28.68	28.68	28.69
Altitude (ft)	1168	1163	1167	1161	1158	1164	1163	1156
Intake AIR Consumption lbs/hr	969.41	877.91	753.63	608.24	589.20	515.24	458.74	200.95
LAB FACTOR-NA	1.026	1.028	1.028	1.028	1.030	1.032	1.032	1.036
LAB FACTOR-TURBO	1.011	1.015	1.015	1.015	1.019	1.024	1.024	1.033
Intake Air Temperature DEG F	73.38	74.41	74.00	74.00	76.25	78.00	78.00	81.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	315.00	265.25	202.72	137.50	236.64	188.50	149.50	98.48
Boost air Pressure (@manifold) psi	21.30	16.18	9.98	3.90	12.96	8.35	4.91	0.30
FUEL Temperature DEG F	95.33	95.50	95.14	94.33	94.05	94.03	93.95	92.48
FUEL Cunsumption lbs/hr	33.42	25.96	17.63	7.42	25.79	18.86	12.74	1.52
DEW Point DEG F	51.78	53.44	52.47	53.10	52.17	52.67	52.75	52.05
Grains Water (H2O) per lb dry air	58.61	62.33	60.12	61.57	59.47	60.59	60.76	59.18
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	946.69	818.45	656.66	396.31	996.38	851.91	664.95	265.58
FINAL EXHAUST TEMP	887.13	778.69	630.31	398.44	875.63	780.20	629.08	297.80
Coolant Temperature IN DEG F	158	160	162.4375	165	155.51563	159.75	160.5	165
Coolant Temperature OUT DEG F	172	170.95313	170.5	169.90625	169.59375	170.54688	168.48438	168.48438
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.55	13.37	10.56	7.83	7.68	6.37	5.44	2.10
Exhaust Restriction (mmHg)	21.54	16.70	10.94	5.84	10.60	9.20	5.75	1.32
Exhaust Restriction (inH2O)	11.53	8.94	5.85	3.13	5.67	4.92	3.08	0.71
EXHAUST FLOW LB/HR	1002.83	903.86	771.27	615.66	614.99	534.10	471.48	202.47
FUEL /AIR RATIO	0.0345	0.0296	0.0234	0.0122	0.0438	0.0366	0.0278	0.0076
J CONVER	0.9226	0.9310	0.9430	0.9636	0.9051	0.9182	0.9347	0.9728
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.8	6.6	5.3	2.8	9.9	8.2	6.3	1.8
CO PPM DRY	2.0	0.0	0.0	117.9	0.0	0.0	0.0	83.3
NOX PPM DRY	629.3	464.9	360.5	135.6	921.9	732.9	562.9	206.4
NO PPM DRY	556.4	403.6	332.2	135.6	838.3	614.8	491.9	204.8
NO2 PPM DRY	72.9	61.4	28.3	0.0	83.6	118.1	71.1	1.6
%O2								
NO WET	513.3207	375.7102	313.2288	130.6849	758.7258	564.5332	459.7539	199.2362
NO2 WET	67.2948	57.1313	26.7227	0.0151	75.6571	108.4578	66.4248	1.5869
CO2 WET	7.1966	6.1446	4.9980	2.6651	8.9148	7.5295	5.8944	1.7511
CO WET	0.0002	0.0000	0.0000	0.0114	0.0000	0.0000	0.0000	0.0061
G	0.0013	0.0019	0.0026	0.0039	0.0002	0.0011	0.0021	0.0044
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0327	1.0268	1.0335	1.0322	1.0289	1.0326	1.0388	1.0725
NO CORR	497.0670	365.9017	303.0878	126.6107	737.3943	546.7063	442.5877	185.7625
NO2 CORR	65.1640	55.6398	25.8576	0.0146	73.5300	105.0329	63.9446	1.4796
GAS EMISSIONS								
NO GR/HR	234.28	155.44	109.87	36.64	213.14	137.24	98.08	17.68
NO2 GR/HR	47.05	36.21	14.36	0.01	32.56	40.39	21.71	0.22
CO2 GR/HR	49724.55	38266.09	26559.43	11304.93	37774.60	27708.23	19147.99	2442.77
CO GR/HR	0.81	0.00	0.00	30.63	0.00	0.00	0.00	7.18
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4346	2883	2038	680	3954	2546	1819	328
NO2 CFM 5 ppm	2846	2190	869	0	1969	2443	1313	13
CO2 CFM 5000 ppm	3133	2411	1673	712	2380	1746	1206	154
CO CFM 50 ppm	8	0	0	304	0	0	0	71
NOX ppm - wet EURO, EPA, ISO	580.62	432.84	339.95	130.70	834.38	672.99	526.18	200.82
NOX ppm(corr) EURO,EPA,ISO	562.23	421.54	328.95	126.63	810.92	651.74	506.53	187.24
NOX GR/HR EURO, EPA, ISO	405.95	274.33	182.67	56.13	359.07	250.63	171.95	27.30
NOX cfm EURO, EPA, ISO	4911	3319	2210	679	4344	3032	2080	330

DPM EC/OC DATA

EC	TWA (ug/m3)	23274	28299	20332	14895	33431	27289	15217	906
OC	TWA (ug/m3)	8756	8078	6988	7329	6427	4867	4387	1878
TC	TWA (ug/m3)	32037	36377	27320	22224	39857	32156	19604	2791

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: 2005 spec LSD Certified
Engine: Isuzu 4JG1T
DOC: NONE

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.2	2499.9	2500.3	2499.0	1799.9	1800.2	1799.8	989.9
TORQUE lbft	176.79	135.11	90.07	19.93	209.97	157.49	104.90	8.04
HORSEPOWER	84.16	64.31	42.88	9.48	71.96	53.98	35.95	1.52
Barometric Pressure INHG	28.84	28.83	28.83	28.83	28.83	28.83	28.83	28.83
Laminar flow air temp DEG F	62.27	62.64	62.42	62.25	62.22	62.62	62.71	62.10
Laminar flow diff pressure in. of H2O	4.41	3.98	3.40	2.73	2.65	2.32	2.04	0.87
Laminar Flow cfm	224.51	202.88	173.66	139.89	135.88	119.26	104.99	45.14
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.50	74.35	74.34	74.40	75.90	77.52	78.46	81.50
Boost/Air In Manifold (degF)	318.74	266.70	204.13	138.16	238.28	191.92	150.53	100.26
Altitude Barrel Pressure (inHg)	28.76	28.76	28.76	28.76	28.75	28.75	28.75	28.75
Altitude (ft)	1083.15	1091.46	1088.45	1089.60	1092.24	1094.54	1094.20	1094.74
Intake AIR Consumption lbs/hr	978.19	882.93	756.28	609.60	592.06	518.96	456.74	196.72
LAB FACTOR-NA	1.023	1.024	1.023	1.024	1.026	1.029	1.029	1.033
LAB FACTOR-TURBO	1.009	1.011	1.011	1.012	1.016	1.022	1.023	1.031
Intake Air Temperature DEG F	73.50	74.35	74.34	74.40	75.90	77.52	78.46	81.50
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	318.74	266.70	204.13	138.16	238.28	191.92	150.53	100.26
Boost air Pressure (@manifold) psi	21.53	16.20	9.92	3.76	12.99	8.42	4.71	0.07
FUEL Temperature DEG F	94.77	95.04	94.79	94.04	93.74	93.69	93.92	92.52
FUEL Cunsumption lbs/hr	33.60	25.61	17.51	7.35	25.72	18.88	12.68	1.44
DEW Point DEG F	50.95	50.97	50.77	50.48	50.67	50.87	50.81	50.78
Grains Water (H2O) per lb dry air	56.67	56.72	56.31	55.68	56.09	56.51	56.42	56.35
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	944.17	807.09	651.38	398.19	983.30	851.87	666.13	293.07
FINAL EXHAUST TEMP	855.88	743.42	608.71	395.98	834.23	752.16	606.84	323.95
Coolant Temperature IN DEG F	167.89	165.63	158.97	160.41	159.27	155.05	157.48	159.60
Coolant Temperature OUT DEG F	180.75	176.59	167.37	165.36	173.05	166.25	165.50	163.59
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.11	12.98	10.38	7.64	7.53	6.26	5.31	2.00
Exhaust Restriction (mmHg)	6.44	4.93	3.02	1.56	4.13	3.70	2.00	0.37
Exhaust Restriction (inH2O)	3.45	2.64	1.62	0.84	2.21	1.98	1.07	0.20
EXHAUST FLOW LB/HR	1011.79	908.54	773.79	616.95	617.78	537.84	469.42	198.15
FUEL /AIR RATIO	0.03	0.03	0.02	0.01	0.04	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.97	0.91	0.92	0.94	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.70	6.50	5.20	2.71	9.71	8.14	6.25	1.80
CO PPM DRY	132.68	96.18	78.24	234.79	125.62	75.67	73.73	142.34
NOX PPM DRY	657.84	503.13	372.25	132.08	987.17	811.01	589.86	203.36
NO PPM DRY	628.94	474.77	345.68	113.21	947.50	769.55	560.69	176.10
NO2 PPM DRY	28.90	28.35	26.57	18.87	39.67	41.46	29.17	27.26
%O2								
NO WET	580.70	443.09	326.43	109.27	858.83	707.62	524.62	171.51
NO2 WET	26.69	26.46	25.09	18.22	35.96	38.12	27.30	26.55
CO2 WET	7.11	6.06	4.91	2.61	8.80	7.48	5.85	1.75
CO WET	0.0123	0.0090	0.0074	0.0227	0.0114	0.0070	0.0069	0.0139
G	0.0013	0.0019	0.0026	0.0039	0.0003	0.0011	0.0021	0.0045
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0373	1.0410	1.0450	1.0530	1.0354	1.0412	1.0509	1.0849
NO CORR	559.78	425.64	312.36	103.77	829.44	679.60	499.19	158.08
NO2 CORR	25.73	25.39	23.99	17.29	34.73	36.63	25.97	24.47
GAS EMISSIONS								
NO GR/HR	266.19	181.75	113.60	30.09	240.84	171.80	110.14	14.72
NO2 GR/HR	18.75	16.60	13.36	7.68	15.45	14.21	8.78	3.49
CO2 GR/HR	49561.67	37960.34	26179.77	11112.84	37466.47	27730.09	18918.68	2393.43
CO GR/HR	54.29	35.72	25.04	61.23	30.81	16.39	14.18	12.03
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4938	3371	2107	558	4468	3187	2043	273
NO2 CFM 5 ppm	1134	1004	808	465	935	860	531	211
CO2 CFM 5000 ppm	3122	2392	1649	700	2360	1747	1192	151
CO CFM 50 ppm	539	355	249	609	306	163	141	120
NOX ppm - wet EURO, EPA, ISO	607.4	469.6	351.5	127.5	894.8	745.7	551.9	198.1
NOX ppm(corr) EURO,EPA,ISO	585.5	451.0	336.4	121.1	864.2	716.2	525.2	182.6
NOX GR/HR EURO, EPA, ISO	426.5	295.0	187.4	53.8	384.4	277.4	177.5	26.0
NOX cfm EURO, EPA, ISO	5160.4	3569.4	2267.1	650.6	4650.6	3356.1	2147.5	315.1

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/20/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2005 spedc LSD test fuel; Engine only, gravimetric test

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.3	2500.2	2500.8	2498.2	1799.9	1800.3	1799.6	990.6
TORQUE lbft	176.9	135.1	90.2	20.0	210.6	160.0	104.9	8.0
HORSEPOWER	84.2	64.3	42.9	9.5	72.2	54.8	35.9	1.5
Barometric Pressure INHG	28.84	28.84	28.84	28.84	28.84	28.84	28.84	28.83
Laminar flow air temp DEG F	62.22	62.59	63.08	62.33	61.71	62.67	62.56	62.60
Laminar flow diff pressure in. of H2O	4.42	3.99	3.41	2.73	2.65	2.34	2.05	0.88
Laminar Flow cfm	225.13	203.41	174.35	140.21	135.86	120.28	105.15	45.39
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.00	73.00	73.67	73.80	75.30	77.00	78.00	81.00
Boost/Air In Manifold (degF)	318.00	264.00	203.45	137.83	237.95	193.36	150.00	99.83
Altitude Barrel Pressure (inHg)	28.77	28.77	28.77	28.77	28.76	28.76	28.76	28.76
Altitude (ft)	1075	1081	1081	1080	1084	1087	1086	1091
Intake AIR Consumption lbs/hr	981.20	885.48	757.84	610.98	593.07	523.35	457.70	197.54
LAB FACTOR-NA	1.022	1.022	1.022	1.022	1.024	1.028	1.029	1.033
LAB FACTOR-TURBO	1.007	1.008	1.009	1.009	1.014	1.020	1.022	1.031
Intake Air Temperature DEG F	73.00	73.00	73.67	73.80	75.30	77.00	78.00	81.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	318.00	264.00	203.45	137.83	237.95	193.36	150.00	99.83
Boost air Pressure (@manifold) psi	21.56	16.10	9.94	3.81	13.06	8.63	4.74	0.09
FUEL Temperature DEG F	93.86	93.72	93.78	93.05	92.78	93.34	93.75	92.06
FUEL Cunsumption lbs/hr	33.60	25.65	17.62	7.37	25.83	19.19	12.73	1.43
DEW Point DEG F	51.09	51.22	51.25	50.60	50.56	51.28	51.03	51.16
Grains Water (H2O) per lb dry air	56.94	57.26	57.30	55.92	55.86	57.34	56.86	57.15
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	943.75	797.67	649.63	401.06	987.23	858.00	664.17	291.31
FINAL EXHAUST TEMP	861.50	735.19	606.83	399.48	845.38	758.58	605.41	321.31
Coolant Temperature IN DEG F	160	159	162	164.82813	160.5	157	160.95313	163.79688
Coolant Temperature OUT DEG F	173	170	170	169.71875	174.09375	168	169	167.51563
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.12	12.99	10.38	7.60	7.52	6.27	5.30	1.98
Exhaust Restriction (mmHg)	6.49	4.97	3.02	1.60	3.94	3.78	1.91	0.36
Exhaust Restriction (inH2O)	3.47	2.66	1.62	0.86	2.11	2.02	1.02	0.19
EXHAUST FLOW LB/HR	1014.80	911.13	775.46	618.34	618.90	542.54	470.44	198.97
FUEL /AIR RATIO	0.0342	0.0290	0.0233	0.0121	0.0435	0.0367	0.0278	0.0072
J CONVER	0.9234	0.9332	0.9439	0.9651	0.9063	0.9188	0.9355	0.9739
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.7	6.5	5.2	2.7	9.7	8.2	6.2	1.8
CO PPM DRY	129.8	95.7	79.5	224.6	122.6	75.4	73.3	138.0
NOX PPM DRY	651.2	492.1	365.2	131.5	1002.7	822.4	591.7	201.4
NO PPM DRY	620.0	471.7	343.9	114.3	954.2	771.0	563.8	174.0
NO2 PPM DRY	31.2	20.4	21.3	17.2	48.6	51.4	27.9	27.3
%O2								
NO WET	572.5180	440.2072	324.6142	110.2737	864.7353	708.4175	527.4249	169.4731
NO2 WET	28.7941	19.0407	20.1053	16.6367	44.0283	47.2409	26.1232	26.6173
CO2 WET	7.1105	6.0616	4.9083	2.6059	8.7909	7.5342	5.8394	1.7530
CO WET	0.0120	0.0089	0.0075	0.0217	0.0111	0.0069	0.0069	0.0134
G	0.0013	0.0019	0.0026	0.0039	0.0002	0.0010	0.0021	0.0045
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0361	1.0370	1.0405	1.0499	1.0356	1.0386	1.0488	1.0800
NO CORR	552.5639	424.4871	311.9809	105.0347	834.9800	682.0819	502.8760	156.9229
NO2 CORR	27.7906	18.3607	19.3229	15.8463	42.5133	45.4847	24.9073	24.6462
GAS EMISSIONS								
NO GR/HR	263.55	181.78	113.71	30.53	242.88	173.93	111.19	14.68
NO2 GR/HR	20.31	12.04	10.79	7.05	18.94	17.77	8.44	3.53
CO2 GR/HR	49716.59	38052.76	26224.98	11102.10	37486.39	28163.75	18927.33	2403.23
CO GR/HR	53.30	35.62	25.49	58.72	30.13	16.47	14.12	11.72
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4889	3372	2109	566	4505	3226	2063	272
NO2 CFM 5 ppm	1228	729	653	427	1146	1075	510	214
CO2 CFM 5000 ppm	3132	2397	1652	699	2362	1774	1192	151
CO CFM 50 ppm	530	354	253	584	299	164	140	116
NOX ppm - wet EURO, EPA, ISO	601.31	459.25	344.72	126.91	908.76	755.66	553.55	196.09
NOX ppm(corr) EURO,EPA,ISO	580.35	442.85	331.30	120.88	877.49	727.57	527.78	181.57
NOX GR/HR EURO, EPA, ISO	424.04	290.51	184.98	53.82	391.02	284.21	178.77	26.01
NOX cfm EURO, EPA, ISO	5130	3515	2238	651	4731	3439	2163	315
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	15.16	14.29	9.16	7.39	11.86	7.40	4.75	0.68
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	2.27	2.14	1.37	0.74	1.19	0.74	0.47	0.10
Weighted HP	12.636	9.649	6.441	0.951	7.218	5.485	3.594	0.227
Weighted Average HP	46.202 HP							
Weighted Average PARTICULATE	9.031 GR/HR							
	0.195 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	5314.616							

COMPANY NAME Isuzu
DATE 8/20/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2005 spedc LSD test ı ıel; Engine only, ec/oc sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER		1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM		**2500.2**	**2499.6**	**2499.7**	**2499.7**	**1800.0**	**1800.0**	**1800.1**	**989.3**
TORQUE lbft		**176.6**	**135.1**	**90.0**	**19.9**	**209.3**	**155.0**	**104.9**	**8.0**
HORSEPOWER		**84.1**	**64.3**	**42.8**	**9.4**	**71.7**	**53.1**	**36.0**	**1.5**
Barometric Pressure INHG		**28.83**	**28.83**	**28.83**	**28.82**	**28.82**	**28.82**	**28.82**	**28.82**
Laminar flow air temp DEG F		**62.32**	**62.68**	**61.76**	**62.17**	**62.73**	**62.57**	**62.87**	**61.60**
Laminar flow diff pressure in. of H2O		**4.40**	**3.97**	**3.38**	**2.72**	**2.65**	**2.30**	**2.04**	**0.87**
Laminar Flow cfm		**223.89**	**202.36**	**172.97**	**139.57**	**135.89**	**118.23**	**104.82**	**44.88**
Altitude Barrel Air (degF)		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)		74.00	75.70	75.00	75.00	76.50	78.03	78.92	82.00
Boost/Air In Manifold (degF)		319.48	269.39	204.80	138.50	238.61	190.48	151.06	100.69
Altitude Barrel Pressure (inHg)		28.76	28.74	28.75	28.75	28.75	28.74	28.74	28.75
Altitude (ft)		1091	1102	1096	1100	1100	1102	1102	1099
Intake AIR Consumption lbs/hr		**975.18**	**880.38**	**754.73**	**608.22**	**591.05**	**514.56**	**455.78**	**195.89**
LAB FACTOR-NA		**1.024**	**1.025**	**1.024**	**1.025**	**1.027**	**1.029**	**1.030**	**1.034**
LAB FACTOR-TURBO		**1.011**	**1.015**	**1.013**	**1.014**	**1.018**	**1.023**	**1.024**	**1.032**
Intake Air Temperature DEG F		**74.00**	**75.70**	**75.00**	**75.00**	**76.50**	**78.03**	**78.92**	**82.00**
TurboCharged Air TemperaturedeF		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF		**319.48**	**269.39**	**204.80**	**138.50**	**238.61**	**190.48**	**151.06**	**100.69**
Boost air Pressure (@manifold) psi		**21.51**	**16.30**	**9.90**	**3.70**	**12.93**	**8.21**	**4.67**	**0.05**
FUEL Temperature DEG F		**95.69**	**96.36**	**95.80**	**95.03**	**94.70**	**94.03**	**94.09**	**92.97**
FUEL Cunsumption lbs/hr		**33.60**	**25.67**	**17.40**	**7.34**	**25.62**	**18.58**	**12.63**	**1.45**
DEW Point DEG F		**50.80**	**50.71**	**50.29**	**50.35**	**50.77**	**50.46**	**50.60**	**50.40**
Grains Water (H2O) per lb dry air		**56.40**	**56.17**	**55.31**	**55.44**	**56.32**	**55.68**	**55.99**	**55.55**
Oil Temperature DEG F		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F		944.59	816.52	653.13	395.31	979.36	845.73	668.08	294.83
FINAL EXHAUST TEMP		850.27	751.66	610.59	392.47	823.08	745.73	608.28	326.59
Coolant Temperature IN DEG F		175.78125	172.25	155.9375	156	158.03125	153.10938	154	155.40625
Coolant Temperature OUT DEG F		188.5	183.1875	164.73438	161	172	164.5	162	159.65625
Oil Pressure PSI		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)		15.10	12.98	10.38	7.68	7.53	6.26	5.31	2.02
Exhaust Restriction (mmHg)		6.39	4.90	3.03	1.53	4.33	3.61	2.08	0.38
Exhaust Restriction (inH2O)		3.42	2.62	1.62	0.82	2.32	1.93	1.11	0.20
EXHAUST FLOW LB/HR		1008.78	905.95	772.12	615.56	616.67	533.14	468.41	197.33
FUEL /AIR RATIO		0.0345	0.0290	0.0231	0.0121	0.0433	0.0361	0.0277	0.0074
J CONVER		0.9232	0.9333	0.9447	0.9652	0.9066	0.9202	0.9359	0.9740
ECH4 % DRY		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY		**7.7**	**6.5**	**5.2**	**2.7**	**9.7**	**8.1**	**6.3**	**1.8**
CO PPM DRY		**135.5**	**96.7**	**77.0**	**244.9**	**128.6**	**75.9**	**74.2**	**146.6**
NOX PPM DRY		**664.5**	**514.1**	**379.3**	**132.7**	**971.6**	**799.6**	**588.0**	**205.4**
NO PPM DRY		**637.9**	**477.8**	**347.5**	**112.2**	**940.8**	**768.1**	**557.6**	**178.2**
NO2 PPM DRY		26.6	36.3	31.8	20.5	30.8	31.5	30.4	27.2
%O2									
NO WET		588.6780	445.9809	328.2541	108.2637	852.9229	706.8233	521.8053	173.5451
NO2 WET		24.5821	33.8856	30.0748	19.7934	27.8878	28.9906	28.4676	26.4801
CO2 WET		7.1084	6.0666	4.9126	2.6227	8.8134	7.4310	5.8593	1.7532
CO WET		0.0125	0.0090	0.0073	0.0236	0.0117	0.0070	0.0069	0.0143
G		0.0013	0.0019	0.0026	0.0039	0.0003	0.0011	0.0021	0.0044
R		-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR		1.0386	1.0450	1.0496	1.0562	1.0352	1.0439	1.0531	1.0898
NO CORR		567.0037	426.7833	312.7446	102.5076	823.8976	677.1179	495.5075	159.2439
NO2 CORR		23.6690	32.4269	28.6538	18.7411	26.9387	27.7722	27.0329	24.2980
GAS EMISSIONS									
NO GR/HR		268.83	181.72	113.49	29.66	238.79	169.67	109.09	14.77
NO2 GR/HR		17.19	21.15	15.93	8.31	11.96	10.66	9.12	3.45
CO2 GR/HR		49406.76	37867.91	26134.56	11123.58	37446.56	27296.42	18910.03	2383.63
CO GR/HR		55.27	35.81	24.59	63.75	31.49	16.32	14.25	12.34
VENTILLATION RATES									
PART 7, SUBPART E CATEGORY B									
NO CFM	25 ppm	**4987**	**3371**	**2105**	**550**	**4430**	**3147**	**2024**	**274**
NO2 CFM	5 ppm	**1040**	**1279**	**964**	**502**	**724**	**645**	**551**	**209**
CO2 CFM	5000 ppm	**3113**	**2386**	**1646**	**701**	**2359**	**1720**	**1191**	**150**
CO CFM	50 ppm	**549**	**356**	**244**	**633**	**313**	**162**	**142**	**123**
NOX ppm - wet EURO, EPA, ISO		613.46	479.87	358.33	128.06	880.81	735.81	550.27	200.03
NOX ppm(corr) EURO,EPA,ISO		590.67	459.21	341.40	121.25	850.84	704.89	522.54	183.54
NOX GR/HR EURO, EPA, ISO		429.02	299.54	189.79	53.74	377.77	270.56	176.23	26.08
NOX cfm EURO, EPA, ISO		5191	3624	2296	650	4571	3274	2132	316

DPM EC/OC DATA

EC	TWA (ug/m3)	22617	25554	18887	14111	32748	24076	16282	1106
OC	TWA (ug/m3)	11468	11104	10198	13718	13341	9673	9510	7616
TC	TWA (ug/m3)	34085	36659	29085	27829	46089	33750	25799	8722

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: 2007 spec ULSD Certified
Engine: Isuzu 4JG1T
DOC: ECS Purifier A16-0119

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.0	2499.6	2499.4	2499.3	1800.0	1800.2	1800.1	992.2
TORQUE lbft	179.95	134.90	89.82	19.94	210.14	160.02	105.05	8.64
HORSEPOWER	85.66	64.20	42.74	9.49	72.02	54.85	36.01	1.63
Barometric Pressure INHG	28.71	28.70	28.70	28.69	28.69	28.68	28.68	28.68
Laminar flow air temp DEG F	60.03	60.93	60.11	60.69	61.18	60.82	60.67	61.41
Laminar flow diff pressure in. of H2O	4.41	3.97	3.38	2.73	2.68	2.33	2.05	0.91
Laminar Flow cfm	224.76	202.38	172.69	139.79	137.32	119.71	105.43	47.19
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	72.50	73.01	72.91	73.50	74.56	76.10	76.50	80.38
Boost/Air in Manifold (degF)	318.25	261.13	200.04	135.81	235.94	189.64	148.12	97.33
Altitude Barrel Pressure (inHg)	28.64	28.64	28.64	28.63	28.63	28.62	28.62	28.62
Altitude (ft)	1198.01	1203.72	1204.73	1209.08	1213.13	1218.31	1219.83	1221.81
Intake AIR Consumption lbs/hr	982.42	882.03	754.42	609.56	597.81	521.65	459.57	205.24
LAB FACTOR-NA	1.025	1.026	1.026	1.026	1.028	1.030	1.031	1.036
LAB FACTOR-TURBO	1.009	1.010	1.010	1.012	1.016	1.019	1.021	1.032
Intake Air Temperature DEG F	72.50	73.01	72.91	73.50	74.56	76.10	76.50	80.38
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	318.25	261.13	200.04	135.81	235.94	189.64	148.12	97.33
Boost air Pressure (@manifold) psi	21.50	15.68	9.61	3.62	12.77	8.32	4.63	0.02
FUEL Temperature DEG F	95.64	94.51	95.74	96.06	95.10	93.84	93.91	92.20
FUEL Cunsumption lbs/hr	34.41	25.45	17.37	7.14	26.04	19.18	12.74	1.50
DEW Point DEG F	48.72	48.68	48.54	48.53	48.69	48.48	48.57	48.55
Grains Water (H2O) per lb dry air	52.37	52.29	52.02	51.99	52.34	51.91	52.09	52.08
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	957.64	807.81	649.77	390.86	993.07	857.24	659.91	261.45
FINAL EXHAUST TEMP	893.85	766.16	625.37	392.36	871.81	780.99	623.91	289.93
Coolant Temperature IN DEG F	164.00	158.50	160.34	162.18	156.01	157.88	159.91	159.00
Coolant Temperature OUT DEG F	177.24	169.50	168.35	166.75	170.02	169.40	168.23	162.73
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.04	12.76	10.19	7.55	7.44	6.21	5.27	1.99
Exhaust Restriction (mmHg)	21.96	16.34	10.84	5.75	10.61	9.23	5.75	1.29
Exhaust Restriction (inH2O)	11.75	8.75	5.80	3.08	5.68	4.94	3.08	0.69
EXHAUST FLOW LB/HR	1016.83	907.48	771.79	616.70	623.85	540.84	472.32	206.74
FUEL /AIR RATIO	0.04	0.03	0.02	0.01	0.04	0.04	0.03	0.01
J CONVER	0.92	0.93	0.95	0.97	0.91	0.92	0.94	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.90	6.60	5.29	2.73	9.89	8.30	6.30	1.85
CO PPM DRY	3.50	0.00	0.00	120.28	0.00	0.00	0.00	109.75
NOX PPM DRY	660.38	477.63	364.76	136.66	935.88	766.53	561.10	214.08
NO PPM DRY	597.13	407.81	326.99	137.21	841.61	624.86	467.52	211.30
NO2 PPM DRY	63.25	69.82	37.77	-0.54	94.27	141.67	93.58	2.77
%O2								
NO WET	551.14	381.12	309.17	132.63	763.36	574.75	437.92	205.99
NO2 WET	58.38	65.25	35.71	-0.53	85.50	130.31	87.65	2.70
CO2 WET	7.29	6.17	5.00	2.63	8.97	7.64	5.90	1.80
CO WET	0.0003	0.0000	0.0000	0.0116	0.0000	0.0000	0.0000	0.0107
G	0.0012	0.0020	0.0026	0.0039	0.0002	0.0010	0.0021	0.0045
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0456	1.0497	1.0533	1.0618	1.0421	1.0494	1.0581	1.0948
NO CORR	527.13	363.08	293.52	124.91	732.55	547.68	413.89	188.17
NO2 CORR	55.84	62.17	33.90	-0.49	82.05	124.17	82.85	2.47
GAS EMISSIONS								
NO GR/HR	251.93	154.86	106.47	36.21	214.79	139.21	91.88	18.28
NO2 GR/HR	40.88	40.62	18.84	-0.22	36.86	48.36	28.18	0.37
CO2 GR/HR	51105.09	38565.46	26600.15	11195.67	38569.78	28451.18	19203.65	2567.94
CO GR/HR	1.44	0.00	0.00	31.41	0.00	0.00	0.00	9.69
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4673	2873	1975	672	3984	2582	1704	339
NO2 CFM 5 ppm	2473	2457	1140	-13	2229	2925	1705	22
CO2 CFM 5000 ppm	3220	2430	1676	705	2430	1792	1210	162
CO CFM 50 ppm	14	0	0	312	0	0	0	96
NOX ppm - wet EURO, EPA, ISO	609.5	446.4	344.9	132.1	848.9	705.1	525.6	208.7
NOX ppm(corr) EURO,EPA,ISO	583.0	425.2	327.4	124.4	814.6	671.8	496.7	190.6
NOX GR/HR EURO, EPA, ISO	426.8	277.9	181.9	55.2	365.9	261.6	168.9	28.4
NOX cfm EURO, EPA, ISO	5163.9	3361.6	2201.2	668.4	4426.9	3165.2	2043.8	343.3

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/25/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2007 spec ULSD test fue Engine with DOC, gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.0	2499.5	2499.1	2499.0	1800.1	1800.2	1800.0	992.0
TORQUE lbft	181.6	134.8	89.5	20.0	209.8	160.0	105.0	8.6
HORSEPOWER	86.4	64.2	42.6	9.5	71.9	54.8	36.0	1.6
Barometric Pressure INHG	28.72	28.72	28.71	28.71	28.71	28.70	28.70	28.70
Laminar flow air temp DEG F	60.22	60.94	60.18	61.28	61.24	61.28	60.48	61.18
Laminar flow diff pressure in. of H2O	4.44	3.97	3.39	2.74	2.68	2.34	2.05	0.91
Laminar Flow cfm	226.24	202.31	173.07	140.54	137.29	120.24	105.65	47.10
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	72.00	72.02	72.83	73.00	74.13	76.00	76.00	80.00
Boost/Air In Manifold (degF)	319.00	260.28	199.66	135.50	235.00	189.02	147.73	96.98
Altitude Barrel Pressure (inHg)	28.66	28.65	28.65	28.64	28.64	28.64	28.64	28.64
Altitude (ft)	1186	1189	1196	1201	1197	1200	1202	1204
Intake AIR Consumption lbs/hr	988.76	882.19	756.24	612.01	597.95	523.56	461.08	205.13
LAB FACTOR-NA	1.023	1.024	1.025	1.025	1.027	1.029	1.030	1.035
LAB FACTOR-TURBO	1.007	1.008	1.009	1.010	1.014	1.018	1.020	1.030
Intake Air Temperature DEG F	72.00	72.02	72.83	73.00	74.13	76.00	76.00	80.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	319.00	260.28	199.66	135.50	235.00	189.02	147.73	96.98
Boost air Pressure (@manifold) psi	21.63	15.68	9.60	3.64	12.73	8.30	4.63	0.02
FUEL Temperature DEG F	92.94	96.08	97.22	97.89	96.50	94.05	94.39	92.47
FUEL Cunsumption lbs/hr	34.63	25.51	17.30	7.11	26.02	19.28	12.80	1.50
DEW Point DEG F	48.99	48.53	48.89	48.72	48.36	48.38	48.46	48.46
Grains Water (H2O) per lb dry air	52.87	51.96	52.68	52.34	51.68	51.69	51.85	51.89
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	959.41	809.28	650.28	391.03	992.39	856.58	659.20	261.20
FINAL EXHAUST TEMP	892.41	769.28	626.64	392.77	870.86	780.08	623.25	288.78
Coolant Temperature IN DEG F	160	158	159	161.35938	155.54688	156	158	160
Coolant Temperature OUT DEG F	173.48438	169	167	166	169.53125	167.90625	166.5	163.46875
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.10	12.73	10.14	7.52	7.41	6.19	5.25	1.98
Exhaust Restriction (mmHg)	22.10	16.39	10.85	5.75	10.61	9.29	5.75	1.28
Exhaust Restriction (inH2O)	11.83	8.77	5.81	3.08	5.68	4.97	3.08	0.69
EXHAUST FLOW LB/HR	1023.39	907.70	773.54	619.12	623.97	542.84	473.88	206.63
FUEL /AIR RATIO	0.0350	0.0289	0.0229	0.0116	0.0435	0.0368	0.0278	0.0073
J CONVER	0.9229	0.9345	0.9456	0.9668	0.9073	0.9198	0.9367	0.9749
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.9	6.6	5.3	2.7	9.9	8.3	6.3	1.9
CO PPM DRY	4.0	0.0	0.0	119.4	0.0	0.0	0.0	111.3
NOX PPM DRY	663.7	479.6	360.4	136.1	925.8	767.6	566.7	217.0
NO PPM DRY	600.4	404.3	322.1	135.9	833.2	618.9	465.1	213.2
NO2 PPM DRY	63.3	75.4	38.3	0.3	92.6	148.7	101.6	3.7
%O2								
NO WET	554.0750	377.7977	304.5894	131.3340	755.9364	569.2084	435.6329	207.8996
NO2 WET	58.4412	70.4286	36.1732	0.2779	84.0370	136.7999	95.2019	3.6377
CO2 WET	7.3080	6.1676	4.9941	2.6238	8.9690	7.6342	5.9011	1.8036
CO WET	0.0004	0.0000	0.0000	0.0115	0.0000	0.0000	0.0000	0.0108
G	0.0012	0.0019	0.0026	0.0040	0.0003	0.0010	0.0021	0.0045
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0438	1.0485	1.0513	1.0587	1.0432	1.0498	1.0576	1.0938
NO CORR	530.8277	360.3108	289.7272	124.0508	724.6020	542.2088	411.8984	190.0777
NO2 CORR	55.9892	67.1687	34.4081	0.2625	80.5536	130.3110	90.0151	3.3259
GAS EMISSIONS								
NO GR/HR	255.32	153.72	105.33	36.10	212.50	138.34	91.74	18.46
NO2 GR/HR	41.25	43.90	19.16	0.12	36.19	50.93	30.71	0.49
CO2 GR/HR	51529.90	38573.00	26617.03	11192.67	38559.56	28553.07	19267.40	2567.79
CO GR/HR	1.65	0.00	0.00	31.31	0.00	0.00	0.00	9.82
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4736	2851	1954	670	3942	2566	1702	342
NO2 CFM 5 ppm	2496	2655	1159	7	2189	3081	1858	30
CO2 CFM 5000 ppm	3246	2430	1677	705	2429	1799	1214	162
CO CFM 50 ppm	16	0	0	311	0	0	0	98
NOX ppm - wet EURO, EPA, ISO	612.52	448.23	340.76	131.61	839.97	706.01	530.83	211.54
NOX ppm(corr) EURO,EPA,ISO	586.82	427.48	324.14	124.31	805.16	672.52	501.91	193.40
NOX GR/HR EURO, EPA, ISO	432.39	279.38	180.53	55.41	361.73	262.85	171.25	28.77
NOX cfm EURO, EPA, ISO	5231	3380	2184	670	4376	3180	2072	348
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	13.51	12.18	7.05	4.72	11.09	6.19	3.62	0.16
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	2.03	1.83	1.06	0.47	1.11	0.62	0.36	0.02
Weighted HP	12.965	9.623	6.388	0.953	7.190	5.483	3.598	0.244
Weighted Average HP	46.445 HP							
Weighted Average PARTICULATE	7.495 GR/HR							
	0.161 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	4410.515							

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/25/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2007 spec ULSD test fuel; E: line w/ ECS DOC, ec/oc sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.9	2499.7	2499.7	2499.5	1799.9	1800.1	1800.1	992.5
TORQUE lbft	178.3	135.0	90.1	19.8	210.5	160.1	105.1	8.7
HORSEPOWER	84.9	64.3	42.9	9.4	72.1	54.9	36.0	1.6
Barometric Pressure INHG	28.69	28.69	28.68	28.68	28.68	28.67	28.66	28.66
Laminar flow air temp DEG F	59.84	60.91	60.05	60.10	61.12	60.35	60.87	61.64
Laminar flow diff pressure in. of H2O	4.39	3.97	3.37	2.71	2.68	2.32	2.05	0.92
Laminar Flow cfm	223.27	202.44	172.30	139.04	137.36	119.18	105.21	47.28
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.00	74.00	73.00	74.00	75.00	76.20	77.00	80.75
Boost/Air In Manifold (degF)	317.50	261.98	200.42	136.13	236.88	190.27	148.50	97.67
Altitude Barrel Pressure (inHg)	28.63	28.62	28.63	28.62	28.61	28.60	28.60	28.60
Altitude (ft)	1210	1219	1214	1217	1229	1236	1238	1239
Intake AIR Consumption lbs/hr	976.08	881.87	752.60	607.11	597.67	519.74	458.06	205.35
LAB FACTOR-NA	1.026	1.027	1.026	1.027	1.030	1.031	1.032	1.037
LAB FACTOR-TURBO	1.011	1.013	1.011	1.013	1.017	1.021	1.023	1.033
Intake Air Temperature DEG F	73.00	74.00	73.00	74.00	75.00	76.20	77.00	80.75
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	317.50	261.98	200.42	136.13	236.88	190.27	148.50	97.67
Boost air Pressure (@manifold) psi	21.37	15.68	9.63	3.60	12.81	8.34	4.62	0.02
FUEL Temperature DEG F	98.34	92.94	94.27	94.23	93.70	93.64	93.44	91.92
FUEL Cunsumption lbs/hr	34.19	25.39	17.44	7.17	26.06	19.09	12.69	1.50
DEW Point DEG F	48.45	48.84	48.19	48.34	49.02	48.58	48.68	48.64
Grains Water (H2O) per lb dry air	51.86	52.62	51.36	51.64	53.01	52.14	52.34	52.26
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	955.88	806.34	649.27	390.69	993.75	857.91	660.63	261.70
FINAL EXHAUST TEMP	895.30	763.05	624.09	391.95	872.77	781.91	624.58	291.08
Coolant Temperature IN DEG F	168	159	161.67188	163	156.46875	159.75	161.8125	158
Coolant Temperature OUT DEG F	181	170	169.70313	167.5	170.5	170.89063	169.96875	162
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	14.97	12.78	10.24	7.58	7.46	6.23	5.28	2.00
Exhaust Restriction (mmHg)	21.82	16.29	10.83	5.74	10.60	9.17	5.75	1.29
Exhaust Restriction (inH2O)	11.68	8.72	5.79	3.07	5.68	4.91	3.08	0.69
EXHAUST FLOW LB/HR	1010.27	907.26	770.05	614.28	623.73	538.83	470.75	206.86
FUEL /AIR RATIO	0.0350	0.0288	0.0232	0.0118	0.0436	0.0367	0.0277	0.0073
J CONVER	0.9231	0.9346	0.9454	0.9666	0.9068	0.9198	0.9367	0.9748
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.9	6.6	5.3	2.7	9.9	8.3	6.3	1.8
CO PPM DRY	3.0	0.0	0.0	121.1	0.0	0.0	0.0	108.2
NOX PPM DRY	657.1	475.6	369.2	137.2	945.9	765.5	555.5	211.2
NO PPM DRY	593.9	411.3	331.9	138.6	850.0	630.9	470.0	209.4
NO2 PPM DRY	63.2	64.3	37.3	-1.4	95.9	134.6	85.5	1.8
%O2								
NO WET	548.2088	384.4330	313.7434	133.9323	770.7847	580.2984	440.2028	204.0895
NO2 WET	58.3191	60.0763	35.2441	-1.3290	86.9652	123.8156	80.1069	1.7638
CO2 WET	7.2809	6.1683	5.0104	2.6460	8.9773	7.6361	5.9011	1.8019
CO WET	0.0003	0.0000	0.0000	0.0117	0.0000	0.0000	0.0000	0.0105
G	0.0012	0.0020	0.0026	0.0039	0.0002	0.0010	0.0021	0.0045
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0473	1.0508	1.0553	1.0648	1.0409	1.0491	1.0585	1.0958
NO CORR	523.4399	365.8460	297.3118	125.7776	740.5078	553.1474	415.8789	186.2553
NO2 CORR	55.6842	57.1717	33.3983	-1.2481	83.5491	118.0225	75.6805	1.6097
GAS EMISSIONS								
NO GR/HR	248.54	156.00	107.60	36.31	217.08	140.09	92.01	18.11
NO2 GR/HR	40.50	37.35	18.52	-0.55	37.52	45.79	25.65	0.24
CO2 GR/HR	50680.27	38557.93	26583.28	11198.67	38580.00	28349.29	19139.91	2568.09
CO GR/HR	1.23	0.00	0.00	31.50	0.00	0.00	0.00	9.56
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4610	2894	1996	674	4027	2599	1707	336
NO2 CFM 5 ppm	2450	2259	1120	-33	2270	2770	1552	15
CO2 CFM 5000 ppm	3193	2429	1675	706	2431	1786	1206	162
CO CFM 50 ppm	12	0	0	313	0	0	0	95
NOX ppm - wet EURO, EPA, ISO	606.53	444.51	348.99	132.60	857.75	704.11	520.31	205.85
NOX ppm(corr) EURO,EPA,ISO	579.12	423.02	330.71	124.53	824.06	671.17	491.56	187.86
NOX GR/HR EURO, EPA, ISO	421.25	276.33	183.36	55.08	370.07	260.39	166.61	27.98
NOX cfm EURO, EPA, ISO	5097	3343	2218	666	4477	3150	2016	339

DPM EC/OC DATA

EC	TWA (ug/m3)	23341	28821	20707	12638	41127	28157	16690	---
OC	TWA (ug/m3)	5637	5764	6048	5926	5472	3935	4622	2422
TC	TWA (ug/m3)	28978	34585	26754	18563	46600	32099	21312	3147

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: 2007 spec ULSD Certified
Engine: Isuzu 4JG1T
DOC: NONE

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.9	2459.5	2499.3	2499.0	1800.2	1800.1	1800.1	998.3
TORQUE lbft	178.88	135.14	90.01	19.84	211.06	160.05	105.12	4.28
HORSEPOWER	85.15	64.31	42.83	9.44	72.34	54.86	36.03	0.81
Barometric Pressure INHG	28.86	28.86	28.85	28.85	28.84	28.84	28.84	28.84
Laminar flow air temp DEG F	60.61	60.51	59.46	60.15	60.13	60.72	59.87	59.95
Laminar flow diff pressure in. of H2O	4.41	3.96	3.38	2.72	2.65	2.33	2.04	0.89
Laminar Flow cfm	224.48	202.10	172.79	139.64	136.14	119.83	105.01	46.07
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.20	74.00	73.57	74.00	75.59	77.50	77.50	81.77
Boost/Air In Manifold (degF)	320.48	265.63	202.99	137.75	238.93	192.75	149.20	100.30
Altitude Barrel Pressure (inHg)	28.80	28.80	28.79	28.79	28.79	28.78	28.78	28.77
Altitude (ft)	1051.59	1052.04	1057.61	1062.67	1062.64	1070.95	1067.93	1073.24
Intake AIR Consumption lbs/hr	983.47	885.63	759.91	612.78	597.27	524.64	460.98	202.21
LAB FACTOR-NA	1.022	1.023	1.022	1.022	1.025	1.028	1.028	1.033
LAB FACTOR-TURBO	1.008	1.010	1.009	1.010	1.014	1.021	1.020	1.032
Intake Air Temperature DEG F	73.20	74.00	73.57	74.00	75.59	77.50	77.50	81.77
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	320.48	265.63	202.99	137.75	238.93	192.75	149.20	100.30
Boost air Pressure (@manifold) psi	21.76	16.17	9.88	3.76	13.10	8.55	4.68	0.05
FUEL Temperature DEG F	95.75	95.95	95.89	95.38	94.72	95.49	94.57	93.99
FUEL Cunsumption lbs/hr	34.34	25.90	17.72	7.30	25.84	19.20	12.79	1.34
DEW Point DEG F	51.23	51.53	50.30	50.07	50.46	50.71	50.50	50.42
Grains Water (H2O) per lb dry air	57.23	57.88	55.26	54.81	55.64	56.16	55.70	55.57
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	950.55	804.84	647.77	397.53	983.55	852.91	661.07	278.61
FINAL EXHAUST TEMP	854.84	739.71	601.53	393.35	827.38	745.82	596.91	307.15
Coolant Temperature IN DEG F	163.49	158.16	160.00	161.07	158.55	156.81	158.42	157.60
Coolant Temperature OUT DEG F	177.00	169.05	167.98	165.50	172.28	168.50	166.50	162.00
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.19	12.98	10.33	7.65	7.56	6.32	5.35	2.06
Exhaust Restriction (mmHg)	6.63	5.02	3.17	1.62	4.23	3.76	2.01	0.36
Exhaust Restriction (inH2O)	3.55	2.69	1.70	0.87	2.27	2.01	1.08	0.19
EXHAUST FLOW LB/HR	1017.80	911.53	777.63	620.09	623.11	543.84	473.77	203.55
FUEL /AIR RATIO	0.03	0.03	0.02	0.01	0.04	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.97	0.91	0.92	0.94	0.98
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.84	6.61	5.26	2.75	9.77	8.26	6.30	1.60
CO PPM DRY	134.75	98.39	78.69	241.51	131.72	71.03	73.21	163.16
NOX PPM DRY	675.99	493.48	373.82	133.02	979.36	827.34	594.45	176.75
NO PPM DRY	639.70	476.15	349.34	113.20	960.47	794.74	564.96	146.83
NO2 PPM DRY	36.28	17.33	24.48	19.81	18.89	32.60	29.49	29.93
%O2								
NO WET	589.88	444.05	329.86	109.32	871.01	730.52	528.73	143.20
NO2 WET	33.46	16.16	23.11	19.13	17.14	29.97	27.60	29.19
CO2 WET	7.23	6.07	4.97	2.66	8.86	7.59	5.90	1.56
CO WET	0.0124	0.0092	0.0074	0.0233	0.0119	0.0065	0.0069	0.0159
G	0.0013	0.0019	0.0026	0.0039	0.0003	0.0011	0.0021	0.0045
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0355	1.0373	1.0459	1.0544	1.0363	1.0418	1.0508	1.0898
NO CORR	569.68	428.08	315.40	103.68	840.48	701.24	503.16	131.41
NO2 CORR	32.31	15.57	22.10	18.15	16.54	28.76	26.26	26.78
GAS EMISSIONS								
NO GR/HR	272.52	183.40	115.27	30.21	246.15	179.24	112.04	12.57
NO2 GR/HR	23.67	10.21	12.37	8.10	7.43	11.27	8.96	3.93
CO2 GR/HR	50682.10	38116.28	26611.30	11348.76	38054.78	28444.86	19246.04	2188.60
CO GR/HR	55.40	36.63	25.31	63.34	32.60	15.55	14.22	14.19
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	5055	3402	2138	560	4566	3325	2078	233
NO2 CFM 5 ppm	1432	617	748	490	449	682	542	238
CO2 CFM 5000 ppm	3193	2401	1677	715	2397	1792	1213	138
CO CFM 50 ppm	551	364	252	630	324	155	141	141
NOX ppm - wet EURO, EPA, ISO	623.3	460.2	353.0	128.4	888.2	760.5	556.3	172.4
NOX ppm(corr) EURO,EPA,ISO	602.0	443.6	337.5	121.8	857.0	730.0	529.4	158.2
NOX GR/HR EURO, EPA, ISO	441.2	291.2	189.0	54.4	384.5	285.8	180.6	23.2
NOX cfm EURO, EPA, ISO	5337.4	3522.6	2286.2	658.0	4651.9	3458.4	2184.9	280.5

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/21/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2007 spec ULSD test fuel; Engine only, gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.8	2499.9	2499.5	2499.4	1800.3	1800.6	1800.4	999.1
TORQUE lbft	180.2	135.0	90.0	19.8	211.4	160.0	105.2	4.3
HORSEPOWER	85.8	64.3	42.8	9.4	72.5	54.9	36.1	0.8
Barometric Pressure INHG	28.88	28.88	28.87	28.87	28.86	28.85	28.85	28.85
Laminar flow air temp DEG F	61.01	61.10	59.41	60.57	59.40	60.22	59.47	59.91
Laminar flow diff pressure in. of H2O	4.42	3.98	3.38	2.74	2.65	2.33	2.05	0.90
Laminar Flow cfm	225.16	203.10	173.00	140.44	135.95	119.94	105.41	46.36
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.02	74.00	73.00	74.00	75.69	77.00	77.00	81.59
Boost/Air in Manifold (degF)	321.89	265.84	202.13	137.00	239.36	192.00	148.50	100.44
Altitude Barrel Pressure (inHg)	28.81	28.81	28.81	28.80	28.80	28.79	28.79	28.79
Altitude (ft)	1039	1036	1042	1048	1053	1062	1058	1060
Intake AIR Consumption lbs/hr	985.81	888.76	761.58	615.93	598.03	526.21	463.55	203.59
LAB FACTOR-NA	1.021	1.022	1.020	1.021	1.024	1.027	1.027	1.032
LAB FACTOR-TURBO	1.008	1.010	1.007	1.009	1.014	1.019	1.019	1.031
Intake Air Temperature DEG F	73.02	74.00	73.00	74.00	75.69	77.00	77.00	81.59
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	321.89	265.84	202.13	137.00	239.36	192.00	148.50	100.44
Boost air Pressure (@manifold) psi	21.89	16.18	9.88	3.78	13.14	8.58	4.69	0.05
FUEL Temperature DEG F	96.50	95.61	94.92	94.84	94.77	95.00	94.14	94.00
FUEL Cunsumption lbs/hr	34.69	26.06	17.74	7.59	25.64	19.19	12.75	1.28
DEW Point DEG F	51.82	52.27	49.93	50.18	50.60	50.51	50.30	49.93
Grains Water (H2O) per lb dry air	58.45	59.42	54.47	55.00	55.91	55.72	55.27	54.54
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	955.39	805.00	645.80	393.88	986.16	847.39	656.88	280.61
FINAL EXHAUST TEMP	860.80	740.63	599.05	388.27	831.02	740.44	591.70	310.30
Coolant Temperature IN DEG F	160	155.8125	160	160.1875	160.15625	156.04688	157.84375	156.90625
Coolant Temperature OUT DEG F	174	166.54688	167.96875	165	174	168	166	161
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.21	12.96	10.30	7.61	7.51	6.29	5.33	2.03
Exhaust Restriction (mmHg)	6.64	5.00	3.16	1.60	4.09	3.72	1.98	0.40
Exhaust Restriction (inH2O)	3.55	2.68	1.69	0.86	2.19	1.99	1.06	0.21
EXHAUST FLOW LB/HR	1020.50	914.82	779.31	623.51	623.66	545.41	476.30	204.87
FUEL /AIR RATIO	0.0352	0.0293	0.0233	0.0123	0.0429	0.0365	0.0275	0.0063
J CONVER	0.9213	0.9321	0.9445	0.9649	0.9075	0.9195	0.9364	0.9763
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.9	6.5	5.2	2.8	9.8	8.2	6.3	1.6
CO PPM DRY	136.7	98.7	78.4	243.5	137.7	70.9	74.2	163.7
NOX PPM DRY	680.7	487.4	377.4	131.4	996.3	830.2	594.1	178.5
NO PPM DRY	646.0	474.9	350.6	112.2	964.4	790.7	564.4	146.7
NO2 PPM DRY	34.6	12.4	26.7	19.2	31.9	39.5	29.7	31.8
%O2								
NO WET	595.2202	442.6909	331.1747	108.2703	875.1888	727.0317	528.4778	143.2419
NO2 WET	31.9070	11.5987	25.2439	18.5375	28.8728	36.3445	27.7906	31.0359
CO2 WET	7.2771	6.0732	4.9526	2.6549	8.8895	7.5560	5.8993	1.5620
CO WET	0.0126	0.0092	0.0074	0.0235	0.0125	0.0065	0.0069	0.0160
G	0.0012	0.0019	0.0026	0.0039	0.0003	0.0011	0.0021	0.0046
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0324	1.0334	1.0466	1.0536	1.0361	1.0423	1.0511	1.0931
NO CORR	576.5337	428.3780	316.4322	102.7670	844.6911	697.5110	502.7857	131.0429
NO2 CORR	30.9053	11.2237	24.1201	17.5953	27.9632	34.8688	26.4395	28.3928
GAS EMISSIONS								
NO GR/HR	276.52	184.19	115.90	30.12	247.60	178.80	112.55	12.62
NO2 GR/HR	22.71	7.39	13.53	7.90	12.56	13.69	9.07	4.19
CO2 GR/HR	51167.00	38279.96	26592.57	11405.43	38198.71	28394.27	19359.77	2204.82
CO GR/HR	56.29	36.88	25.28	64.18	34.13	15.58	14.49	14.34
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	5130	3417	2150	559	4593	3317	2088	234
NO2 CFM 5 ppm	1374	447	819	478	760	828	548	253
CO2 CFM 5000 ppm	3224	2412	1675	719	2407	1789	1220	139
CO CFM 50 ppm	559	366	251	638	339	155	144	143
NOX ppm - wet EURO, EPA, ISO	627.13	454.29	356.42	126.81	904.16	763.38	556.27	174.28
NOX ppm(corr) EURO,EPA,ISO	607.44	439.60	340.55	120.36	872.65	732.38	529.23	159.44
NOX GR/HR EURO, EPA, ISO	446.32	289.55	191.09	54.03	391.86	287.60	181.49	23.52
NOX cfm EURO, EPA, ISO	5400	3503	2312	654	4741	3480	2196	285
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	15.52	14.48	9.40	6.81	11.47	6.93	4.79	0.73
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	2.33	2.17	1.41	0.68	1.15	0.69	0.48	0.11
Weighted HP	12.863	9.640	6.422	0.944	7.248	5.486	3.605	0.123
Weighted Average HP	46.332 HP							
Weighted Average PARTICULATE	9.020 GR/HR							
	0.195 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	5308.163							

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/21/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Certified 2007 spec ULSD test fuel, Engine only, ec/oc sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.0	2499.0	2499.0	2498.5	1800.1	1799.7	1799.8	997.5
TORQUE lbft	177.6	136.3	90.1	19.8	210.7	160.1	105.1	4.3
HORSEPOWER	84.5	64.4	42.9	9.4	72.2	54.9	36.0	0.8
Barometric Pressure INHG	28.84	28.84	28.83	28.83	28.83	28.83	28.83	28.83
Laminar flow air temp DEG F	60.21	59.91	59.51	59.74	60.87	61.22	60.27	59.98
Laminar flow diff pressure in. of H2O	4.39	3.94	3.37	2.71	2.66	2.33	2.03	0.89
Laminar Flow cfm	223.74	201.10	172.58	138.83	136.33	119.72	104.60	45.79
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.38	74.00	74.14	74.00	75.50	78.00	78.00	81.95
Boost/Air In Manifold (degF)	319.08	265.42	203.86	138.50	238.50	193.50	149.89	100.16
Altitude Barrel Pressure (inHg)	28.78	28.78	28.77	28.77	28.78	28.77	28.77	28.76
Altitude (ft)	1064	1068	1074	1077	1072	1080	1078	1086
Intake AIR Consumption lbs/hr	981.13	882.49	758.23	609.64	596.52	523.07	458.41	200.82
LAB FACTOR-NA	1.022	1.023	1.024	1.023	1.025	1.029	1.028	1.034
LAB FACTOR-TURBO	1.009	1.010	1.011	1.011	1.014	1.022	1.022	1.032
Intake Air Temperature DEG F	73.38	74.00	74.14	74.00	75.50	78.00	78.00	81.95
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	319.08	265.42	203.86	138.50	238.50	193.50	149.89	100.16
Boost air Pressure (@manifold) psi	21.63	16.16	9.88	3.74	13.06	8.52	4.67	0.06
FUEL Temperature DEG F	96.00	96.28	96.86	95.92	94.67	95.98	95.00	93.98
FUEL Cunsumption lbs/hr	33.98	25.74	17.70	7.02	26.04	19.21	12.82	1.41
DEW Point DEG F	50.64	50.79	50.67	49.96	50.32	50.92	50.70	50.92
Grains Water (H2O) per lb dry air	56.01	56.34	56.06	54.63	55.37	56.61	56.13	56.60
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	945.72	804.69	649.73	401.19	980.95	858.44	665.27	276.61
FINAL EXHAUST TEMP	848.88	738.80	604.02	398.44	823.73	751.20	602.11	304.00
Coolant Temperature IN DEG F	166.98438	160.5	160	161.95313	156.95313	157.57813	159	158.29688
Coolant Temperature OUT DEG F	180	171.5625	168	166	170.5625	169	167	163
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.16	13.00	10.35	7.69	7.62	6.35	5.37	2.10
Exhaust Restriction (mmHg)	6.61	5.04	3.18	1.64	4.38	3.81	2.04	0.33
Exhaust Restriction (inH2O)	3.54	2.70	1.70	0.88	2.34	2.04	1.09	0.17
EXHAUST FLOW LB/HR	1015.11	908.23	775.94	616.66	622.56	542.28	471.23	202.23
FUEL /AIR RATIO	0.0346	0.0292	0.0233	0.0115	0.0437	0.0367	0.0280	0.0070
J CONVER	0.9229	0.9331	0.9440	0.9664	0.9062	0.9189	0.9353	0.9744
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.8	6.5	5.3	2.8	9.8	8.3	6.3	1.6
CO PPM DRY	132.8	98.0	79.0	239.5	125.8	71.1	72.3	162.6
NOX PPM DRY	671.3	499.6	370.3	134.6	962.4	824.5	594.9	175.0
NO PPM DRY	633.4	477.4	348.0	114.2	956.6	798.8	565.5	146.9
NO2 PPM DRY	37.9	22.2	22.2	20.4	5.9	25.7	29.3	28.1
%O2								
NO WET	584.5357	445.4129	328.5515	110.3613	866.8338	734.0180	528.9830	143.1650
NO2 WET	35.0128	20.7286	20.9775	19.7305	5.3069	23.5920	27.4086	27.3444
CO2 WET	7.1771	6.0649	4.9811	2.6577	8.8382	7.6266	5.8927	1.5591
CO WET	0.0123	0.0091	0.0075	0.0231	0.0114	0.0065	0.0068	0.0158
G	0.0013	0.0019	0.0026	0.0040	0.0002	0.0010	0.0021	0.0045
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0386	1.0412	1.0451	1.0552	1.0365	1.0412	1.0505	1.0864
NO CORR	562.8205	427.7825	314.3692	104.5875	836.2744	704.9644	503.5303	131.7752
NO2 CORR	33.7121	19.9081	20.0720	18.6982	5.1198	22.6582	26.0898	25.1689
GAS EMISSIONS								
NO GR/HR	268.52	182.61	114.65	30.31	244.70	179.68	111.52	12.53
NO2 GR/HR	24.64	13.02	11.21	8.30	2.29	8.85	8.85	3.66
CO2 GR/HR	50197.20	37952.61	26630.04	11292.09	37910.86	28495.46	19132.31	2172.38
CO GR/HR	54.50	36.39	25.33	62.51	31.07	15.52	13.95	14.04
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4981	3387	2127	562	4539	3333	2069	232
NO2 CFM 5 ppm	1490	787	678	502	139	535	535	222
CO2 CFM 5000 ppm	3162	2391	1678	711	2388	1795	1205	137
CO CFM 50 ppm	542	362	252	621	309	154	139	139
NOX ppm - wet EURO, EPA, ISO	619.55	466.14	349.53	130.09	872.14	757.61	556.39	170.51
NOX ppm(corr) EURO,EPA,ISO	596.53	447.69	334.44	123.29	841.39	727.62	529.62	156.94
NOX GR/HR EURO, EPA, ISO	435.99	292.76	186.84	54.74	377.15	284.09	179.69	22.85
NOX cfm EURO, EPA, ISO	5275	3542	2261	662	4563	3437	2174	276

DPM EC/OC DATA

EC	TWA (ug/m3)	25116	30935	19728	13010	34517	23256	16370	---
OC	TWA (ug/m3)	10718	9786	9564	14488	10348	8618	10689	8403
TC	TWA (ug/m3)	36093	40713	29292	27498	44872	31874	27058	9002

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: PetroSA Fischer-Tropsch Synthetic diesel
Engine: Isuzu 4JG1T
DOC: ECS Purifier A16-0119

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.8	2499.7	2499.5	2498.7	1800.3	1800.3	1800.5	974.4
TORQUE lbft	162.65	122.48	82.59	20.01	192.87	145.09	97.44	9.36
HORSEPOWER	77.41	58.29	39.31	9.52	66.11	49.73	33.41	1.74
Barometric Pressure INHG	29.05	29.04	29.04	29.04	29.03	29.02	29.02	29.02
Laminar flow air temp DEG F	61.12	61.52	61.19	61.72	61.67	61.40	61.73	61.63
Laminar flow diff pressure in. of H2O	4.34	3.84	3.33	2.73	2.57	2.27	2.05	0.91
Laminar Flow cfm	220.99	195.89	170.11	140.22	131.72	116.91	105.43	47.01
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	70.74	71.00	71.51	72.01	73.50	74.89	75.02	78.00
Boost/Air In Manifold (degF)	302.45	246.84	192.54	135.75	220.23	178.82	142.41	94.49
Altitude Barrel Pressure (inHg)	29.01	29.01	29.01	29.00	28.99	28.99	28.98	28.98
Altitude (ft)	848.76	849.56	855.72	858.19	869.51	870.03	877.15	882.85
Intake AIR Consumption lbs/hr	975.09	862.97	750.13	617.29	579.78	514.95	463.89	206.91
LAB FACTOR-NA	1.009	1.011	1.011	1.012	1.014	1.016	1.016	1.020
LAB FACTOR-TURBO	0.994	0.997	0.998	0.999	1.003	1.007	1.008	1.016
Intake Air Temperature DEG F	70.74	71.00	71.51	72.01	73.50	74.89	75.02	78.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	302.45	246.84	192.54	135.75	220.23	178.82	142.41	94.49
Boost air Pressure (@manifold) psi	20.36	14.65	9.23	3.84	11.63	7.63	4.42	0.13
FUEL Temperature DEG F	94.88	96.22	96.50	96.55	95.81	94.49	94.58	92.60
FUEL Cunsumption lbs/hr	30.43	22.86	15.89	6.97	22.93	16.87	11.54	1.42
DEW Point DEG F	47.10	47.39	47.29	47.21	47.18	47.26	47.10	47.19
Grains Water (H2O) per lb dry air	48.66	49.22	49.05	48.89	48.84	48.99	48.71	48.87
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	912.81	777.41	628.82	400.38	946.67	816.24	630.52	256.66
FINAL EXHAUST TEMP	850.02	734.68	603.23	401.01	830.48	739.94	580.28	266.76
Coolant Temperature IN DEG F	163.00	161.49	163.86	165.00	160.87	159.48	162.74	165.50
Coolant Temperature OUT DEG F	175.44	171.40	171.00	170.00	173.28	169.76	170.00	168.95
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.42	12.93	10.42	7.87	7.39	6.25	5.40	2.03
Exhaust Restriction (mmHg)	20.68	15.27	10.33	5.88	10.99	9.20	5.40	1.20
Exhaust Restriction (inH2O)	11.07	8.17	5.53	3.15	5.88	4.93	2.89	0.64
EXHAUST FLOW LB/HR	1005.52	885.83	766.02	624.27	602.71	531.81	475.43	208.33
FUEL /AIR RATIO	0.03	0.03	0.02	0.01	0.04	0.03	0.02	0.01
J CONVER	0.93	0.94	0.95	0.97	0.92	0.93	0.94	0.98
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	6.95	5.88	4.77	2.59	8.75	7.30	5.59	1.73
CO PPM DRY	1.00	0.00	0.00	2.00	1.50	0.00	0.00	40.00
NOX PPM DRY	475.53	352.49	278.81	101.66	720.60	560.19	432.03	177.56
NO PPM DRY	412.22	303.19	258.78	101.26	620.88	447.44	375.03	177.53
NO2 PPM DRY	63.32	49.31	20.03	0.40	99.73	112.75	57.00	0.04
%O2								
NO WET	383.74	284.89	245.73	98.04	568.28	415.21	353.54	173.35
NO2 WET	58.95	46.33	19.02	0.39	91.27	104.62	53.72	0.04
CO2 WET	6.47	5.52	4.53	2.51	8.01	6.77	5.27	1.69
CO WET	0.0001	0.0000	0.0000	0.0002	0.0001	0.0000	0.0000	0.0039
G	0.0017	0.0022	0.0028	0.0040	0.0007	0.0015	0.0024	0.0045
R	-0.0024	-0.0026	-0.0029	-0.0033	-0.0021	-0.0024	-0.0027	-0.0035
HUM&TEM CORR FACTOR	1.0534	1.0546	1.0588	1.0663	1.0514	1.0582	1.0663	1.0959
NO CORR	364.30	270.14	232.09	91.94	540.50	392.37	331.56	158.17
NO2 CORR	55.95	43.93	17.96	0.36	86.81	98.87	50.39	0.03
GAS EMISSIONS								
NO GR/HR	172.19	112.50	83.57	26.97	153.10	98.08	74.08	15.49
NO2 GR/HR	40.48	28.04	9.90	0.16	37.67	37.85	17.24	0.00
CO2 GR/HR	44826.11	33702.06	23906.04	10777.67	33257.31	24822.01	17274.02	2420.38
CO GR/HR	0.41	0.00	0.00	0.53	0.36	0.00	0.00	3.57
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3194	2087	1550	500	2840	1819	1374	287
NO2 CFM 5 ppm	2449	1696	599	10	2278	2289	1043	0
CO2 CFM 5000 ppm	2824	2123	1506	679	2095	1564	1088	152
CO CFM 50 ppm	4	0	0	5	4	0	0	35
NOX ppm - wet EURO, EPA, ISO	442.7	331.2	264.8	98.4	659.6	519.8	407.3	173.4
NOX ppm(corr) EURO,EPA,ISO	420.2	314.1	250.0	92.3	627.3	491.2	381.9	158.2
NOX GR/HR EURO, EPA, ISO	304.3	200.4	137.9	41.5	272.2	188.1	130.7	23.7
NOX cfm EURO, EPA, ISO	3681.3	2424.2	1658.7	601.9	3293.2	2275.6	1581.5	287.1

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

COMPANY NAME Isuzu
DATE 9/24/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: PetroSA coal derived Fischer-Tropsch Synthetic Fuel, Engine with ECS DOC, Gravimetric sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.8	2499.8	2499.5	2498.3	1800.5	1800.4	1800.8	973.4
TORQUE lbft	164.6	124.9	85.2	20.0	193.6	145.1	99.9	9.1
HORSEPOWER	78.4	59.5	40.6	9.5	66.4	49.8	34.3	1.7
Barometric Pressure INHG	29.07	29.06	29.06	29.05	29.04	29.04	29.04	29.04
Laminar flow air temp DEG F	60.70	61.12	61.25	61.62	61.58	61.59	61.68	61.62
Laminar flow diff pressure in. of H2O	4.35	3.87	3.34	2.72	2.55	2.25	2.03	0.89
Laminar Flow cfm	221.63	197.64	170.88	139.72	130.96	115.58	104.54	46.19
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	70.00	70.00	71.00	71.02	73.00	74.00	75.00	78.00
Boost/Air in Manifold (degF)	303.05	249.69	194.95	135.50	220.95	178.39	144.00	94.50
Altitude Barrel Pressure (inHg)	29.04	29.04	29.03	29.02	29.01	29.01	29.00	28.99
Altitude (ft)	827	824	834	840	851	852	860	866
Intake AIR Consumption lbs/hr	979.85	872.39	753.82	615.61	576.85	509.07	460.29	203.39
LAB FACTOR-NA	1.007	1.009	1.010	1.010	1.013	1.015	1.016	1.020
LAB FACTOR-TURBO	0.991	0.993	0.995	0.997	1.002	1.005	1.007	1.015
Intake Air Temperature DEG F	70.00	70.00	71.00	71.02	73.00	74.00	75.00	78.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	303.05	249.69	194.95	135.50	220.95	178.39	144.00	94.50
Boost air Pressure (@manifold) psi	20.60	15.08	9.57	3.88	11.72	7.69	4.54	0.15
FUEL Temperature DEG F	94.00	94.44	94.98	95.09	94.58	94.00	94.16	92.20
FUEL Cunsumption lbs/hr	30.79	23.45	16.36	7.06	23.09	16.86	11.87	1.40
DEW Point DEG F	47.18	47.35	47.35	47.36	47.30	47.22	47.05	47.27
Grains Water (H2O) per lb dry air	48.75	49.10	49.11	49.13	49.06	48.91	48.62	48.99
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	915.86	784.47	637.97	401.81	950.97	815.89	640.45	260.11
FINAL EXHAUST TEMP	853.58	742.94	610.78	402.88	835.88	740.13	599.03	274.14
Coolant Temperature IN DEG F	163	161	163.8125	165	161.85938	158.46875	162.48438	165
Coolant Temperature OUT DEG F	175.875	171.07813	171	170	174.0625	169	170	168.89063
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.50	13.10	10.57	7.84	7.38	6.25	5.40	1.99
Exhaust Restriction (mmHg)	21.15	15.91	10.75	5.99	10.96	9.28	5.55	1.21
Exhaust Restriction (inH2O)	11.32	8.52	5.75	3.21	5.87	4.96	2.97	0.65
EXHAUST FLOW LB/HR	1010.65	895.85	770.18	622.67	599.94	525.93	472.15	204.79
FUEL /AIR RATIO	0.0314	0.0269	0.0217	0.0115	0.0400	0.0331	0.0258	0.0069
J CONVER	0.9305	0.9389	0.9486	0.9678	0.9144	0.9273	0.9411	0.9763
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.0	6.0	4.9	2.6	8.8	7.3	5.7	1.8
CO PPM DRY	2.0	0.0	0.0	0.0	3.0	0.0	0.0	38.0
NOX PPM DRY	482.4	360.5	285.1	102.3	733.9	561.5	445.4	178.0
NO PPM DRY	425.6	308.4	266.6	101.6	629.8	445.9	383.5	177.9
NO2 PPM DRY	56.8	52.2	18.5	0.7	104.0	115.6	61.9	0.1
%O2								
NO WET	396.0311	289.5391	252.9305	98.3207	575.8728	413.5034	360.9142	173.7335
NO2 WET	52.8468	48.9769	17.5403	0.7228	95.1240	107.1669	58.2128	0.0702
CO2 WET	6.5135	5.5881	4.6007	2.5162	8.0463	6.7693	5.3857	1.7131
CO WET	0.0002	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0037
G	0.0017	0.0022	0.0028	0.0040	0.0007	0.0015	0.0023	0.0045
R	-0.0024	-0.0026	-0.0028	-0.0033	-0.0020	-0.0023	-0.0027	-0.0035
HUM&TEM CORR FACTOR	1.0519	1.0525	1.0570	1.0615	1.0503	1.0567	1.0657	1.0954
NO CORR	376.5056	275.0955	239.2980	92.6247	548.3189	391.3015	338.6663	158.5960
NO2 CORR	50.2413	46.5337	16.5949	0.6809	90.5726	101.4129	54.6244	0.0641
GAS EMISSIONS								
NO GR/HR	178.84	115.83	86.62	27.11	154.61	96.73	75.15	15.26
NO2 GR/HR	36.56	30.01	9.20	0.31	39.12	38.40	18.57	0.01
CO2 GR/HR	45356.09	34491.79	24413.95	10794.82	33260.01	24529.70	17455.50	2417.23
CO GR/HR	0.82	0.00	0.00	0.00	0.72	0.00	0.00	3.33
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3318	2149	1607	503	2868	1794	1394	283
NO2 CFM 5 ppm	2211	1816	557	18	2367	2323	1123	1
CO2 CFM 5000 ppm	2857	2173	1538	680	2095	1545	1100	152
CO CFM 50 ppm	8	0	0	0	7	0	0	33
NOX ppm - wet EURO, EPA, ISO	448.88	338.52	270.47	99.04	671.00	520.67	419.13	173.80
NOX ppm(corr) EURO,EPA,ISO	426.75	321.63	255.89	93.31	638.89	492.71	393.29	158.66
NOX GR/HR EURO, EPA, ISO	310.53	207.45	141.90	41.83	275.97	186.58	133.70	23.39
NOX cfm EURO, EPA, ISO	3757	2510	1717	506	3339	2257	1618	283
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	12.70	9.61	5.17	4.01	7.70	4.84	2.55	0.19
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.91	1.44	0.77	0.40	0.77	0.48	0.26	0.03
Weighted HP	11.753	8.920	6.084	0.952	6.638	4.976	3.426	0.253
Weighted Average HP	43.003 HP							
Weighted Average PARTICULATE	6.060 GR/HR							
	0.141 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	3566.259							

COMPANY NAME Isuzu
DATE 9/24/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: PetroSA coal derived Fischer-Tropsch Synthetic Fuel, Engine with ECS DOC, EC/OC sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.8	2499.6	2499.5	2499.0	1800.1	1800.2	1800.2	975.4
TORQUE lbft	160.7	120.0	80.0	20.0	192.1	145.0	95.0	9.6
HORSEPOWER	76.5	57.1	38.1	9.5	65.8	49.7	32.5	1.8
Barometric Pressure INHG	29.03	29.02	29.02	29.02	29.01	29.01	29.01	29.01
Laminar flow air temp DEG F	61.54	61.92	61.13	61.82	61.76	61.20	61.77	61.63
Laminar flow diff pressure in. of H2O	4.33	3.80	3.31	2.74	2.58	2.30	2.07	0.93
Laminar Flow cfm	220.36	194.13	169.35	140.72	132.48	118.23	106.31	47.84
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	71.48	72.00	72.02	73.00	74.00	75.78	75.05	78.00
Boost/Air In Manifold (degF)	301.86	244.00	190.13	136.00	219.50	179.25	140.83	94.48
Altitude Barrel Pressure (inHg)	28.99	28.98	28.98	28.98	28.97	28.97	28.96	28.96
Altitude (ft)	870	875	878	877	888	888	894	899
Intake AIR Consumption lbs/hr	970.33	853.55	746.44	618.98	582.72	520.82	467.49	210.44
LAB FACTOR-NA	1.011	1.013	1.013	1.013	1.015	1.017	1.017	1.021
LAB FACTOR-TURBO	0.997	1.000	1.000	1.001	1.004	1.009	1.008	1.017
Intake Air Temperature DEG F	71.48	72.00	72.02	73.00	74.00	75.78	75.05	78.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	301.86	244.00	190.13	136.00	219.50	179.25	140.83	94.48
Boost air Pressure (@manifold) psi	20.12	14.22	8.90	3.80	11.55	7.58	4.30	0.10
FUEL Temperature DEG F	95.75	98.00	98.02	98.00	97.05	94.98	95.00	93.00
FUEL Cunsumption lbs/hr	30.07	22.26	15.41	6.89	22.77	16.87	11.22	1.43
DEW Point DEG F	47.02	47.43	47.24	47.05	47.05	47.29	47.15	47.10
Grains Water (H2O) per lb dry air	48.56	49.33	48.99	48.65	48.62	49.07	48.81	48.75
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	909.77	770.36	619.67	398.95	942.38	816.59	620.58	253.20
FINAL EXHAUST TEMP	846.47	726.42	595.67	399.14	825.09	739.75	561.53	259.38
Coolant Temperature IN DEG F	163	161.98438	163.90625	165	159.875	160.5	163	166
Coolant Temperature OUT DEG F	175	171.71875	171	170	172.5	170.51563	170	169
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.34	12.76	10.27	7.90	7.41	6.24	5.40	2.06
Exhaust Restriction (mmHg)	20.21	14.63	9.92	5.76	11.01	9.13	5.25	1.18
Exhaust Restriction (inH2O)	10.82	7.83	5.31	3.08	5.90	4.89	2.81	0.63
EXHAUST FLOW LB/HR	1000.40	875.81	761.86	625.87	605.48	537.69	478.71	211.87
FUEL /AIR RATIO	0.0310	0.0261	0.0206	0.0111	0.0391	0.0324	0.0240	0.0068
J CONVER	0.9314	0.9404	0.9506	0.9685	0.9162	0.9286	0.9444	0.9766
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	6.9	5.8	4.7	2.6	8.7	7.3	5.5	1.7
CO PPM DRY	0.0	0.0	0.0	4.0	0.0	0.0	0.0	42.0
NOX PPM DRY	468.7	344.5	272.5	101.0	707.4	558.9	418.7	177.1
NO PPM DRY	398.8	298.0	250.9	100.9	611.9	449.0	366.6	177.1
NO2 PPM DRY	69.8	46.5	21.6	0.1	95.4	109.9	52.1	0.0
%O2								
NO WET	371.4549	280.2334	238.5291	97.7502	560.6854	416.9246	346.1677	172.9587
NO2 WET	65.0477	43.6802	20.5005	0.0515	87.4242	102.0772	49.2371	0.0031
CO2 WET	6.4265	5.4542	4.4575	2.4954	7.9713	6.7790	5.1822	1.6602
CO WET	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0041
G	0.0017	0.0023	0.0029	0.0040	0.0008	0.0015	0.0025	0.0045
R	-0.0024	-0.0027	-0.0029	-0.0033	-0.0021	-0.0024	-0.0027	-0.0035
HUM&TEM CORR FACTOR	1.0550	1.0567	1.0607	1.0712	1.0526	1.0597	1.0670	1.0964
NO CORR	352.0850	265.1925	224.8739	91.2531	532.6743	393.4334	324.4439	157.7492
NO2 CORR	61.6557	41.3358	19.3269	0.0480	83.0566	96.3257	46.1472	0.0028
GAS EMISSIONS								
NO GR/HR	165.55	109.16	80.52	26.84	151.59	99.43	73.00	15.71
NO2 GR/HR	44.41	26.07	10.60	0.02	36.21	37.29	15.91	0.00
CO2 GR/HR	44296.13	32912.32	23398.12	10760.52	33254.61	25114.32	17092.54	2423.52
CO GR/HR	0.00	0.00	0.00	1.06	0.00	0.00	0.00	3.81
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3071	2025	1494	498	2812	1844	1354	291
NO2 CFM 5 ppm	2686	1577	641	1	2190	2256	962	0
CO2 CFM 5000 ppm	2791	2073	1474	678	2095	1582	1077	153
CO CFM 50 ppm	0	0	0	11	0	0	0	38
NOX ppm - wet EURO, EPA, ISO	436.50	323.91	259.03	97.80	648.11	519.00	395.40	172.96
NOX ppm(corr) EURO,EPA,ISO	413.74	306.53	244.20	91.30	615.73	489.76	370.59	157.75
NOX GR/HR EURO, EPA, ISO	298.01	193.29	133.95	41.14	268.43	169.61	127.73	24.06
NOX cfm EURO, EPA, ISO	3606	2339	1621	498	3248	2294	1545	291

DPM EC/OC DATA

EC	TWA (ug/m3)	24669	20418	10726	11380	27878	18509	9195	---
OC	TWA (ug/m3)	6425	5501	4653	4643	4895	4497	3598	2450
TC	TWA (ug/m3)	31094	25919	15380	16023	32773	23006	12785	2776

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: PetroSA Fischer-Tropsch Synthetic diesel
Engine: Isuzu 4JG1T
DOC: NONE

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.5	2500.3	2499.9	2498.1	1800.0	1800.0	1799.9	972.5
TORQUE lbft	158.31	120.08	80.08	20.03	189.69	142.41	95.18	9.61
HORSEPOWER	75.37	57.17	38.12	9.53	65.01	48.81	32.62	1.78
Barometric Pressure INHG	28.97	28.97	28.96	28.96	28.95	28.95	28.95	28.95
Laminar flow air temp DEG F	59.85	59.70	59.82	60.57	60.60	60.69	59.72	59.57
Laminar flow diff pressure in. of H2O	4.35	3.87	3.34	2.80	2.62	2.33	2.08	0.92
Laminar Flow cfm	221.75	197.31	170.90	143.26	134.53	119.57	106.78	47.43
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	69.50	70.00	70.00	70.00	71.27	72.50	72.50	74.50
Boost/Air In Manifold (degF)	300.53	245.07	189.09	134.17	216.48	175.91	138.46	93.66
Altitude Barrel Pressure (inHg)	28.86	28.86	28.85	28.85	28.84	28.84	28.84	28.84
Altitude (ft)	990.96	996.48	1000.20	1005.41	1006.85	1008.99	1010.86	1010.63
Intake AIR Consumption lbs/hr	980.14	872.42	755.28	631.63	592.95	526.88	471.88	209.68
LAB FACTOR-NA	1.010	1.010	1.010	1.011	1.013	1.014	1.014	1.018
LAB FACTOR-TURBO	0.992	0.993	0.994	0.994	0.998	1.001	1.001	1.008
Intake Air Temperature DEG F	69.50	70.00	70.00	70.00	71.27	72.50	72.50	74.50
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	300.53	245.07	189.09	134.17	216.48	175.91	138.46	93.66
Boost air Pressure (@manifold) psi	20.45	14.80	9.22	4.02	11.69	7.74	4.47	0.26
FUEL Temperature DEG F	94.27	94.78	94.92	94.49	92.95	93.00	92.51	90.27
FUEL Cunsumption lbs/hr	29.91	22.31	15.40	6.97	22.30	16.54	11.24	1.37
DEW Point DEG F	45.42	45.30	45.21	45.39	45.42	45.41	45.27	45.20
Grains Water (H2O) per lb dry air	45.76	45.57	45.44	45.75	45.80	45.79	45.52	45.42
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	894.33	760.50	613.95	397.23	924.97	800.63	620.03	291.42
FINAL EXHAUST TEMP	813.52	703.80	575.48	389.48	788.92	706.47	566.19	302.69
Coolant Temperature IN DEG F	162.29	160.75	163.00	164.50	158.00	159.88	162.00	163.51
Coolant Temperature OUT DEG F	174.20	170.71	170.05	169.14	170.50	169.68	169.30	167.18
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.33	12.85	10.28	7.81	7.29	6.16	5.29	1.93
Exhaust Restriction (mmHg)	6.16	4.58	2.93	1.61	4.61	3.15	0.88	0.46
Exhaust Restriction (inH2O)	3.30	2.45	1.57	0.86	2.47	1.69	0.47	0.24
EXHAUST FLOW LB/HR	1010.06	894.73	770.68	638.60	615.25	543.41	483.12	211.05
FUEL /AIR RATIO	0.03	0.03	0.02	0.01	0.04	0.03	0.02	0.01
J CONVER	0.93	0.94	0.95	0.97	0.92	0.93	0.95	0.98
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	6.79	5.75	4.60	2.52	8.53	7.15	5.49	1.75
CO PPM DRY	112.53	84.31	84.99	186.40	83.94	72.66	81.26	95.96
NOX PPM DRY	478.37	367.99	274.78	102.75	762.72	607.46	448.37	179.90
NO PPM DRY	452.44	345.37	253.05	82.64	731.78	579.15	415.64	153.91
NO2 PPM DRY	25.93	22.62	21.73	20.10	30.94	28.31	32.73	25.99
%O2								
NO WET	422.06	325.39	240.87	80.11	672.95	539.32	392.96	150.49
NO2 WET	24.19	21.31	20.69	19.49	28.45	26.37	30.95	25.41
CO2 WET	6.33	5.41	4.38	2.45	7.85	6.66	5.19	1.71
CO WET	0.0105	0.0079	0.0081	0.0181	0.0077	0.0068	0.0077	0.0094
G	0.0018	0.0023	0.0029	0.0040	0.0009	0.0017	0.0025	0.0045
R	-0.0025	-0.0027	-0.0029	-0.0033	-0.0021	-0.0024	-0.0028	-0.0035
HUM&TEM CORR FACTOR	1.0587	1.0624	1.0653	1.0688	1.0573	1.0632	1.0697	1.0925
NO CORR	398.68	306.28	226.11	74.95	636.49	507.28	367.36	137.74
NO2 CORR	22.85	20.06	19.42	18.23	26.91	24.80	28.93	23.26
GAS EMISSIONS								
NO GR/HR	189.28	128.80	81.90	22.50	184.05	129.58	83.41	13.66
NO2 GR/HR	16.61	12.92	10.78	8.38	11.92	9.70	10.06	3.53
CO2 GR/HR	44068.42	33373.94	23250.68	10758.95	33257.19	24930.60	17291.59	2488.12
CO GR/HR	46.46	31.13	27.31	50.54	20.80	16.10	16.26	8.67
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3511	2389	1519	417	3414	2404	1547	253
NO2 CFM 5 ppm	1005	782	652	507	721	587	609	214
CO2 CFM 5000 ppm	2776	2103	1465	678	2095	1571	1089	157
CO CFM 50 ppm	462	309	271	502	207	160	162	86
NOX ppm - wet EURO, EPA, ISO	446.3	346.7	261.6	99.6	701.4	565.7	423.9	175.9
NOX ppm(corr) EURO,EPA,ISO	421.5	326.3	245.5	93.2	663.4	532.1	396.3	161.0
NOX GR/HR EURO, EPA, ISO	306.6	210.2	136.2	42.8	293.9	208.2	137.8	24.5
NOX cfm EURO, EPA, ISO	3709.1	2543.5	1648.3	518.3	3555.5	2518.9	1667.7	296.0

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

COMPANY NAME Isuzu
DATE 9/24/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: PetroSA coal derived Fischer-Tropsch Synthetic Fuel, Engine Only, Gravimetric sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.9	2499.7	2499.6	2498.5	1799.9	1800.2	1799.9	971.7
TORQUE lbft	160.4	119.9	80.1	20.1	189.2	139.9	95.2	9.5
HORSEPOWER	76.4	57.1	38.1	9.6	64.8	47.9	32.6	1.8
Barometric Pressure INHG	28.99	28.98	28.97	28.97	28.96	28.96	28.96	28.95
Laminar flow air temp DEG F	59.70	59.68	59.98	59.87	61.31	59.97	59.89	59.64
Laminar flow diff pressure in. of H2O	4.39	3.85	3.33	2.79	2.62	2.31	2.07	0.92
Laminar Flow cfm	223.54	196.51	170.51	142.97	134.63	118.42	106.68	47.71
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	69.00	70.00	70.00	70.00	71.98	73.00	73.00	75.00
Boost/Air In Manifold (degF)	303.23	244.53	189.14	134.00	217.02	174.31	138.78	93.89
Altitude Barrel Pressure (inHg)	28.88	28.87	28.87	28.86	28.86	28.85	28.85	28.84
Altitude (ft)	974	980	987	993	997	1000	1003	1008
Intake AIR Consumption lbs/hr	989.07	869.32	753.45	631.92	592.18	523.15	471.32	210.92
LAB FACTOR-NA	1.009	1.010	1.010	1.011	1.013	1.015	1.015	1.018
LAB FACTOR-TURBO	0.991	0.993	0.994	0.994	1.000	1.002	1.002	1.010
Intake Air Temperature DEG F	69.00	70.00	70.00	70.00	71.98	73.00	73.00	75.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	303.23	244.53	189.14	134.00	217.02	174.31	138.78	93.89
Boost air Pressure (@manifold) psi	20.74	14.74	9.21	4.02	11.66	7.55	4.49	0.30
FUEL Temperature DEG F	93.59	93.58	94.00	94.00	93.41	93.00	92.98	90.53
FUEL Cunsumption lbs/hr	30.47	22.28	15.51	7.07	22.22	16.36	11.33	1.30
DEW Point DEG F	45.40	45.35	45.32	45.27	45.63	45.30	45.35	45.34
Grains Water (H2O) per lb dry air	45.69	45.65	45.62	45.52	46.15	45.59	45.65	45.66
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	903.13	758.58	613.69	394.31	929.42	793.63	619.61	289.28
FINAL EXHAUST TEMP	825.91	705.47	577.44	387.28	800.77	704.28	568.02	302.56
Coolant Temperature IN DEG F	162	161	163	165	158	159.76563	162	163.53125
Coolant Temperature OUT DEG F	174.01563	170.9375	170.046875	169.28125	171	169.35938	169	167.35938
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.42	12.76	10.22	7.75	7.24	6.06	5.27	1.90
Exhaust Restriction (mmHg)	6.30	4.58	2.89	1.60	4.53	3.11	0.84	0.46
Exhaust Restriction (inH2O)	3.37	2.45	1.55	0.86	2.43	1.67	0.45	0.25
EXHAUST FLOW LB/HR	1019.53	891.59	768.96	638.99	614.41	539.51	482.65	212.21
FUEL /AIR RATIO	0.0308	0.0256	0.0206	0.0112	0.0375	0.0313	0.0240	0.0061
J CONVER	0.9323	0.9420	0.9515	0.9691	0.9197	0.9315	0.9450	0.9785
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	6.9	5.8	4.6	2.5	8.5	7.1	5.5	1.8
CO PPM DRY	117.2	84.6	84.9	186.5	84.7	73.1	80.1	90.7
NOX PPM DRY	480.4	367.8	273.7	103.8	761.8	599.2	448.9	181.4
NO PPM DRY	455.9	344.5	252.8	83.7	730.6	569.5	417.7	155.9
NO2 PPM DRY	24.6	23.3	20.9	20.1	31.2	29.7	31.2	25.5
%O2								
NO WET	425.0286	324.5271	240.5379	81.0797	671.9533	530.4833	394.7321	152.5466
NO2 WET	22.8892	21.9348	19.8528	19.5113	28.6678	27.6599	29.4958	24.9693
CO2 WET	6.3866	5.4167	4.3767	2.4665	7.8474	6.6137	5.1975	1.7123
CO WET	0.0109	0.0080	0.0081	0.0181	0.0078	0.0068	0.0076	0.0089
G	0.0017	0.0023	0.0029	0.0040	0.0009	0.0017	0.0025	0.0046
R	-0.0024	-0.0027	-0.0029	-0.0033	-0.0021	-0.0024	-0.0027	-0.0035
HUM&TEM CORR FACTOR	1.0578	1.0621	1.0646	1.0695	1.0572	1.0646	1.0704	1.0944
NO CORR	401.7897	305.5388	225.9335	75.8109	635.5744	498.2891	368.7568	139.3898
NO2 CORR	21.6377	20.6514	18.6474	18.2434	27.1158	25.9812	27.5548	22.8158
GAS EMISSIONS								
NO GR/HR	192.53	128.04	81.66	22.77	183.54	126.35	83.65	13.90
NO2 GR/HR	15.88	13.26	10.32	8.39	12.00	10.09	9.58	3.49
CO2 GR/HR	44863.05	33275.43	23188.55	10859.37	33219.93	24584.35	17284.00	2503.67
CO GR/HR	48.78	31.12	27.21	50.58	20.97	16.09	16.01	8.25
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3571	2375	1515	422	3405	2344	1552	258
NO2 CFM 5 ppm	961	802	625	508	726	610	579	211
CO2 CFM 5000 ppm	2826	2096	1461	684	2093	1549	1089	158
CO CFM 50 ppm	485	309	270	503	208	160	159	82
NOX ppm - wet EURO, EPA, ISO	447.92	346.46	260.39	100.59	700.62	558.14	424.23	177.52
NOX ppm(corr) EURO,EPA,ISO	423.43	326.19	244.58	94.05	662.69	524.27	396.31	162.21
NOX GR/HR EURO, EPA, ISO	310.82	209.40	135.41	43.27	293.16	203.65	137.72	24.78
NOX cfm EURO, EPA, ISO	3761	2533	1638	524	3547	2464	1666	300
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	14.63	9.39	5.27	4.11	7.17	4.70	2.69	0.46
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	2.20	1.41	0.79	0.41	0.72	0.47	0.27	0.07
Weighted HP	11.459	8.561	5.719	0.955	6.484	4.795	3.263	0.264

Weighted Average HP 41.500 HP
Weighted Average PARTICULATE 6.331 GR/HR
0.153 **(GR/HP-HR)**

PARTICULATE INDEX (PI) CFM 3725.949

COMPANY NAME Isuzu
DATE 9/25/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: PetroSA coal derived Fischer-Tropsch Synthetic Fuel, Engine Only, EC/OC sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.1	2501.0	2500.2	2497.8	1800.0	1799.8	1799.9	973.4
TORQUE lbft	156.2	120.2	80.0	20.0	190.2	145.0	95.1	9.7
HORSEPOWER	74.4	57.3	38.1	9.5	65.2	49.7	32.6	1.8
Barometric Pressure INHG	28.95	28.95	28.95	28.95	28.95	28.94	28.94	28.94
Laminar flow air temp DEG F	60.01	59.72	59.67	61.26	59.90	61.41	59.54	59.50
Laminar flow diff pressure in. of H2O	4.32	3.88	3.35	2.80	2.62	2.35	2.08	0.91
Laminar Flow cfm	219.97	198.11	171.28	143.55	134.44	120.72	106.87	47.14
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	70.00	70.00	70.00	70.00	70.56	72.00	72.00	74.00
Boost/Air In Manifold (degF)	297.83	245.61	189.03	134.34	215.95	177.50	138.14	93.44
Altitude Barrel Pressure (inHg)	28.84	28.84	28.84	28.83	28.83	28.83	28.83	28.84
Altitude (ft)	1007	1013	1013	1018	1017	1018	1018	1013
Intake AIR Consumption lbs/hr	971.22	875.53	757.12	631.35	593.72	530.60	472.44	208.43
LAB FACTOR-NA	1.011	1.011	1.010	1.011	1.012	1.014	1.014	1.017
LAB FACTOR-TURBO	0.993	0.994	0.993	0.994	0.997	1.001	1.000	1.007
Intake Air Temperature DEG F	70.00	70.00	70.00	70.00	70.56	72.00	72.00	74.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	297.83	245.61	189.03	134.34	215.95	177.50	138.14	93.44
Boost air Pressure (@manifold) psi	20.16	14.87	9.23	4.01	11.72	7.93	4.46	0.23
FUEL Temperature DEG F	94.94	95.98	95.84	94.98	92.50	93.00	92.03	90.00
FUEL Cunsumption lbs/hr	29.36	22.34	15.28	6.86	22.37	16.72	11.15	1.45
DEW Point DEG F	45.44	45.25	45.10	45.51	45.21	45.52	45.19	45.05
Grains Water (H2O) per lb dry air	45.84	45.49	45.25	45.98	45.45	46.00	45.40	45.19
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	885.53	762.42	614.22	400.16	920.52	807.63	620.45	293.56
FINAL EXHAUST TEMP	801.14	702.14	573.52	391.69	777.08	708.66	564.36	302.81
Coolant Temperature IN DEG F	162.57813	160.5	163	164	158	160	162	163.48438
Coolant Temperature OUT DEG F	174.39063	170.48438	170.04688	169	170	170	169.60938	167
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.25	12.93	10.34	7.88	7.35	6.26	5.30	1.95
Exhaust Restriction (mmHg)	6.01	4.59	2.98	1.61	4.69	3.19	0.92	0.45
Exhaust Restriction (inH2O)	3.22	2.46	1.59	0.86	2.51	1.71	0.49	0.24
EXHAUST FLOW LB/HR	1000.58	897.87	772.40	638.21	616.09	547.32	483.59	209.89
FUEL /AIR RATIO	0.0302	0.0255	0.0202	0.0109	0.0377	0.0315	0.0236	0.0070
J CONVER	0.9334	0.9423	0.9523	0.9696	0.9195	0.9310	0.9459	0.9770
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	6.7	5.7	4.6	2.5	8.5	7.2	5.5	1.8
CO PPM DRY	107.9	84.0	85.1	186.3	83.2	72.2	82.4	101.2
NOX PPM DRY	476.3	368.2	275.9	101.7	763.6	615.7	447.8	178.4
NO PPM DRY	449.0	346.2	253.3	81.6	732.9	588.8	413.6	151.9
NO2 PPM DRY	27.3	22.0	22.6	20.1	30.7	26.9	34.3	26.5
%O2								
NO WET	419.0996	326.2562	241.2012	79.1308	673.9537	548.1539	391.1829	148.4240
NO2 WET	25.4990	20.6917	21.5221	19.4608	28.2300	25.0748	32.3993	25.8579
CO2 WET	6.2770	5.4107	4.3806	2.4239	7.8434	6.7029	5.1920	1.7098
CO WET	0.0101	0.0079	0.0081	0.0181	0.0076	0.0067	0.0078	0.0099
G	0.0018	0.0023	0.0030	0.0040	0.0009	0.0016	0.0026	0.0045
R	-0.0025	-0.0027	-0.0029	-0.0033	-0.0021	-0.0024	-0.0028	-0.0035
HUM&TEM CORR FACTOR	1.0595	1.0626	1.0659	1.0681	1.0573	1.0616	1.0689	1.0907
NO CORR	395.5714	307.0262	226.2848	74.0837	637.4149	516.2647	365.9542	136.0834
NO2 CORR	24.0675	19.4721	20.1911	18.2195	26.6995	23.6160	30.3098	23.7079
GAS EMISSIONS								
NO GR/HR	186.03	129.56	82.15	22.22	184.57	132.80	83.18	13.42
NO2 GR/HR	17.34	12.59	11.23	8.37	11.84	9.31	10.55	3.58
CO2 GR/HR	43273.80	33472.44	23312.81	10658.54	33294.44	25276.84	17299.18	2472.57
CO GR/HR	44.14	31.14	27.41	50.50	20.64	16.12	16.50	9.09
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM (25 ppm)	3451	2403	1524	412	3424	2464	1543	249
NO2 CFM (5 ppm)	1049	761	679	506	716	563	638	217
CO2 CFM (5000 ppm)	2726	2109	1469	671	2098	1592	1090	156
CO CFM (50 ppm)	439	310	272	502	205	160	164	90
NOX ppm - wet EURO, EPA, ISO	444.60	346.95	262.72	98.59	702.18	573.23	423.58	174.28
NOX ppm(corr) EURO,EPA,ISO	419.64	326.50	246.48	92.30	664.11	539.88	396.26	159.79
NOX GR/HR EURO, EPA, ISO	302.32	211.07	137.07	42.41	294.59	212.75	137.97	24.15
NOX cfm EURO, EPA, ISO	3658	2554	1658	513	3564	2574	1669	292

DPM EC/OC DATA

		1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
EC	TWA (ug/m3)	24423	18580	9290	8775	24354	16964	8871	---
OC	TWA (ug/m3)	8359	8650	7853	7144	6948	4935	5203	4213
TC	TWA (ug/m3)	32783	27222	17136	15926	31302	21900	14081	4437

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: Highway (typical) ULSD
Engine: Isuzu 4JG1T
DOC: ECS Purifier A16-0119

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.9	2500.2	2500.6	2498.5	1800.1	1800.1	1800.1	980.0
TORQUE lbft	168.54	125.24	85.17	20.10	200.74	147.50	100.19	8.96
HORSEPOWER	80.22	69.62	40.55	9.56	68.80	50.56	34.34	1.67
Barometric Pressure INHG	28.71	28.71	28.70	28.70	28.70	28.70	28.70	28.69
Laminar flow air temp DEG F	62.21	62.80	62.77	62.65	62.84	63.07	62.08	62.82
Laminar flow diff pressure in. of H2O	4.35	3.87	3.35	2.73	2.62	2.28	2.03	0.88
Laminar Flow cfm	221.40	197.50	171.12	139.97	134.49	117.15	104.60	45.46
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	74.00	74.50	74.50	74.85	76.41	78.00	77.52	81.76
Boost/Air In Manifold (degF)	310.66	254.00	198.45	139.17	230.41	184.45	146.55	100.27
Altitude Barrel Pressure (inHg)	28.65	28.65	28.65	28.65	28.64	28.64	28.63	28.63
Altitude (ft)	1189.90	1190.06	1194.14	1193.85	1197.99	1201.43	1205.81	1208.09
Intake AIR Consumption lbs/hr	957.87	853.14	739.29	604.96	580.79	505.54	452.68	196.33
LAB FACTOR-NA	1.030	1.031	1.031	1.032	1.034	1.036	1.036	1.041
LAB FACTOR-TURBO	1.015	1.017	1.017	1.018	1.022	1.027	1.027	1.037
Intake Air Temperature DEG F	74.00	74.50	74.50	74.85	76.41	78.00	77.52	81.76
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	310.66	254.00	198.45	139.17	230.41	184.45	146.55	100.27
Boost air Pressure (@manifold) psi	20.54	14.73	9.29	3.69	12.11	7.58	4.36	0.00
FUEL Temperature DEG F	95.38	98.25	98.42	98.29	97.43	95.64	94.96	93.45
FUEL Cunsumption lbs/hr	32.14	23.83	16.88	7.33	25.07	17.69	11.98	1.41
DEW Point DEG F	56.12	55.65	55.41	55.12	55.51	55.50	55.50	55.01
Grains Water (H2O) per lb dry air	68.91	67.70	67.15	66.43	67.40	67.36	67.39	66.16
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	929.34	790.34	639.34	405.41	958.93	826.23	634.63	286.98
FINAL EXHAUST TEMP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coolant Temperature IN DEG F	159.45	159.03	161.46	163.84	157.65	158.41	160.86	164.58
Coolant Temperature OUT DEG F	172.16	169.25	169.43	168.77	170.99	169.23	168.25	168.52
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.35	12.79	10.37	7.82	7.57	6.22	5.38	2.04
Exhaust Restriction (mmHg)	0.00	0.00	0.00	0.00	0.00	0.05	0.86	0.58
Exhaust Restriction (inH2O)	0.00	0.00	0.00	0.00	0.00	0.03	0.46	0.31
EXHAUST FLOW LB/HR	990.01	876.97	756.17	612.28	605.86	523.23	464.66	197.74
FUEL /AIR RATIO	0.03	0.03	0.02	0.01	0.04	0.03	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.90	0.92	0.94	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.40	6.19	5.00	2.69	9.32	7.70	5.91	1.80
CO PPM DRY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOX PPM DRY	554.73	398.71	309.58	113.78	812.54	651.28	491.18	186.04
NO PPM DRY	476.07	327.26	276.82	111.93	704.79	497.33	407.09	183.74
NO2 PPM DRY	78.66	71.45	32.76	1.85	107.74	153.95	84.09	2.30
%O2								
NO WET	438.98	305.29	260.91	107.76	637.45	457.40	380.91	178.60
NO2 WET	72.54	66.65	30.88	1.78	97.45	141.60	78.68	2.24
CO2 WET	6.82	5.77	4.71	2.59	8.43	7.08	5.53	1.75
CO WET	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.0014	0.0021	0.0027	0.0039	0.0003	0.0012	0.0022	0.0045
R	-0.0023	-0.0026	-0.0028	-0.0033	-0.0019	-0.0023	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0099	1.0136	1.0153	1.0196	1.0143	1.0185	1.0212	1.0520
NO CORR	434.69	301.19	256.97	105.69	628.45	449.08	372.99	169.76
NO2 CORR	71.79	65.76	30.41	1.75	96.10	139.03	77.05	2.13
GAS EMISSIONS								
NO GR/HR	202.25	124.14	91.33	30.41	178.94	110.44	81.45	15.78
NO2 GR/HR	51.19	41.52	16.56	0.77	41.93	52.37	25.78	0.30
CO2 GR/HR	46524.75	34872.78	24552.80	10927.97	35197.91	25525.75	17690.65	2383.74
CO GR/HR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3752	2303	1694	564	3319	2049	1511	293
NO2 CFM 5 ppm	3096	2512	1002	47	2536	3168	1560	18
CO2 CFM 5000 ppm	2931	2197	1547	688	2217	1608	1115	150
CO CFM 50 ppm	0	0	0	0	0	0	0	0
NOX ppm - wet EURO, EPA, ISO	511.5	371.9	291.8	109.5	734.9	599.0	459.6	180.8
NOX ppm(corr) EURO,EPA,ISO	506.5	366.9	287.4	107.4	724.6	588.1	450.0	171.9
NOX GR/HR EURO, EPA, ISO	361.0	231.7	156.5	47.4	316.1	221.6	150.6	24.5
NOX cfm EURO, EPA, ISO	4367.9	2803.2	1893.0	573.0	3823.8	2680.5	1821.6	296.1

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/18/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Highway D-2 ULSD Engine + ECS Purifier DOC

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2501.0	2500.0	2501.0	2499.3	1800.3	1800.3	1800.2	979.9
TORQUE lbft	168.0	125.2	85.3	19.9	200.7	150.1	100.3	9.0
HORSEPOWER	80.0	59.6	40.6	9.5	68.8	51.5	34.4	1.7
Barometric Pressure INHG	28.72	28.72	28.72	28.71	28.71	28.71	28.71	28.71
Laminar flow air temp DEG F	62.47	62.78	62.64	61.95	63.12	62.93	62.68	63.32
Laminar flow diff pressure in. of H2O	4.34	3.86	3.33	2.71	2.62	2.28	2.03	0.88
Laminar Flow cfm	221.01	196.95	170.42	138.95	134.18	117.05	104.37	45.27
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	74.00	74.00	74.00	74.00	76.83	78.00	77.02	82.00
Boost/Air In Manifold (degF)	310.31	253.27	197.48	137.86	232.36	186.06	145.61	99.31
Altitude Barrel Pressure (inHg)	28.66	28.66	28.66	28.66	28.66	28.65	28.65	28.65
Altitude (ft)	1179	1181	1182	1180	1186	1187	1196	1195
Intake AIR Consumption lbs/hr	955.31	851.16	736.97	602.18	579.34	505.52	451.25	195.30
LAB FACTOR-NA	1.030	1.030	1.030	1.030	1.034	1.035	1.035	1.040
LAB FACTOR-TURBO	1.015	1.015	1.015	1.016	1.023	1.027	1.025	1.037
Intake Air Temperature DEG F	74.00	74.00	74.00	74.00	76.83	78.00	77.02	82.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	310.31	253.27	197.48	137.86	232.36	186.06	145.61	99.31
Boost air Pressure (@manifold) psi	20.48	14.73	9.27	3.67	12.19	7.76	4.36	0.00
FUEL Temperature DEG F	96.64	97.86	97.55	97.77	96.34	94.84	93.92	92.38
FUEL Cunsumption lbs/hr	32.25	23.66	16.93	7.34	25.16	17.93	12.02	1.48
DEW Point DEG F	56.79	55.45	55.01	54.66	54.98	55.31	55.22	54.92
Grains Water (H2O) per lb dry air	70.60	67.19	66.13	65.28	66.09	66.86	66.71	65.93
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	929.11	787.97	634.91	397.75	972.36	830.80	628.73	274.38
FINAL EXHAUST TEMP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coolant Temperature IN DEG F	159.42188	158.95313	162	164	157.51563	157.14063	163	165
Coolant Temperature OUT DEG F	172.3125	169	170	169	171.23438	168.45313	170	168.96875
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.30	12.80	10.35	7.79	7.55	6.27	5.38	2.03
Exhaust Restriction (mmHg)	0.00	0.00	0.00	0.00	0.00	0.11	0.96	0.50
Exhaust Restriction (inH2O)	0.00	0.00	0.00	0.00	0.00	0.06	0.51	0.27
EXHAUST FLOW LB/HR	987.57	874.82	753.91	609.51	604.50	523.45	463.27	196.78
FUEL /AIR RATIO	0.0338	0.0278	0.0230	0.0122	0.0434	0.0355	0.0266	0.0076
J CONVER	0.9213	0.9332	0.9425	0.9629	0.9043	0.9190	0.9355	0.9713
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.4	6.2	5.0	2.7	9.3	7.8	5.9	1.8
CO PPM DRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX PPM DRY	551.1	396.6	310.2	114.5	822.5	666.3	494.9	185.1
NO PPM DRY	481.6	325.5	279.8	112.8	724.7	513.4	415.8	184.4
NO2 PPM DRY	69.5	71.1	30.4	1.7	97.7	153.0	79.1	0.7
%O2								
NO WET	443.7420	303.7650	263.7155	108.5802	655.3359	471.7448	388.9832	179.0886
NO2 WET	64.0416	66.3647	28.6102	1.6609	88.3820	140.5913	73.9921	0.7255
CO2 WET	6.8121	5.7613	4.7124	2.5817	8.4208	7.1650	5.5297	1.7484
CO WET	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.0014	0.0021	0.0026	0.0039	0.0003	0.0012	0.0022	0.0044
R	-0.0023	-0.0026	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0060	1.0139	1.0168	1.0201	1.0168	1.0194	1.0218	1.0536
NO CORR	441.0773	299.6018	259.3474	106.4444	644.5161	462.7658	380.6756	169.9843
NO2 CORR	63.6570	65.4551	28.1364	1.6283	86.9228	137.9153	72.4118	0.6886
GAS EMISSIONS								
NO GR/HR	204.73	123.19	91.90	30.49	183.12	113.85	82.89	15.72
NO2 GR/HR	45.26	41.23	15.27	0.71	37.83	51.98	24.15	0.10
CO2 GR/HR	46352.00	34726.07	24478.21	10841.80	35072.87	25841.08	17650.41	2370.45
CO GR/HR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3798	2285	1705	566	3397	2112	1538	292
NO2 CFM 5 ppm	2738	2494	924	43	2288	3144	1461	6
CO2 CFM 5000 ppm	2920	2188	1542	683	2210	1628	1112	149
CO CFM 50 ppm	0	0	0	0	0	0	0	0
NOX ppm - wet EURO, EPA, ISO	507.78	370.13	292.33	110.24	743.72	612.34	462.98	179.81
NOX ppm(corr) EURO,EPA,ISO	504.73	365.06	287.48	108.07	731.44	600.68	453.09	170.67
NOX GR/HR EURO, EPA, ISO	358.89	229.94	156.05	47.43	318.35	226.39	151.13	24.18
NOX cfm EURO, EPA, ISO	4342	2782	1888	574	3852	2739	1828	293
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	13.94	13.70	5.88	4.46	24.47	4.94	2.82	0.28
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	2.09	2.05	0.88	0.45	2.45	0.49	0.28	0.04
Weighted HP	12.000	8.940	6.096	0.947	6.879	5.147	3.438	0.251
Weighted Average HP	43.697 HP							
Weighted Average PARTICULATE	8.738 GR/HR							
	0.200 **(GR/HP-HR)**							
PARTICULATE INDEX (PI) CFM	5142.309							

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/18/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Highway D-2 ULSD Engine + ECS Purifier DOC - EC/OC samples

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2498.8	2500.4	2500.2	2497.7	1799.9	1800.0	1800.0	980.0
TORQUE lbft	169.1	125.3	85.0	20.3	200.8	144.9	100.1	9.0
HORSEPOWER	80.4	59.6	40.5	9.7	68.8	49.6	34.3	1.7
Barometric Pressure INHG	28.70	28.70	28.69	28.69	28.69	28.69	28.69	28.68
Laminar flow air temp DEG F	61.96	62.83	62.90	63.36	62.57	63.20	61.59	62.32
Laminar flow diff pressure in. of H2O	4.36	3.88	3.36	2.75	2.63	2.28	2.04	0.88
Laminar Flow cfm	221.78	198.05	171.83	141.00	134.80	117.25	104.84	45.65
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	74.00	75.00	75.00	75.70	76.00	78.00	78.02	81.52
Boost/Air In Manifold (degF)	311.00	254.73	199.41	140.48	228.47	182.83	147.50	101.23
Altitude Barrel Pressure (inHg)	28.64	28.64	28.63	28.63	28.63	28.62	28.62	28.62
Altitude (ft)	1200	1199	1206	1208	1210	1215	1216	1221
Intake AIR Consumption lbs/hr	960.43	855.12	741.60	607.74	582.24	505.56	454.12	197.36
LAB FACTOR-NA	1.030	1.032	1.032	1.033	1.034	1.036	1.037	1.041
LAB FACTOR-TURBO	1.015	1.019	1.018	1.020	1.022	1.027	1.029	1.037
Intake Air Temperature DEG F	74.00	75.00	75.00	75.70	76.00	78.00	78.02	81.52
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	311.00	254.73	199.41	140.48	228.47	182.83	147.50	101.23
Boost air Pressure (@manifold) psi	20.60	14.74	9.30	3.72	12.03	7.39	4.36	0.00
FUEL Temperature DEG F	94.11	98.64	99.30	98.81	98.52	96.44	96.00	94.52
FUEL Cunsumption lbs/hr	32.03	24.01	16.83	7.32	24.98	17.45	11.94	1.34
DEW Point DEG F	55.45	55.85	55.82	55.57	56.03	55.69	55.77	55.09
Grains Water (H2O) per lb dry air	67.23	68.21	68.18	67.59	68.70	67.86	68.06	66.40
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	929.58	792.72	643.77	413.08	945.50	821.66	640.53	299.59
FINAL EXHAUST TEMP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coolant Temperature IN DEG F	159.48438	159.10938	160.92188	163.6875	157.78125	159.6875	158.71875	164.15625
Coolant Temperature OUT DEG F	172.01563	169.5	168.85938	168.54688	170.75	170	166.5	168.0625
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.40	12.78	10.39	7.85	7.60	6.16	5.38	2.05
Exhaust Restriction (mmHg)	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.66
Exhaust Restriction (inH2O)	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.36
EXHAUST FLOW LB/HR	992.46	879.13	758.43	615.06	607.22	523.00	466.05	198.70
FUEL /AIR RATIO	0.0333	0.0281	0.0227	0.0120	0.0429	0.0345	0.0263	0.0068
J CONVER	0.9228	0.9325	0.9426	0.9626	0.9047	0.9205	0.9359	0.9727
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.4	6.2	5.0	2.7	9.3	7.6	5.9	1.8
CO PPM DRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX PPM DRY	558.3	400.8	309.0	113.1	802.6	636.2	487.5	187.0
NO PPM DRY	470.5	329.0	273.8	111.1	684.9	481.3	398.4	183.1
NO2 PPM DRY	87.8	71.8	35.2	2.0	117.7	154.9	89.1	3.8
%O2								
NO WET	434.2147	306.8058	258.1055	106.9467	619.5595	443.0630	372.8381	178.1077
NO2 WET	81.0377	66.9416	33.1402	1.8982	106.5200	142.6007	83.3860	3.7450
CO2 WET	6.8291	5.7815	4.7129	2.5991	8.4429	6.9961	5.5217	1.7509
CO WET	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.0014	0.0020	0.0027	0.0039	0.0003	0.0013	0.0023	0.0045
R	-0.0023	-0.0026	-0.0028	-0.0033	-0.0019	-0.0023	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0138	1.0133	1.0138	1.0192	1.0117	1.0176	1.0206	1.0505
NO CORR	428.2936	302.7715	254.5989	104.9336	612.3804	435.4034	365.3050	169.5429
NO2 CORR	79.9326	66.0613	32.6900	1.8624	105.2857	140.1355	81.6816	3.5649
GAS EMISSIONS								
NO GR/HR	199.78	125.10	90.75	30.33	174.77	107.03	80.02	15.83
NO2 GR/HR	57.12	41.81	17.85	0.82	46.03	52.77	27.41	0.51
CO2 GR/HR	46697.49	35019.48	24627.39	11014.13	35322.94	25210.42	17730.69	2397.03
CO GR/HR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	3706	2321	1684	563	3242	1985	1484	294
NO2 CFM 5 ppm	3455	2529	1080	50	2784	3192	1658	31
CO2 CFM 5000 ppm	2942	2206	1552	694	2225	1588	1117	151
CO CFM 50 ppm	0	0	0	0	0	0	0	0
NOX ppm - wet EURO, EPA, ISO	515.25	373.75	291.25	108.84	726.08	585.66	456.20	181.85
NOX ppm(corr) EURO,EPA,ISO	508.23	368.83	287.29	106.80	717.67	575.54	446.89	173.11
NOX GR/HR EURO, EPA, ISO	363.16	233.46	156.88	47.29	313.76	216.73	149.99	24.76
NOX cfm EURO, EPA, ISO	4394	2825	1898	572	3796	2622	1815	300

DPM EC/OC DATA

EC	TWA (ug/m3)	27260	27093	16735	15755	41303	22586	13569	1059
OC	TWA (ug/m3)	5591	5416	9079	4998	4464	4179	4976	2693
TC	TWA (ug/m3)	32851	32501	25814	20752	45774	26764	18544	3752

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: Highway (typical) ULSD
Engine: **Isuzu 4JG1T**
DOC: NONE

COMPANY NAME **Isuzu**
DATE
ENGINE MODEL **Isuzu 4JG1T**
COMMENTS: **AVERAGE DATA**

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.5	2500.8	2499.8	2498.7	1800.1	1799.9	1800.1	980.6
TORQUE lbft	172.00	127.66	84.94	19.77	201.64	149.93	99.95	9.74
HORSEPOWER	81.89	60.79	40.43	9.40	69.11	51.38	34.26	1.82
Barometric Pressure INHG	28.56	28.56	28.56	28.56	28.56	28.55	28.55	28.55
Laminar flow air temp DEG F	61.47	61.71	62.04	61.21	61.78	61.87	62.04	61.94
Laminar flow diff pressure in. of H2O	4.33	3.85	3.29	2.67	2.57	2.23	1.97	0.81
Laminar Flow cfm	220.34	196.56	168.12	136.75	131.98	114.56	101.39	41.90
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	72.00	72.38	72.48	73.00	74.50	75.25	75.71	78.39
Boost/Air In Manifold (degF)	316.31	256.89	196.91	136.88	233.04	186.10	144.71	95.57
Altitude Barrel Pressure (inHg)	28.46	28.46	28.45	28.46	28.45	28.44	28.45	28.44
Altitude (ft)	1373.23	1375.46	1379.07	1376.96	1385.39	1388.42	1385.10	1394.87
Intake AIR Consumption lbs/hr	950.21	847.00	723.95	590.28	568.67	493.36	436.40	180.47
LAB FACTOR-NA	1.033	1.034	1.034	1.034	1.037	1.038	1.039	1.042
LAB FACTOR-TURBO	1.013	1.015	1.015	1.016	1.020	1.024	1.024	1.032
Intake Air Temperature DEG F	72.00	72.38	72.48	73.00	74.50	75.25	75.71	78.39
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	316.31	256.89	196.91	136.88	233.04	186.10	144.71	95.57
Boost air Pressure (@manifold) psi	21.30	15.36	9.47	3.89	12.72	8.18	4.55	0.19
FUEL Temperature DEG F	92.34	94.54	95.10	95.46	94.85	92.71	92.45	90.13
FUEL Cunsumption lbs/hr	33.05	24.23	16.57	7.16	24.72	17.85	12.05	1.52
DEW Point DEG F	56.41	56.49	55.92	56.08	55.86	55.99	55.95	55.18
Grains Water (H2O) per lb dry air	70.29	70.45	69.09	69.50	68.95	69.17	69.13	67.19
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	940.16	784.53	631.58	400.71	960.77	825.11	633.64	267.08
FINAL EXHAUST TEMP	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Coolant Temperature IN DEG F	163.76	157.56	159.84	161.67	162.31	171.50	162.92	161.50
Coolant Temperature OUT DEG F	177.12	168.28	167.73	166.70	175.09	181.85	170.75	165.16
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	10.10	10.36	8.70	5.55	2.28	2.46	2.56	0.76
Exhaust Restriction (mmHg)	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Exhaust Restriction (inH2O)	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
EXHAUST FLOW LB/HR	983.26	871.23	740.52	597.45	593.39	511.22	448.44	181.99
FUEL /AIR RATIO	0.03	0.03	0.02	0.01	0.04	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.90	0.92	0.93	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.48	6.17	4.96	2.64	9.29	7.70	5.90	1.90
CO PPM DRY	134.59	95.21	87.24	144.60	156.36	74.96	71.28	90.02
NOX PPM DRY	588.08	429.16	317.00	115.44	858.85	734.24	530.82	193.18
NO PPM DRY	556.69	402.09	291.58	95.86	841.02	700.37	492.78	165.20
NO2 PPM DRY	31.39	27.06	26.42	19.58	17.83	33.87	38.04	27.98
%O2								
NO WET	511.89	374.33	274.66	92.22	759.93	642.35	459.84	160.14
NO2 WET	28.83	25.19	23.94	18.84	16.07	31.05	35.50	27.12
CO2 WET	6.87	5.74	4.67	2.54	8.40	7.06	5.51	1.84
CO WET	0.0124	0.0089	0.0082	0.0139	0.0141	0.0069	0.0067	0.0087
G	0.0013	0.0020	0.0026	0.0039	0.0003	0.0011	0.0021	0.0043
R	-0.0023	-0.0025	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0034
HUM&TEM CORR FACTOR	1.0047	1.0027	1.0047	1.0025	1.0112	1.0113	1.0128	1.0331
NO CORR	509.53	373.57	273.52	92.02	751.37	635.00	454.13	155.10
NO2 CORR	28.85	25.15	23.89	18.81	16.07	30.75	35.05	26.27
GAS EMISSIONS								
NO GR/HR	235.47	152.95	95.16	25.83	209.60	152.62	95.69	13.25
NO2 GR/HR	20.35	15.77	12.71	8.09	6.77	11.30	11.32	3.44
CO2 GR/HR	46572.34	34455.05	23842.35	10470.32	34330.64	24874.17	17012.15	2306.15
CO GR/HR	53.29	33.82	26.66	36.42	36.72	15.39	13.06	6.95
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4368	2837	1765	479	3888	2831	1775	246
NO2 CFM 5 ppm	1231	954	769	489	410	683	685	208
CO2 CFM 5000 ppm	2934	2171	1502	660	2163	1567	1072	145
CO CFM 50 ppm	530	336	265	362	365	153	130	69
NOX ppm - wet EURO, EPA, ISO	540.7	399.5	298.6	111.1	776.0	673.4	495.3	187.3
NOX ppm(corr) EURO,EPA,ISO	538.4	398.7	297.4	110.8	767.4	665.8	489.2	181.4
NOX GR/HR EURO, EPA, ISO	381.1	250.1	158.5	47.7	327.9	245.1	157.9	23.7
NOX cfm EURO, EPA, ISO	4610.4	3025.5	1917.6	576.6	3966.7	2965.4	1910.5	287.2

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

COMPANY NAME Isuzu
DATE 8/12/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Highway D-2 ULSD bare engine test

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	500.9	2500.6	2500.1	2498.7	1800.0	1799.9	1800.1	981.4
TORQUE lbft	171.6	125.0	84.9	19.8	201.6	150.0	100.0	9.8
HORSEPOWER	81.7	59.5	40.4	9.4	69.1	51.4	34.3	1.8
Barometric Pressure INHG	28.61	28.61	28.61	28.61	28.60	28.59	28.59	28.58
Laminar flow air temp DEG F	62.25	62.62	63.13	61.56	62.60	62.79	62.98	63.00
Laminar flow diff pressure in. of H2O	4.38	3.87	3.35	2.71	2.62	2.28	2.02	0.86
Laminar Flow cfm	222.80	197.50	171.16	139.24	134.26	116.88	104.07	44.52
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	73.00	73.75	73.00	74.00	76.00	76.50	77.00	80.00
Boost/Air In Manifold (degF)	316.63	254.77	197.42	137.31	234.50	187.00	145.81	98.64
Altitude Barrel Pressure (inHg)	28.48	28.48	28.48	28.48	28.47	28.46	28.46	28.45
Altitude (ft)	1351	1355	1357	1357	1366	1374	1371	1381
Intake AIR Consumption lbs/hr	961.73	851.42	737.09	602.35	578.94	503.39	448.02	191.67
LAB FACTOR-NA	1.031	1.032	1.032	1.032	1.035	1.037	1.037	1.042
LAB FACTOR-TURBO	1.014	1.016	1.015	1.016	1.022	1.025	1.026	1.035
Intake Air Temperature DEG F	73.00	73.75	73.00	74.00	76.00	76.50	77.00	80.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	316.63	254.77	197.42	137.31	234.50	187.00	145.81	98.64
Boost air Pressure (@manifold) psi	21.28	15.03	9.46	3.88	12.67	8.20	4.60	0.21
FUEL Temperature DEG F	96.11	97.03	96.31	96.58	95.20	93.00	93.03	91.72
FUEL Cunsumption lbs/hr	32.78	23.84	16.66	7.19	24.67	17.76	12.10	1.50
DEW Point DEG F	53.65	53.90	53.00	53.20	53.00	53.58	53.29	52.72
Grains Water (H2O) per lb dry air	63.14	63.70	61.63	62.08	61.64	63.02	62.36	61.03
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	940.13	781.27	631.30	399.17	968.30	824.73	633.73	284.61
FINAL EXHAUST TEMP	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Coolant Temperature IN DEG F	167	155.51563	156.6875	158.71875	168.875	183.70313	164.79688	158
Coolant Temperature OUT DEG F	180	166.46875	164.46875	163.84375	180.89063	193.53125	173	162.28125
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	11.58	11.40	9.50	6.02	3.02	3.55	2.77	1.00
Exhaust Restriction (mmHg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exhaust Restriction (inH2O)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXHAUST FLOW LB/HR	994.51	875.26	753.74	609.53	603.60	521.15	460.12	193.16
FUEL /AIR RATIO	0.0341	0.0280	0.0226	0.0119	0.0426	0.0353	0.0270	0.0078
J CONVER	0.9224	0.9336	0.9442	0.9640	0.9068	0.9201	0.9358	0.9720
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.5	6.1	5.0	2.7	9.3	7.7	5.9	1.9
CO PPM DRY	133.5	91.6	88.3	146.8	156.9	73.4	70.5	88.6
NOX PPM DRY	586.2	422.2	314.0	116.5	864.7	751.2	535.2	194.1
NO PPM DRY	584.1	396.1	291.0	97.0	860.9	719.8	496.6	166.0
NO2 PPM DRY	22.1	26.1	23.1	19.5	3.8	31.4	38.6	28.1
%O2								
NO WET	520.3212	369.7851	274.7179	93.5349	780.6337	662.3581	464.6784	161.3283
NO2 WET	20.3815	24.3616	21.7928	18.7684	3.4797	28.8868	36.1303	27.3401
CO2 WET	6.8745	5.6951	4.7002	2.5547	8.4329	7.0851	5.5212	1.8453
CO WET	0.0123	0.0085	0.0063	0.0142	0.0142	0.0068	0.0066	0.0086
G	0.0013	0.0021	0.0027	0.0039	0.0004	0.0012	0.0022	0.0044
R	-0.0023	-0.0026	-0.0028	-0.0033	-0.0019	-0.0022	-0.0026	-0.0035
HUM&TEM CORR FACTOR	1.0219	1.0223	1.0268	1.0306	1.0254	1.0263	1.0330	1.0615
NO CORR	509.1771	361.7036	267.5511	90.7606	761.3229	645.3681	449.8250	151.9625
NO2 CORR	19.9450	23.8291	21.2243	18.2118	3.3936	28.1458	34.9754	25.7563
GAS EMISSIONS								
NO GR/HR	238.00	148.80	94.78	26.00	215.98	158.08	97.28	13.80
NO2 GR/HR	14.28	15.02	11.52	7.99	1.47	10.56	11.59	3.58
CO2 GR/HR	47105.79	34344.35	24409.76	10728.86	35071.20	25440.67	17503.39	2455.84
CO GR/HR	53.64	32.77	27.52	37.79	37.62	15.43	13.29	7.28
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4415	2760	1758	482	4006	2932	1805	256
NO2 CFM 5 ppm	864	908	697	483	89	639	701	217
CO2 CFM 5000 ppm	2968	2164	1538	676	2209	1603	1103	155
CO CFM 50 ppm	533	326	274	376	374	153	132	72
NOX ppm - wet EURO, EPA, ISO	540.70	394.15	296.51	112.30	784.11	691.24	500.81	188.67
NOX ppm(corr) EURO,EPA,ISO	529.12	385.53	288.78	108.97	764.72	673.51	484.80	177.74
NOX GR/HR EURO, EPA, ISO	378.88	242.96	156.72	47.82	332.34	252.72	160.61	24.72
NOX cfm EURO, EPA, ISO	4584	2939	1896	579	4021	3058	1943	299
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	11.86	11.68	7.35	6.67	11.42	5.01	3.03	0.46
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.78	1.75	1.10	0.67	1.14	0.50	0.30	0.07
Weighted HP	12.254	8.931	6.061	0.943	6.911	5.140	3.427	0.273
Weighted Average HP	43.940 HP							
Weighted Average PARTICULATE	7.313 GR/HR							
	0.166 **(GR/HP-HR)**							

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/13/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Highway D-2 ULSD bare engine (ec/oc) filters

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.0	2501.0	2499.5	2498.8	1800.2	1799.8	1800.1	979.9
TORQUE lbft	172.4	130.3	85.0	19.7	201.6	149.9	99.9	9.7
HORSEPOWER	82.1	62.0	40.5	9.4	69.1	51.4	34.2	1.8
Barometric Pressure INHG	28.52	28.52	28.52	28.52	28.51	28.51	28.51	28.51
Laminar flow air temp DEG F	60.69	60.79	60.95	60.87	60.97	60.94	61.10	60.88
Laminar flow diff pressure in. of H2O	4.28	3.83	3.23	2.62	2.53	2.18	1.92	0.76
Laminar Flow cfm	217.87	195.61	165.08	134.27	129.70	112.25	98.71	39.29
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	71.00	71.00	71.97	72.00	73.00	74.00	74.42	76.78
Boost/Air In Manifold (degF)	316.00	259.02	196.41	136.45	231.58	185.20	143.61	92.50
Altitude Barrel Pressure (inHg)	28.44	28.44	28.43	28.43	28.43	28.43	28.43	28.42
Altitude (ft)	1396	1396	1401	1397	1405	1402	1399	1409
Intake AIR Consumption lbs/hr	938.69	842.59	710.81	578.22	558.40	483.34	424.77	169.27
LAB FACTOR-NA	1.035	1.036	1.036	1.036	1.038	1.040	1.040	1.043
LAB FACTOR-TURBO	1.013	1.014	1.015	1.015	1.018	1.022	1.023	1.030
Intake Air Temperature DEG F	71.00	71.00	71.97	72.00	73.00	74.00	74.42	76.78
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	316.00	259.02	196.41	136.45	231.58	185.20	143.61	92.50
Boost air Pressure (@manifold) psi	21.32	15.69	9.48	3.90	12.77	8.16	4.50	0.18
FUEL Temperature DEG F	88.56	92.05	93.89	94.34	94.50	92.42	91.88	88.53
FUEL Cunsumption lbs/hr	33.31	24.61	16.47	7.14	24.78	17.94	12.00	1.55
DEW Point DEG F	59.17	59.07	58.83	58.96	58.72	58.39	58.60	57.64
Grains Water (H2O) per lb dry air	77.45	77.19	76.55	76.92	76.27	75.33	75.89	73.35
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	940.19	787.80	631.86	402.25	953.25	825.48	633.55	249.55
FINAL EXHAUST TEMP	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Coolant Temperature IN DEG F	160.515625	159.60938	163	164.625	155.75	159.29688	161.04688	165
Coolant Temperature OUT DEG F	174.234375	170.09375	171	169.54688	169.28125	170.17188	168.5	168.04688
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	8.61	9.31	7.90	5.09	1.53	1.38	2.36	0.52
Exhaust Restriction (mmHg)	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
Exhaust Restriction (inH2O)	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
EXHAUST FLOW LB/HR	972.00	867.20	727.29	585.36	583.18	501.28	436.77	170.82
FUEL /AIR RATIO	0.0355	0.0292	0.0232	0.0123	0.0444	0.0371	0.0282	0.0092
J CONVER	0.9166	0.9284	0.9398	0.9600	0.9003	0.9140	0.9305	0.9667
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.5	6.2	4.9	2.6	9.3	7.7	5.9	1.9
CO PPM DRY	135.7	98.9	86.2	142.4	155.8	76.5	72.1	91.5
NOX PPM DRY	590.0	436.1	320.0	114.4	853.0	717.2	526.5	192.3
NO PPM DRY	549.3	408.1	292.2	94.7	821.1	680.9	489.0	164.4
NO2 PPM DRY	40.7	28.0	27.8	19.7	31.8	36.3	37.5	27.8
%O2								
NO WET	503.4647	378.8832	274.6067	90.8994	739.2294	622.3378	454.9975	158.9529
NO2 WET	37.2855	26.0269	26.0947	18.9119	28.6534	33.2212	34.8672	26.9086
CO2 WET	6.8745	5.7851	4.6448	2.5320	8.3597	7.0378	5.4899	1.8323
CO WET	0.0124	0.0092	0.0081	0.0137	0.0140	0.0070	0.0067	0.0088
G	0.0012	0.0019	0.0026	0.0039	0.0002	0.0010	0.0020	0.0042
R	-0.0022	-0.0025	-0.0028	-0.0033	-0.0018	-0.0022	-0.0026	-0.0034
HUM&TEM CORR FACTOR	0.9874	0.9830	0.9825	0.9744	0.9970	0.9963	0.9925	1.0047
NO CORR	509.8759	385.4304	279.4846	93.2882	741.4203	624.6419	458.4354	158.2147
NO2 CORR	37.7603	26.4767	26.5582	19.4089	28.7383	33.3442	35.1306	26.7836
GAS EMISSIONS								
NO GR/HR	232.93	157.10	95.53	25.67	203.22	147.17	94.11	12.70
NO2 GR/HR	26.43	16.53	13.91	8.18	12.07	12.03	11.05	3.29
CO2 GR/HR	46038.89	34565.74	23274.94	10211.78	33590.09	24307.67	16520.90	2156.45
CO GR/HR	52.94	34.86	25.80	35.04	35.83	15.35	12.83	6.62
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4321	2914	1772	476	3770	2730	1746	236
NO2 CFM 5 ppm	1599	1000	841	495	730	728	668	199
CO2 CFM 5000 ppm	2900	2178	1466	643	2116	1531	1041	136
CO CFM 50 ppm	526	346	256	348	356	153	128	66
NOX ppm - wet EURO, EPA, ISO	540.75	404.91	300.70	109.81	767.88	655.56	489.86	185.86
NOX ppm(corr) EURO,EPA,ISO	547.64	411.91	306.04	112.70	770.16	657.99	493.57	185.00
NOX GR/HR EURO, EPA, ISO	383.26	257.19	160.26	47.50	323.38	237.48	155.21	22.75
NOX cfm EURO, EPA, ISO	4637	3112	1939	575	3912	2873	1878	275

DPM EC/OC DATA

EC	TWA (ug/m3)	21974	27941	16546	17912	43091	24139	10254	1156
OC	TWA (ug/m3)	11284	8948	10225	12634	9819	7052	7969	6621
TC	TWA (ug/m3)	33250	36890	26770	30546	52910	31191	18223	7777

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: IRE REG-9000-5 biodiesel

Engine: Isuzu 4JG1T

DOC: ECS Purifier A16-0119

COMPANY NAME Isuzu

DATE

ENGINE MODEL Isuzu 4JG1T

COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.0	2500.4	2499.6	2498.1	1800.0	1799.9	1799.9	990.6
TORQUE lbft	176.31	130.00	89.87	19.80	207.43	154.97	105.05	9.75
HORSEPOWER	83.93	61.89	42.77	9.42	71.09	53.11	36.00	1.84
Barometric Pressure INHG	28.72	28.72	28.72	28.72	28.72	28.73	28.73	28.73
Laminar flow air temp DEG F	58.63	58.64	58.47	58.44	58.31	58.08	58.08	57.84
Laminar flow diff pressure in. of H2O	4.36	3.83	3.36	2.75	2.63	2.32	2.06	0.91
Laminar Flow cfm	221.96	195.46	171.96	140.82	135.11	119.43	105.71	47.09
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	66.50	66.51	66.30	66.05	66.79	67.51	67.50	69.00
Boost/Air in Manifold (degF)	300.98	241.77	190.52	127.88	218.96	172.95	136.94	86.01
Altitude Barrel Pressure (inHg)	28.84	28.84	28.84	28.84	28.84	28.84	28.85	28.85
Altitude (ft)	1014.29	1008.21	1007.87	1015.16	1013.31	1011.04	1005.95	1006.31
Intake AIR Consumption lbs/hr	974.33	857.86	755.34	618.64	593.79	525.38	464.99	207.33
LAB FACTOR-NA	1.016	1.017	1.016	1.016	1.017	1.018	1.018	1.019
LAB FACTOR-TURBO	0.991	0.992	0.991	0.990	0.993	0.995	0.994	0.998
Intake Air Temperature DEG F	66.50	66.51	66.30	66.05	66.79	67.51	67.50	69.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	300.98	241.77	190.52	127.88	218.96	172.95	136.94	86.01
Boost air Pressure (@manifold) psi	20.74	14.71	9.64	3.73	12.29	7.87	4.71	0.19
FUEL Temperature DEG F	91.26	92.47	91.35	91.86	90.95	90.51	89.43	84.52
FUEL Cunsumption lbs/hr	37.47	27.56	19.81	8.06	28.46	20.56	14.30	1.84
DEW Point DEG F	50.00	49.98	49.58	49.45	49.33	49.10	49.20	48.90
Grains Water (H2O) per lb dry air	54.86	54.90	54.04	53.80	53.57	53.09	53.26	52.65
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	904.52	762.52	627.40	382.95	942.07	805.25	631.22	258.34
FINAL EXHAUST TEMP	842.13	719.25	596.85	385.06	816.50	721.85	585.06	277.85
Coolant Temperature IN DEG F	163.90	160.00	161.00	162.01	158.26	158.29	160.00	158.88
Coolant Temperature OUT DEG F	176.00	170.00	168.94	167.00	171.50	169.00	167.99	162.68
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.50	12.87	10.43	7.70	7.44	6.17	5.31	1.90
Exhaust Restriction (mmHg)	12.95	9.94	6.81	3.62	6.63	5.56	3.77	0.29
Exhaust Restriction (inH2O)	6.93	5.32	3.65	1.94	3.55	2.98	2.02	0.15
EXHAUST FLOW LB/HR	1011.80	885.41	775.15	626.70	622.25	545.94	479.29	209.17
FUEL /AIR RATIO	0.04	0.03	0.03	0.01	0.05	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.90	0.92	0.93	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.63	6.38	5.20	2.70	9.56	7.99	6.20	1.90
CO PPM DRY	0.00	0.00	0.00	4.50	0.00	0.00	0.00	75.43
NOX PPM DRY	626.96	456.72	353.00	128.66	935.18	750.94	556.03	215.65
NO PPM DRY	532.54	387.07	312.07	127.31	787.80	581.06	473.26	213.86
NO2 PPM DRY	94.41	69.65	40.93	1.35	147.38	169.88	82.77	1.79
%O2								
NO WET	487.82	359.15	293.06	122.70	707.89	531.74	440.50	207.82
NO2 WET	86.48	64.63	38.43	1.30	132.44	155.47	77.03	1.74
CO2 WET	6.98	5.92	4.88	2.60	8.59	7.31	5.77	1.85
CO WET	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0073
G	0.0008	0.0016	0.0023	0.0038	-0.0003	0.0008	0.0017	0.0043
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0021	-0.0024	-0.0034
HUM&TEM CORR FACTOR	1.0336	1.0315	1.0313	1.0269	1.0389	1.0383	1.0367	1.0421
NO CORR	471.95	348.19	284.15	119.49	681.35	512.11	424.91	199.43
NO2 CORR	83.65	62.64	37.26	1.27	127.49	149.74	74.30	1.67
GAS EMISSIONS								
NO GR/HR	224.45	144.90	103.62	35.20	199.28	131.39	95.71	19.61
NO2 GR/HR	60.89	39.93	20.78	0.57	57.17	58.90	25.65	0.25
CO2 GR/HR	48692.86	36084.91	26084.04	11236.53	36815.50	27501.26	19056.74	2661.05
CO GR/HR	0.00	0.00	0.00	1.19	0.00	0.00	0.00	6.72
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4163	2688	1920	653	3697	2437	1775	364
NO2 CFM 5 ppm	3684	2415	1257	34	3458	3563	1552	15
CO2 CFM 5000 ppm	3068	2273	1643	708	2319	1733	1201	168
CO CFM 50 ppm	0	0	0	12	0	0	0	67
NOX ppm - wet EURO, EPA, ISO	574.3	423.8	331.6	124.0	840.3	687.2	517.5	209.6
NOX ppm(corr) EURO,EPA,ISO	555.6	410.8	321.4	120.8	808.8	661.9	499.2	201.1
NOX GR/HR EURO, EPA, ISO	404.7	261.9	179.4	54.5	362.5	260.2	172.3	30.3
NOX cfm EURO, EPA, ISO	4896.6	3168.6	2170.1	659.2	4385.2	3147.8	2084.2	366.4

PARTICULATE EMISSIONS

Modal Particulate emission (gr/hr)

weight factor

Weighted Particulate (gr/hr)

Weighted HP

Weighted Average HP

Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 9/9/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-5 biodelsel, Engine with ECS DOC, gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.7	2499.5	2499.7	2499.1	1800.2	1800.0	1800.1	990.6
TORQUE lbft	176.4	129.9	89.9	19.9	207.5	155.0	105.1	9.8
HORSEPOWER	84.0	61.8	42.8	9.5	71.1	53.1	36.0	1.8
Barometric Pressure INHG	28.72	28.72	28.73	28.73	28.73	28.73	28.73	28.73
Laminar flow air temp DEG F	59.25	59.37	59.10	59.00	58.81	58.58	58.53	58.21
Laminar flow diff pressure in. of H2O	4.40	3.84	3.39	2.78	2.68	2.35	2.08	0.90
Laminar Flow cfm	224.26	196.01	173.48	142.58	137.55	120.88	106.90	46.36
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	67.00	67.02	67.00	66.69	67.50	68.00	68.00	69.00
Boost/Air In Manifold (degF)	302.44	242.81	191.45	128.44	219.53	173.33	137.38	85.52
Altitude Barrel Pressure (inHg)	28.82	28.83	28.84	28.83	28.84	28.84	28.85	28.85
Altitude (ft)	1031	1017	1013	1019	1013	1011	1005	1003
Intake AIR Consumption lbs/hr	982.28	857.99	760.49	625.33	603.65	531.03	469.66	203.89
LAB FACTOR-NA	1.018	1.018	1.017	1.016	1.018	1.018	1.018	1.019
LAB FACTOR-TURBO	0.993	0.994	0.993	0.991	0.994	0.996	0.995	0.998
Intake Air Temperature DEG F	67.00	67.02	67.00	66.69	67.50	68.00	68.00	69.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	302.44	242.81	191.45	128.44	219.53	173.33	137.38	85.52
Boost air Pressure (@manifold) psi	20.77	14.67	9.61	3.74	12.28	7.84	4.69	0.18
FUEL Temperature DEG F	90.53	92.47	90.72	91.77	90.88	90.05	88.86	91.55
FUEL Cunsumption lbs/hr	37.65	27.54	19.72	8.03	28.44	20.56	14.75	1.99
DEW Point DEG F	50.60	50.77	49.97	49.80	49.61	49.30	49.40	49.00
Grains Water (H2O) per lb dry air	56.09	56.49	54.85	54.50	54.14	53.49	53.66	52.87
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	908.94	764.30	628.53	382.83	944.52	806.31	631.80	253.56
FINAL EXHAUST TEMP	847.50	721.52	596.84	384.31	819.58	722.52	584.86	270.05
Coolant Temperature IN DEG F	163.79688	160	161	162	158.51563	158	160	158
Coolant Temperature OUT DEG F	176	170	168.875	167	172	169	167.98438	162
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.51	12.86	10.45	7.70	7.46	6.18	5.31	1.90
Exhaust Restriction (mmHg)	13.58	10.53	7.02	3.38	6.88	5.57	3.58	0.00
Exhaust Restriction (inH2O)	7.27	5.63	3.76	1.81	3.68	2.98	1.91	0.00
EXHAUST FLOW LB/HR	1019.92	885.53	780.21	633.36	632.09	551.59	484.41	205.88
FUEL /AIR RATIO	0.0383	0.0321	0.0259	0.0128	0.0471	0.0387	0.0314	0.0098
J CONVER	0.9160	0.9275	0.9394	0.9640	0.9000	0.9158	0.9295	0.9701
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.7	6.4	5.2	2.7	9.6	8.0	6.2	1.9
CO PPM DRY	0.0	0.0	0.0	5.0	0.0	0.0	0.0	75.9
NOX PPM DRY	620.9	448.2	346.9	128.5	944.7	756.5	556.3	216.9
NO PPM DRY	635.6	385.5	310.1	128.4	789.9	575.4	469.8	214.5
NO2 PPM DRY	85.3	62.7	36.8	0.1	154.8	181.0	86.4	2.4
%O2								
NO WET	490.5888	357.6069	291.3208	123.7719	710.9019	526.9843	436.7014	208.0920
NO2 WET	78.1113	58.1306	34.5685	0.0934	139.3432	165.8048	80.3530	2.3283
CO2 WET	7.0073	5.9362	4.8866	2.6028	8.6399	7.3266	5.7627	1.8432
CO WET	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000	0.0000	0.0074
G	0.0009	0.0016	0.0023	0.0038	-0.0002	0.0008	0.0017	0.0042
R	-0.0021	-0.0024	-0.0027	-0.0032	-0.0017	-0.0021	-0.0024	-0.0034
HUM&TEM CORR FACTOR	1.0314	1.0284	1.0307	1.0270	1.0376	1.0378	1.0367	1.0413
NO CORR	475.8415	347.7158	282.6573	120.5152	685.1411	507.7829	421.2411	199.8479
NO2 CORR	75.7314	56.5228	33.5405	0.0909	134.2938	159.7635	77.5083	2.2361
GAS EMISSIONS								
NO GR/HR	228.01	144.72	103.65	35.87	203.54	131.64	95.90	19.34
NO2 GR/HR	55.61	36.04	18.84	0.04	61.12	63.45	27.03	0.33
CO2 GR/HR	49242.53	36218.81	26268.56	11358.22	37627.67	27844.48	19233.50	2614.62
CO GR/HR	0.00	0.00	0.00	1.34	0.00	0.00	0.00	6.64
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4229	2685	1923	665	3776	2442	1779	359
NO2 CFM 5 ppm	3364	2180	1140	3	3697	3838	1635	20
CO2 CFM 5000 ppm	3102	2282	1655	716	2371	1754	1212	165
CO CFM 50 ppm	0	0	0	13	0	0	0	66
NOX ppm - wet EURO, EPA, ISO	568.70	415.74	325.89	123.87	850.25	692.79	517.05	210.42
NOX ppm(corr) EURO,EPA,ISO	551.37	404.24	316.20	120.61	819.43	667.55	498.75	202.08
NOX GR/HR EURO, EPA, ISO	404.90	257.73	177.63	55.00	372.93	265.11	173.95	29.96
NOX cfm EURO, EPA, ISO	4899	3118	2149	665	4512	3207	2105	362
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	8.22	7.64	5.07	3.34	6.70	3.48	2.11	0.19
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.23	1.15	0.76	0.33	0.67	0.35	0.21	0.03
Weighted HP	12.596	9.273	6.417	0.945	7.113	5.313	3.601	0.276
Weighted Average HP	45.533 HP							
Weighted Average PARTICULATE	4.733 GR/HR							
	0.104 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	2785.329							

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 9/9/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-5 biodeisel, Engine with ECS DOC, EC/OC sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2500.3	2501.2	2499.5	2497.2	1799.9	1799.8	1799.7	990.6
TORQUE lbft	176.2	130.1	89.8	19.7	207.3	154.9	105.0	9.8
HORSEPOWER	83.9	62.0	42.8	9.4	71.1	53.1	36.0	1.8
Barometric Pressure INHG	28.72	28.72	28.72	28.72	28.71	28.72	28.72	28.72
Laminar flow air temp DEG F	58.01	57.91	57.83	57.87	57.81	57.57	57.63	57.47
Laminar flow diff pressure in. of H2O	4.31	3.82	3.33	2.71	2.59	2.30	2.03	0.93
Laminar Flow cfm	219.67	194.91	170.45	139.06	132.68	117.98	104.52	47.82
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	66.00	66.00	65.61	65.41	66.08	67.02	67.00	69.00
Boost/Air In Manifold (degF)	299.52	240.72	189.59	127.33	218.39	172.56	136.50	86.50
Altitude Barrel Pressure (inHg)	28.85	28.85	28.85	28.84	28.84	28.84	28.85	28.84
Altitude (ft)	998	1000	1003	1011	1014	1011	1006	1010
Intake AIR Consumption lbs/hr	966.37	857.73	750.19	611.95	583.93	519.73	460.32	210.77
LAB FACTOR-NA	1.015	1.015	1.015	1.015	1.016	1.017	1.017	1.019
LAB FACTOR-TURBO	0.989	0.990	0.989	0.989	0.991	0.994	0.994	0.998
Intake Air Temperature DEG F	66.00	66.00	65.61	65.41	66.08	67.02	67.00	69.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	299.52	240.72	189.59	127.33	218.39	172.56	136.50	86.50
Boost air Pressure (@manifold) psi	20.72	14.75	9.67	3.71	12.31	7.90	4.73	0.19
FUEL Temperature DEG F	91.98	92.47	91.98	91.95	91.02	90.97	90.00	77.50
FUEL Cunsumption lbs/hr	37.29	27.57	19.89	8.09	28.48	20.56	13.86	1.70
DEW Point DEG F	49.40	49.20	49.19	49.10	49.05	48.90	49.00	48.80
Grains Water (H2O) per lb dry air	53.63	53.31	53.22	53.11	53.00	52.69	52.87	52.43
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	900.11	760.73	626.27	383.06	939.63	804.19	630.64	263.13
FINAL EXHAUST TEMP	836.75	716.98	596.86	385.81	813.42	721.19	585.27	285.66
Coolant Temperature IN DEG F	164	160	161	162.01563	158	158.57813	160	159.76563
Coolant Temperature OUT DEG F	176	170	169	167	171	169	168	163.35938
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.50	12.87	10.42	7.70	7.43	6.16	5.32	1.90
Exhaust Restriction (mmHg)	12.32	9.36	6.60	3.85	6.38	5.55	3.97	0.57
Exhaust Restriction (inH2O)	6.59	5.01	3.53	2.06	3.42	2.97	2.12	0.31
EXHAUST FLOW LB/HR	1003.67	885.30	770.08	620.04	612.41	540.28	474.18	212.47
FUEL /AIR RATIO	0.0386	0.0321	0.0265	0.0132	0.0488	0.0396	0.0301	0.0081
J CONVER	0.9160	0.9282	0.9387	0.9636	0.8971	0.9144	0.9321	0.9734
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.6	6.4	5.2	2.7	9.5	8.0	6.2	1.9
CO PPM DRY	0.0	0.0	0.0	4.0	0.0	0.0	0.0	75.0
NOX PPM DRY	633.1	465.2	359.1	128.8	925.6	745.4	555.8	214.4
NO PPM DRY	529.5	388.6	314.0	126.2	785.7	586.7	476.7	213.2
NO2 PPM DRY	103.6	76.6	45.1	2.6	139.9	158.7	79.1	1.2
%O2								
NO WET	485.0432	360.6846	294.7960	121.6314	704.8723	536.4990	444.3016	207.5406
NO2 WET	94.8582	71.1212	42.3006	2.5144	125.5436	145.1424	73.7095	1.1559
CO2 WET	6.9619	5.8939	4.8813	2.6017	8.5327	7.2956	5.7769	1.8495
CO WET	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0073
G	0.0008	0.0016	0.0022	0.0038	-0.0004	0.0007	0.0018	0.0044
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0021	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0359	1.0345	1.0320	1.0268	1.0403	1.0388	1.0367	1.0429
NO CORR	468.2548	348.6661	285.6517	118.4577	677.5681	516.4435	428.5715	199.0115
NO2 CORR	91.5750	68.7513	40.9885	2.4488	120.6805	139.7166	71.0999	1.1084
GAS EMISSIONS								
NO GR/HR	220.89	145.08	103.39	34.52	195.03	131.14	95.51	19.87
NO2 GR/HR	66.18	43.82	22.73	1.09	53.21	54.35	24.27	0.17
CO2 GR/HR	48143.19	35951.02	25899.52	11114.85	36003.34	27158.04	18879.97	2707.48
CO GR/HR	0.00	0.00	0.00	1.05	0.00	0.00	0.00	6.79
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4097	2691	1918	640	3618	2433	1772	369
NO2 CFM 5 ppm	4003	2651	1375	66	3219	3288	1468	10
CO2 CFM 5000 ppm	3033	2265	1632	700	2268	1711	1189	171
CO CFM 50 ppm	0	0	0	10	0	0	0	68
NOX ppm - wet EURO, EPA, ISO	579.90	431.81	337.10	124.15	830.42	681.64	518.01	208.70
NOX ppm(corr) EURO,EPA,ISO	559.83	417.42	326.64	120.91	798.25	656.16	499.67	200.12
NOX GR/HR EURO, EPA, ISO	404.56	266.07	181.11	53.98	351.97	255.25	170.59	30.61
NOX cfm EURO, EPA, ISO	4895	3219	2191	653	4258	3088	2064	370

DPM EC/OC DATA

EC	TWA (ug/m3)	10428	11594	7550	4770	18110	8876	6223	---
OC	TWA (ug/m3)	6333	7799	8021	7614	6255	6017	6140	3603
TC	TWA (ug/m3)	16762	19392	15571	12384	24365	14892	12363	4179

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: IRE REG-9000-5 biodiesel
Engine: Isuzu 4JG1T
DOC: NONE

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.3	2499.5	2499.3	2498.8	1800.0	1800.1	1800.1	990.7
TORQUE lbft	176.48	132.46	89.80	19.76	206.88	154.98	104.98	9.75
HORSEPOWER	83.98	63.04	42.73	9.40	70.90	53.12	35.98	1.84
Barometric Pressure INHG	28.89	28.89	28.90	28.89	28.90	28.89	28.89	28.89
Laminar flow air temp DEG F	59.72	59.98	59.77	60.85	60.19	60.00	59.84	60.68
Laminar flow diff pressure in. of H2O	4.40	3.94	3.44	2.76	2.71	2.37	2.12	0.96
Laminar Flow cfm	224.10	200.84	175.85	141.76	138.74	121.53	108.87	49.84
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.74	69.14	69.50	69.50	70.75	72.50	72.50	75.00
Boost/Air in Manifold (degF)	305.29	250.28	195.09	131.66	225.03	179.33	141.84	93.62
Altitude Barrel Pressure (inHg)	28.81	28.81	28.81	28.80	28.80	28.80	28.80	28.79
Altitude (ft)	1036.21	1043.85	1042.61	1044.97	1045.52	1048.76	1052.73	1054.42
Intake AIR Consumption lbs/hr	987.94	884.59	775.32	622.83	610.91	535.37	479.86	219.11
LAB FACTOR-NA	1.012	1.013	1.013	1.013	1.014	1.017	1.017	1.020
LAB FACTOR-TURBO	0.992	0.994	0.995	0.995	0.998	1.003	1.003	1.010
Intake Air Temperature DEG F	68.74	69.14	69.50	69.50	70.75	72.50	72.50	75.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	305.29	250.28	195.09	131.66	225.03	179.33	141.84	93.62
Boost air Pressure (@manifold) psi	21.02	15.37	9.81	3.85	12.50	8.02	4.70	0.20
FUEL Temperature DEG F	93.97	94.48	95.18	95.03	93.98	93.52	93.46	90.88
FUEL Cunsumption lbs/hr	37.22	28.03	19.62	8.12	28.10	20.54	14.19	1.84
DEW Point DEG F	46.39	46.51	46.26	46.31	45.83	46.09	45.81	45.91
Grains Water (H2O) per lb dry air	47.62	47.85	47.38	47.48	46.65	47.08	46.60	46.77
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	898.31	765.78	628.79	385.07	939.79	807.38	636.96	287.23
FINAL EXHAUST TEMP	838.64	724.66	599.43	384.69	829.49	735.95	595.16	303.35
Coolant Temperature IN DEG F	162.33	160.25	162.00	163.50	159.12	158.26	161.24	162.00
Coolant Temperature OUT DEG F	175.00	170.27	170.00	168.01	172.00	169.23	169.00	166.00
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.64	13.15	10.58	7.78	7.56	6.28	5.39	2.02
Exhaust Restriction (mmHg)	8.80	9.45	8.85	7.07	7.70	7.33	7.76	5.43
Exhaust Restriction (inH2O)	4.71	5.06	4.74	3.79	4.12	3.92	4.15	2.90
EXHAUST FLOW LB/HR	1025.16	912.62	794.94	630.95	639.00	555.91	494.05	220.95
FUEL /AIR RATIO	0.04	0.03	0.03	0.01	0.05	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.97	0.90	0.92	0.93	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.61	6.38	5.20	2.70	9.50	7.98	6.20	1.90
CO PPM DRY	106.58	86.71	60.82	120.79	79.29	50.14	60.20	116.44
NOX PPM DRY	681.72	510.57	379.71	127.79	1029.51	878.76	614.97	214.62
NO PPM DRY	649.54	486.31	356.78	113.15	1003.98	841.01	584.42	188.54
NO2 PPM DRY	32.18	24.26	22.92	14.64	25.53	37.75	30.55	26.08
%O2								
NO WET	596.97	452.36	336.18	109.21	907.33	771.97	546.11	183.63
NO2 WET	29.58	22.57	21.60	14.13	23.08	34.65	28.55	25.40
CO2 WET	6.99	5.93	4.90	2.61	8.59	7.32	5.79	1.85
CO WET	0.0098	0.0081	0.0057	0.0117	0.0072	0.0046	0.0056	0.0113
G	0.0009	0.0016	0.0024	0.0038	0.0000	0.0009	0.0019	0.0043
R	-0.0021	-0.0024	-0.0027	-0.0032	-0.0018	-0.0021	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0511	1.0526	1.0564	1.0604	1.0506	1.0551	1.0625	1.0882
NO CORR	567.97	429.76	318.21	102.99	863.64	731.64	513.96	168.76
NO2 CORR	28.14	21.43	20.45	13.32	21.95	32.84	26.86	23.34
GAS EMISSIONS								
NO GR/HR	273.66	184.34	118.89	30.54	259.38	191.16	119.34	17.52
NO2 GR/HR	20.78	14.09	11.70	6.06	10.09	13.14	9.55	3.71
CO2 GR/HR	49406.47	37287.40	26836.36	11328.75	37799.52	28038.41	19721.28	2817.31
CO GR/HR	43.97	32.24	19.95	32.22	20.05	11.20	12.17	10.98
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	5076	3419	2205	566	4811	3546	2214	325
NO2 CFM 5 ppm	1257	852	708	366	611	795	578	225
CO2 CFM 5000 ppm	3113	2349	1691	714	2381	1766	1242	177
CO CFM 50 ppm	437	320	198	320	199	111	121	109
NOX ppm - wet EURO, EPA, ISO	626.6	474.9	357.8	123.3	930.4	806.6	574.7	209.0
NOX ppm(corr) EURO,EPA,ISO	596.1	451.2	338.7	116.3	885.6	764.5	540.8	192.1
NOX GR/HR EURO, EPA, ISO	440.0	296.5	193.8	52.8	407.4	306.0	192.4	30.6
NOX cfm EURO, EPA, ISO	5323.4	3586.9	2345.1	639.2	4929.4	3701.9	2327.5	369.7

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 9/10/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-5 biodelsel, Engine Only, Gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.0	2499.2	2499.2	2499.3	1800.0	1800.3	1800.3	991.3
TORQUE lbft	178.1	135.2	89.5	19.9	207.1	155.0	105.0	9.7
HORSEPOWER	84.7	64.3	42.6	9.5	71.0	53.1	36.0	1.8
Barometric Pressure INHG	28.90	28.90	28.91	28.90	28.90	28.90	28.90	28.89
Laminar flow air temp DEG F	59.50	59.41	59.42	61.29	60.70	59.52	59.94	60.25
Laminar flow diff pressure in. of H2O	4.37	3.92	3.44	2.74	2.71	2.37	2.12	0.96
Laminar Flow cfm	222.41	200.17	175.82	140.37	139.07	121.55	109.04	49.72
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.00	68.28	69.00	69.00	70.50	72.00	72.00	75.00
Boost/Air In Manifold (degF)	306.42	253.08	194.25	131.02	225.13	178.50	141.02	93.70
Altitude Barrel Pressure (inHg)	28.83	28.82	28.82	28.81	28.81	28.81	28.80	28.80
Altitude (ft)	1023	1029	1033	1038	1038	1044	1048	1054
Intake AIR Consumption lbs/hr	980.99	883.25	776.01	615.92	611.47	536.33	480.46	218.85
LAB FACTOR-NA	1.011	1.012	1.012	1.012	1.014	1.016	1.016	1.020
LAB FACTOR-TURBO	0.991	0.992	0.993	0.994	0.998	1.001	1.002	1.010
Intake Air Temperature DEG F	68.00	68.28	69.00	69.00	70.50	72.00	72.00	75.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	306.42	253.08	194.25	131.02	225.13	178.50	141.02	93.70
Boost air Pressure (@manifold) psi	21.25	15.78	9.82	3.85	12.53	8.02	4.70	0.20
FUEL Temperature DEG F	93.84	93.98	94.47	94.50	93.91	93.05	93.00	90.77
FUEL Cunsumption lbs/hr	37.48	28.61	19.45	8.32	28.19	20.45	14.02	1.67
DEW Point DEG F	47.05	46.72	46.82	46.42	46.22	45.95	46.06	46.19
Grains Water (H2O) per lb dry air	48.82	48.20	48.37	47.69	47.32	46.85	47.03	47.25
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	903.55	770.89	626.17	382.30	940.78	803.53	631.98	288.53
FINAL EXHAUST TEMP	846.06	729.66	597.30	381.17	832.63	733.19	590.98	305.16
Coolant Temperature IN DEG F	162	160	162	163	158.5	158.546875	161.5	162
Coolant Temperature OUT DEG F	175	170	170	168	171.5	169.515625	169	166
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.73	13.31	10.56	7.77	7.54	6.25	5.37	2.00
Exhaust Restriction (mmHg)	8.59	9.95	9.35	7.45	8.40	7.57	7.83	5.70
Exhaust Restriction (inH2O)	4.60	5.33	5.01	3.99	4.50	4.05	4.19	3.05
EXHAUST FLOW LB/HR	1018.47	911.85	795.46	624.24	639.67	556.78	494.48	220.51
FUEL /AIR RATIO	0.0382	0.0324	0.0251	0.0135	0.0461	0.0381	0.0292	0.0076
J CONVER	0.9178	0.9288	0.9425	0.9643	0.9034	0.9184	0.9351	0.9754
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.6	6.5	5.2	2.7	9.5	8.0	6.2	1.9
CO PPM DRY	109.0	88.5	61.0	118.7	75.1	49.5	60.0	114.1
NOX PPM DRY	681.2	514.1	374.5	127.9	1012.9	871.3	607.3	213.5
NO PPM DRY	650.2	493.6	361.7	114.1	1000.6	833.7	580.3	187.6
NO2 PPM DRY	31.0	20.5	22.8	13.9	12.4	37.5	27.0	25.8
%O2	596.7524	458.4975	331.4527	109.9729	903.8749	765.7064	542.6170	183.0077
NO WET	28.4665	19.0004	21.4709	13.3850	11.1650	34.4655	25.2733	25.2008
NO2 WET	7.0198	5.9910	4.9009	2.6035	8.5820	7.3012	5.7975	1.8532
CO2 WET	0.0100	0.0082	0.0058	0.0114	0.0068	0.0045	0.0056	0.0111
CO WET	0.0009	0.0015	0.0024	0.0037	0.0000	0.0009	0.0019	0.0044
G	-0.0021	-0.0024	-0.0027	-0.0032	-0.0018	-0.0021	-0.0025	-0.0035
R	1.0477	1.0502	1.0527	1.0577	1.0493	1.0554	1.0608	1.0873
HUM&TEM CORR FACTOR	569.6026	436.5805	314.8672	103.9751	861.3772	725.5382	511.5158	168.3141
NO CORR	27.1714	18.0922	20.3965	12.6550	10.6401	32.6575	23.8247	23.1775
NO2 CORR								
GAS EMISSIONS								
NO GR/HR	272.66	187.11	117.72	30.51	258.97	189.86	118.88	17.44
NO2 GR/HR	19.92	11.88	11.68	5.69	4.90	13.09	8.48	3.68
CO2 GR/HR	49259.76	37639.30	26860.55	11197.65	37823.34	28009.23	19751.72	2815.61
CO GR/HR	44.62	32.82	20.04	31.30	19.00	11.08	12.15	10.75
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	5058	3471	2184	566	4804	3522	2205	324
NO2 CFM 5 ppm	1205	719	707	344	296	792	513	223
CO2 CFM 5000 ppm	3103	2371	1692	705	2383	1765	1244	177
CO CFM 50 ppm	443	326	199	311	189	110	121	107
NOX ppm - wet EURO, EPA, ISO	625.22	477.50	352.92	123.36	915.04	800.17	567.89	208.21
NOX ppm(corr) EURO,EPA,ISO	596.77	454.67	335.26	116.63	872.02	758.20	535.34	191.49
NOX GR/HR EURO, EPA, ISO	437.61	298.51	192.02	52.42	401.62	303.95	190.59	30.40
NOX cfm EURO, EPA, ISO	5294	3612	2323	634	4859	3677	2306	368
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	10.73	13.05	10.15	7.82	7.88	6.91	6.44	1.45
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.61	1.96	1.52	0.78	0.79	0.69	0.64	0.22
Weighted HP	12.709	9.649	6.392	0.947	7.096	5.313	3.599	0.276
Weighted Average HP	45.982 HP							
Weighted Average PARTICULATE	8.212 GR/HR							
	0.179 (GR/HP-HR)							
PARTICULATE INDEX (PI) CFM	4832.521							

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 9/10/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-5 biodeisel, Engine Only, EC/OC sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.6	2499.9	2499.5	2498.4	1799.9	1799.9	1799.9	990.1
TORQUE lbft	174.9	129.7	90.1	19.6	206.7	155.0	104.9	9.8
HORSEPOWER	83.2	61.8	42.9	9.3	70.8	53.1	36.0	1.8
Barometric Pressure INHG	28.89	28.89	28.89	28.89	28.89	28.89	28.89	28.89
Laminar flow air temp DEG F	59.94	60.56	60.11	60.40	59.69	60.48	59.74	61.11
Laminar flow diff pressure in. of H2O	4.44	3.95	3.44	2.79	2.70	2.37	2.11	0.97
Laminar Flow cfm	225.79	201.51	175.89	143.14	138.40	121.51	108.70	49.96
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	69.48	70.00	70.00	70.00	71.00	73.00	73.00	75.00
Boost/Air In Manifold (degF)	304.16	247.48	195.92	132.30	224.94	180.16	142.67	93.53
Altitude Barrel Pressure (inHg)	28.80	28.79	28.80	28.80	28.80	28.80	28.79	28.79
Altitude (ft)	1050	1059	1052	1052	1053	1054	1057	1055
Intake AIR Consumption lbs/hr	994.90	885.93	774.63	629.73	610.34	534.41	479.26	219.38
LAB FACTOR-NA	1.013	1.014	1.014	1.014	1.014	1.017	1.017	1.020
LAB FACTOR-TURBO	0.994	0.996	0.997	0.996	0.998	1.004	1.004	1.010
Intake Air Temperature DEG F	69.48	70.00	70.00	70.00	71.00	73.00	73.00	75.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.16	247.48	195.92	132.30	224.94	180.16	142.67	93.53
Boost air Pressure (@manifold) psi	20.78	14.96	9.79	3.85	12.47	8.02	4.71	0.20
FUEL Temperature DEG F	94.09	94.98	95.89	95.56	94.06	93.98	93.92	91.00
FUEL Cunsumption lbs/hr	36.96	27.45	19.79	7.92	28.00	20.62	14.36	2.01
DEW Point DEG F	45.73	46.30	45.70	46.20	45.45	46.22	45.56	45.64
Grains Water (H2O) per lb dry air	46.41	47.50	46.39	47.27	45.97	47.32	46.17	46.29
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	893.08	760.67	631.41	387.84	938.80	811.22	641.94	285.92
FINAL EXHAUST TEMP	831.22	719.67	601.56	388.20	826.36	738.70	599.34	301.55
Coolant Temperature IN DEG F	162.65625	160.5	162	164	159.73438	157.96875	160.98438	162
Coolant Temperature OUT DEG F	175	170.53125	170	168.01563	172.5	168.9375	169	166
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.56	12.99	10.60	7.79	7.58	6.30	5.40	2.04
Exhaust Restriction (mmHg)	9.01	8.96	8.35	6.70	7.00	7.08	7.69	5.15
Exhaust Restriction (inH2O)	4.83	4.80	4.47	3.59	3.75	3.79	4.12	2.76
EXHAUST FLOW LB/HR	1031.85	913.38	794.41	637.65	638.34	555.03	493.62	221.39
FUEL /AIR RATIO	0.0371	0.0310	0.0255	0.0126	0.0459	0.0386	0.0300	0.0092
J CONVER	0.9203	0.9316	0.9420	0.9661	0.9041	0.9174	0.9338	0.9727
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.6	6.3	5.2	2.7	9.5	8.0	6.2	1.9
CO PPM DRY	104.2	84.9	60.6	122.9	83.5	50.8	60.4	118.8
NOX PPM DRY	682.2	507.1	385.0	127.6	1046.1	886.2	622.6	215.8
NO PPM DRY	648.9	479.0	361.9	112.3	1007.4	848.3	588.6	189.4
NO2 PPM DRY	33.4	28.1	23.1	15.4	38.7	38.0	34.1	26.3
%O2								
NO WET	597.1863	446.2317	340.9075	108.4420	910.7923	778.2416	549.6006	184.2615
NO2 WET	30.6958	26.1402	21.7284	14.8715	34.9861	34.8311	31.8170	25.6053
CO2 WET	6.9700	5.8691	4.8985	2.6084	8.5890	7.3395	5.7897	1.8461
CO WET	0.0096	0.0079	0.0057	0.0119	0.0075	0.0047	0.0056	0.0116
G	0.0010	0.0017	0.0023	0.0038	0.0000	0.0008	0.0018	0.0042
R	-0.0022	-0.0024	-0.0027	-0.0032	-0.0018	-0.0021	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0545	1.0551	1.0602	1.0631	1.0518	1.0549	1.0643	1.0890
NO CORR	566.3455	422.9432	321.5480	102.0027	865.8990	737.7375	516.4138	169.1973
NO2 CORR	29.1104	24.7759	20.4945	13.9885	33.2617	33.0183	29.8958	23.5120
GAS EMISSIONS								
NO GR/HR	274.66	181.57	120.06	30.57	259.79	192.45	119.81	17.61
NO2 GR/HR	21.63	16.29	11.72	6.42	15.29	13.19	10.63	3.75
CO2 GR/HR	49553.18	36935.49	26812.16	11459.85	37775.69	28067.60	19690.84	2819.00
CO GR/HR	43.33	31.66	19.87	33.15	21.10	11.33	12.20	11.21
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	5095	3368	2227	567	4819	3570	2222	327
NO2 CFM 5 ppm	1308	986	709	388	925	798	643	227
CO2 CFM 5000 ppm	3122	2327	1689	722	2380	1768	1241	178
CO CFM 50 ppm	431	315	197	329	210	113	121	111
NOX ppm - wet EURO, EPA, ISO	627.88	472.37	362.64	123.31	945.78	813.07	581.42	209.87
NOX ppm(corr) EURO,EPA,ISO	595.46	447.72	342.04	115.99	899.16	770.76	546.31	192.71
NOX GR/HR EURO, EPA, ISO	442.38	294.44	195.64	53.25	413.26	308.01	194.16	30.72
NOX cfm EURO, EPA, ISO	5352	3562	2367	644	5000	3727	2349	372

DPM EC/OC DATA

EC	TWA (ug/m3)	10012	11820	6667	4619	14017	6727	5055	---
OC	TWA (ug/m3)	17185	23246	19896	19683	14530	18524	20301	13352
TC	TWA (ug/m3)	27204	35066	26563	24302	28546	25259	25355	13866

Fuel Test Data on Isuzu 4JT1T Engine

Fuel:	IRE REG-9000-10 biodiesel
Engine:	Isuzu 4JG1T
DOC:	ECS Purifier A16-0119

PART 7, SUBPART E, CATEGORY B

COMPANY NAME	Isuzu
DATE	
ENGINE MODEL	Isuzu 4JG1T
COMMENTS:	AVERAGE DATA

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.6	2499.3	2499.4	2497.3	1800.1	1800.0	1800.2	990.5
TORQUE lbft	174.55	129.92	89.94	19.95	202.33	152.39	99.99	9.48
HORSEPOWER	83.07	61.82	42.80	9.48	69.35	52.23	34.27	1.79
Barometric Pressure INHG	28.84	28.83	28.83	28.83	28.83	28.82	28.82	28.82
Laminar flow air temp DEG F	59.77	60.50	59.94	60.07	60.83	60.65	59.96	59.71
Laminar flow diff pressure in. of H2O	4.33	3.82	3.33	2.68	2.55	2.24	2.01	0.87
Laminar Flow cfm	220.49	194.77	170.22	137.63	131.07	115.17	103.24	44.76
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	69.96	70.50	70.52	71.50	72.75	74.00	74.50	77.50
Boost/Air In Manifold (degF)	304.29	246.95	195.47	133.16	221.27	178.67	142.05	95.66
Altitude Barrel Pressure (inHg)	28.76	28.76	28.75	28.75	28.74	28.74	28.73	28.73
Altitude (ft)	1086.72	1089.71	1095.14	1100.77	1104.25	1109.34	1113.29	1117.35
Intake AIR Consumption lbs/hr	969.39	854.22	747.78	604.36	574.02	504.62	453.17	196.63
LAB FACTOR-NA	1.016	1.017	1.018	1.018	1.021	1.022	1.023	1.028
LAB FACTOR-TURBO	0.998	1.000	1.000	1.002	1.006	1.010	1.011	1.021
Intake Air Temperature DEG F	69.96	70.50	70.52	71.50	72.75	74.00	74.50	77.50
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.29	246.95	195.47	133.16	221.27	178.67	142.05	95.66
Boost air Pressure (@manifold) psi	20.49	14.58	9.49	3.61	11.74	7.61	4.35	0.06
FUEL Temperature DEG F	95.00	96.41	96.96	96.71	96.38	93.66	93.04	91.23
FUEL Cunsumption lbs/hr	37.46	27.87	19.89	8.21	28.09	20.70	13.85	1.84
DEW Point DEG F	47.78	47.97	47.90	47.89	48.25	48.10	48.57	48.16
Grains Water (H2O) per lb dry air	50.30	50.66	50.53	50.53	51.21	50.94	51.85	51.05
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	907.16	772.04	634.71	389.59	939.63	811.61	632.44	275.97
FINAL EXHAUST TEMP	840.59	726.26	600.95	391.04	808.70	726.48	590.05	303.26
Coolant Temperature IN DEG F	162.17	159.91	161.00	162.02	158.45	158.44	161.05	161.00
Coolant Temperature OUT DEG F	175.00	170.07	169.00	167.00	171.29	169.27	168.59	164.96
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	16.47	12.90	10.58	7.76	7.44	6.27	5.39	2.09
Exhaust Restriction (mmHg)	18.30	16.22	13.68	10.44	13.23	12.71	11.10	6.47
Exhaust Restriction (inH2O)	9.79	8.68	7.32	5.59	7.08	6.80	5.94	3.46
EXHAUST FLOW LB/HR	1006.86	882.10	767.67	612.57	602.10	525.31	467.03	198.47
FUEL /AIR RATIO	0.04	0.03	0.03	0.01	0.05	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.90	0.91	0.93	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.62	6.40	5.26	2.73	9.55	7.91	5.74	1.80
CO PPM DRY	2.50	0.00	0.00	0.00	0.00	0.00	0.00	25.00
NOX PPM DRY	616.53	450.75	347.77	126.30	890.52	730.80	521.69	212.33
NO PPM DRY	526.49	369.40	304.68	125.49	754.26	557.25	436.77	210.00
NO2 PPM DRY	90.04	81.35	43.09	0.80	136.26	173.55	84.83	2.33
%O2								
NO WET	482.61	342.74	286.13	120.91	676.74	508.27	406.81	203.97
NO2 WET	82.53	75.48	40.47	0.77	122.26	158.28	79.01	2.27
CO2 WET	6.99	5.94	4.94	2.63	8.57	7.22	5.34	1.75
CO WET	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0024
G	0.0008	0.0015	0.0022	0.0037	-0.0004	0.0005	0.0018	0.0042
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0016	-0.0020	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0461	1.0477	1.0500	1.0579	1.0408	1.0464	1.0524	1.0833
NO CORR	461.34	327.14	272.51	114.30	650.24	485.74	386.55	188.29
NO2 CORR	78.90	72.04	38.54	0.73	117.46	151.27	75.07	2.09
GAS EMISSIONS								
NO GR/HR	218.32	135.63	98.32	32.91	184.01	119.93	84.85	17.56
NO2 GR/HR	57.19	45.76	21.30	0.32	50.92	57.24	25.24	0.30
CO2 GR/HR	48483.31	36089.99	26109.38	11106.74	35535.06	26124.89	17192.09	2389.28
CO GR/HR	1.01	0.00	0.00	0.00	0.00	0.00	0.00	2.10
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4050	2516	1824	610	3413	2225	1574	326
NO2 CFM 5 ppm	3460	2768	1288	20	3080	3463	1527	18
CO2 CFM 5000 ppm	3054	2274	1645	700	2239	1646	1083	151
CO CFM 50 ppm	10	0	0	0	0	0	0	21
NOX ppm - wet EURO, EPA, ISO	565.1	418.2	326.6	121.7	799.0	666.6	485.8	206.2
NOX ppm(corr) EURO,EPA,ISO	540.2	399.2	311.0	115.0	767.7	637.0	461.6	190.4
NOX GR/HR EURO, EPA, ISO	391.6	253.5	171.9	50.7	332.8	241.0	155.2	27.2
NOX cfm EURO, EPA, ISO	4738.2	3067.3	2080.0	613.8	4026.6	2915.3	1878.0	329.1

PARTICULATE EMISSIONS

Modal Particulate emission (gr/hr)

weight factor

Weighted Particulate (gr/hr)

Weighted HP

Weighted Average HP

Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 9/8/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-10 biodeisel, Engine with ECS DOC, gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.4	2499.6	2499.6	2498.4	1799.8	1799.8	1800.4	991.2
TORQUE lbft	174.6	129.7	89.9	20.0	203.4	154.9	100.0	9.5
HORSEPOWER	83.1	61.7	42.8	9.5	69.7	53.1	34.3	1.8
Barometric Pressure INHG	28.86	28.86	28.85	28.85	28.84	28.83	28.83	28.83
Laminar flow air temp DEG F	59.56	60.35	60.27	59.26	60.82	60.71	59.20	59.65
Laminar flow diff pressure in. of H2O	4.33	3.80	3.33	2.67	2.55	2.26	1.99	0.86
Laminar Flow cfm	220.37	194.10	170.44	137.01	131.06	115.91	102.51	44.28
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	69.92	70.00	70.00	71.00	72.50	74.00	74.00	77.00
Boost/Air In Manifold (degF)	304.22	245.72	194.45	132.50	222.34	180.50	141.53	94.83
Altitude Barrel Pressure (inHg)	28.79	28.78	28.77	28.76	28.76	28.75	28.75	28.74
Altitude (ft)	1060	1065	1074	1086	1090	1096	1096	1102
Intake AIR Consumption lbs/hr	970.10	852.28	748.54	603.50	574.21	507.97	451.26	194.62
LAB FACTOR-NA	1.015	1.016	1.016	1.017	1.020	1.022	1.022	1.027
LAB FACTOR-TURBO	0.997	0.998	0.998	1.000	1.005	1.009	1.009	1.019
Intake Air Temperature DEG F	69.92	70.00	70.00	71.00	72.50	74.00	74.00	77.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.22	245.72	194.45	132.50	222.34	180.50	141.53	94.83
Boost air Pressure (@manifold) psi	20.52	14.56	9.47	3.62	11.85	7.83	4.36	0.06
FUEL Temperature DEG F	95.27	96.05	96.88	96.70	95.66	92.64	92.08	90.23
FUEL Cunsumption lbs/hr	37.53	27.78	19.94	8.20	28.24	21.12	13.84	1.88
DEW Point DEG F	47.92	48.12	47.89	47.88	48.54	48.25	48.32	48.30
Grains Water (H2O) per lb dry air	50.54	50.92	50.48	50.50	51.74	51.19	51.34	51.33
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	907.25	769.08	631.97	388.92	946.66	819.50	632.31	271.89
FINAL EXHAUST TEMP	841.13	723.00	597.05	390.36	816.45	733.22	590.88	297.06
Coolant Temperature IN DEG F	162	160	161	162.03125	159.89063	157.92188	160.73438	161
Coolant Temperature OUT DEG F	175	170.140625	169	167	172.57813	169	168.17188	164.92188
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.45	12.88	10.58	7.72	7.43	6.30	5.37	2.07
Exhaust Restriction (mmHg)	19.85	17.39	14.63	10.93	13.51	13.08	11.31	6.25
Exhaust Restriction (inH2O)	10.63	9.31	7.83	5.85	7.23	7.00	6.06	3.35
EXHAUST FLOW LB/HR	1007.63	880.06	768.47	611.69	602.45	529.10	465.10	196.50
FUEL /AIR RATIO	0.0387	0.0326	0.0266	0.0136	0.0492	0.0416	0.0307	0.0096
J CONVER	0.9165	0.9278	0.9391	0.9635	0.8967	0.9110	0.9313	0.9707
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.6	6.4	5.3	2.7	9.6	8.1	6.1	1.9
CO PPM DRY	3.0	0.0	0.0	0.0	0.0	0.0	0.0	42.0
NOX PPM DRY	617.3	448.4	342.7	126.8	908.1	741.8	522.8	211.7
NO PPM DRY	529.1	370.6	304.8	126.6	773.1	556.4	432.7	209.7
NO2 PPM DRY	88.2	77.8	37.9	0.2	135.0	185.4	90.1	2.1
%O2								
NO WET	484.9636	343.8451	286.2485	121.9817	693.1680	506.8503	402.9579	203.5268
NO2 WET	80.8220	72.1690	35.5738	0.1716	121.0620	168.9207	83.9433	1.9899
CO2 WET	6.9729	5.9382	4.9375	2.6225	8.6023	7.3789	5.6375	1.8443
CO WET	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0041
G	0.0008	0.0015	0.0022	0.0037	-0.0004	0.0005	0.0017	0.0042
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0016	-0.0020	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0456	1.0463	1.0490	1.0561	1.0399	1.0455	1.0528	1.0799
NO CORR	463.8280	328.6180	272.8829	115.4998	666.5861	484.7989	382.7628	188.4652
NO2 CORR	77.2997	68.9730	33.9128	0.1625	116.4195	161.5715	79.7363	1.8426
GAS EMISSIONS								
NO GR/HR	219.66	135.93	98.56	33.21	188.74	120.56	83.67	17.41
NO2 GR/HR	56.08	43.70	18.76	0.07	50.50	61.55	26.70	0.26
CO2 GR/HR	48409.71	36006.92	26143.20	11052.75	35706.66	26899.59	18065.74	2496.91
CO GR/HR	1.21	0.00	0.00	0.00	0.00	0.00	0.00	3.51
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4075	2521	1828	616	3501	2236	1552	323
NO2 CFM 5 ppm	3392	2644	1135	4	3055	3723	1615	16
CO2 CFM 5000 ppm	3050	2268	1647	696	2250	1695	1138	157
CO CFM 50 ppm	12	0	0	0	0	0	0	35
NOX ppm - wet EURO, EPA, ISO	565.79	416.01	321.82	122.15	814.23	675.77	486.90	205.52
NOX ppm(corr) EURO,EPA,ISO	541.13	397.59	306.80	115.66	783.01	646.37	462.50	190.31
NOX GR/HR EURO, EPA, ISO	392.58	251.93	169.75	50.94	339.64	246.23	154.88	26.92
NOX cfm EURO, EPA, ISO	4750	3048	2054	616	4109	2979	1874	326
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	8.98	8.19	4.95	3.40	5.84	3.65	2.27	0.23
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.35	1.23	0.74	0.34	0.58	0.37	0.23	0.03
Weighted HP	12.463	9.260	6.417	0.950	6.969	5.307	3.429	0.268

Weighted Average HP 45.062 HP

Weighted Average PARTICULATE 4.870 GR/HR

0.108 **(GR/HP-HR)**

PARTICULATE INDEX (PI) CFM 2865.708

COMPANY NAME Isuzu
DATE 9/8/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-10 biodeisel, Engine with ECS DOC, EC/OC sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.7	2499.0	2499.3	2496.2	1800.5	1800.3	1800.0	989.7
TORQUE lbft	174.5	130.1	90.0	19.9	201.3	149.9	100.0	9.5
HORSEPOWER	83.1	61.9	42.8	9.5	69.0	51.4	34.3	1.8
Barometric Pressure INHG	28.82	28.81	28.81	28.81	28.81	28.81	28.81	28.80
Laminar flow air temp DEG F	59.99	60.64	59.60	60.88	60.84	60.59	60.72	59.78
Laminar flow diff pressure in. of H2O	4.33	3.83	3.32	2.70	2.55	2.23	2.02	0.88
Laminar Flow cfm	220.62	195.44	169.99	138.25	131.07	114.42	103.97	45.24
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	70.00	71.00	71.05	72.00	73.00	74.00	75.00	78.00
Boost/Air In Manifold (degF)	304.36	248.19	196.48	133.83	220.19	176.84	142.56	96.50
Altitude Barrel Pressure (inHg)	28.73	28.73	28.73	28.73	28.73	28.72	28.71	28.71
Altitude (ft)	1113	1115	1117	1115	1118	1123	1130	1132
Intake AIR Consumption lbs/hr	968.68	856.17	747.02	605.23	573.82	501.26	455.08	198.64
LAB FACTOR-NA	1.017	1.019	1.019	1.020	1.021	1.023	1.024	1.029
LAB FACTOR-TURBO	0.999	1.002	1.002	1.004	1.007	1.011	1.013	1.022
Intake Air Temperature DEG F	70.00	71.00	71.05	72.00	73.00	74.00	75.00	78.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.36	248.19	196.48	133.83	220.19	176.84	142.56	96.50
Boost air Pressure (@manifold) psi	20.45	14.60	9.50	3.59	11.63	7.39	4.34	0.07
FUEL Temperature DEG F	94.73	96.78	97.05	96.72	97.09	94.69	94.00	92.22
FUEL Cunsumption lbs/hr	37.40	27.97	19.85	8.22	27.93	20.27	13.87	1.80
DEW Point DEG F	47.63	47.81	47.91	47.89	47.96	47.95	48.83	48.01
Grains Water (H2O) per lb dry air	50.05	50.41	50.59	50.56	50.69	50.69	52.37	50.78
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	907.08	775.00	637.45	390.25	932.59	803.72	632.56	280.05
FINAL EXHAUST TEMP	840.05	729.52	604.86	391.72	800.94	719.75	589.23	309.45
Coolant Temperature IN DEG F	162.34375	159.8125	161	162	157	158.95313	161.35938	161
Coolant Temperature OUT DEG F	175	170	169	167	170	169.54688	169	165
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.49	12.93	10.59	7.80	7.46	6.23	5.40	2.10
Exhaust Restriction (mmHg)	16.74	15.05	12.73	9.95	12.95	12.34	10.89	6.68
Exhaust Restriction (inH2O)	8.96	8.06	6.82	5.33	6.93	6.61	5.83	3.57
EXHAUST FLOW LB/HR	1006.09	884.14	766.87	613.45	601.76	521.53	468.95	200.44
FUEL /AIR RATIO	0.0386	0.0327	0.0266	0.0136	0.0487	0.0404	0.0305	0.0091
J CONVER	0.9168	0.9278	0.9392	0.9635	0.8978	0.9132	0.9315	0.9719
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.6	6.4	5.3	2.7	9.5	7.7	5.4	1.7
CO PPM DRY	2.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
NOX PPM DRY	615.7	453.1	352.8	125.8	873.0	719.8	520.4	212.9
NO PPM DRY	523.9	368.2	304.5	124.4	735.5	558.1	440.9	210.3
NO2 PPM DRY	91.9	84.9	48.3	1.4	137.5	161.7	79.5	2.6
%O2								
NO WET	480.2614	341.6429	286.0145	119.8399	660.3195	509.6957	410.6705	204.4052
NO2 WET	84.2469	78.7811	45.3681	1.3760	123.4510	147.6450	74.0714	2.5420
CO2 WET	7.0048	5.9381	4.9351	2.6406	8.5293	7.0548	5.0505	1.6522
CO WET	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008
G	0.0008	0.0015	0.0022	0.0037	-0.0003	0.0006	0.0016	0.0042
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0020	-0.0025	-0.0034
HUM&TEM CORR FACTOR	1.0467	1.0490	1.0510	1.0597	1.0417	1.0473	1.0521	1.0866
NO CORR	458.8477	325.6716	272.1295	113.0934	633.8859	486.6801	390.3276	188.1114
NO2 CORR	80.4906	75.0962	43.1656	1.2985	118.5090	140.9780	70.4022	2.3394
GAS EMISSIONS								
NO GR/HR	216.97	135.33	98.08	32.61	179.28	119.29	86.03	17.72
NO2 GR/HR	58.31	47.81	23.83	0.57	51.35	52.94	23.77	0.34
CO2 GR/HR	48556.90	36173.06	26075.55	11160.72	35363.45	25350.20	16318.43	2281.65
CO GR/HR	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.68
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4025	2510	1819	605	3326	2213	1596	329
NO2 CFM 5 ppm	3527	2892	1442	35	3106	3202	1438	20
CO2 CFM 5000 ppm	3059	2279	1643	703	2228	1597	1028	144
CO CFM 50 ppm	8	0	0	0	0	0	0	7
NOX ppm - wet EURO, EPA, ISO	564.51	420.42	331.36	121.22	783.77	657.34	484.74	206.95
NOX ppm(corr) EURO,EPA,ISO	539.34	400.77	315.30	114.39	752.39	627.66	460.73	190.45
NOX GR/HR EURO, EPA, ISO	390.69	255.12	174.09	50.52	325.99	235.69	155.56	27.49
NOX cfm EURO, EPA, ISO	4727	3087	2106	611	3944	2851	1882	333

DPM EC/OC DATA

EC	TWA (ug/m3)	9692	11151	6277	3789	16583	9371	5647	---
OC	TWA (ug/m3)	7563	9439	7790	7124	6057	6510	5781	3474
TC	TWA (ug/m3)	17255	20590	14074	10906	22640	15881	11428	4107

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: IRE REG-9000-10 biodiesel
Engine: Isuzu 4JG1T
DOC: NONE

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.3	2499.7	2500.3	2498.3	1800.0	1800.4	1800.3	992.4
TORQUE lbft	173.92	129.86	89.96	20.08	203.28	152.34	100.04	7.14
HORSEPOWER	82.77	61.80	42.83	9.55	69.67	52.22	34.29	1.35
Barometric Pressure INHG	28.58	28.58	28.57	28.57	28.57	28.58	28.58	28.58
Laminar flow air temp DEG F	58.86	58.98	59.29	59.22	59.25	59.29	59.41	59.32
Laminar flow diff pressure in. of H2O	4.43	3.94	3.45	2.78	2.71	2.39	2.13	0.98
Laminar Flow cfm	225.69	200.95	176.15	142.41	138.75	122.46	109.26	50.69
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	66.70	67.50	67.50	67.50	68.33	69.50	69.50	71.50
Boost/Air In Manifold (degF)	302.02	246.96	193.90	129.49	219.76	175.13	136.44	89.20
Altitude Barrel Pressure (inHg)	28.54	28.54	28.54	28.54	28.54	28.54	28.53	28.54
Altitude (ft)	1292.18	1296.02	1300.60	1298.73	1300.33	1300.62	1303.19	1295.51
Intake AIR Consumption lbs/hr	985.02	876.62	767.58	620.63	604.72	533.68	475.96	220.89
LAB FACTOR-NA	1.022	1.023	1.023	1.023	1.025	1.026	1.026	1.029
LAB FACTOR-TURBO	0.996	0.998	0.998	0.998	1.001	1.004	1.004	1.009
Intake Air Temperature DEG F	66.70	67.50	67.50	67.50	68.33	69.50	69.50	71.50
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	302.02	246.96	193.90	129.49	219.76	175.13	136.44	89.20
Boost air Pressure (@manifold) psi	20.66	15.01	9.75	3.67	12.13	7.77	4.36	0.09
FUEL Temperature DEG F	92.45	92.48	92.33	92.02	91.51	90.94	90.09	87.50
FUEL Cunsumption lbs/hr	37.36	27.88	20.06	7.98	28.77	21.03	14.05	1.71
DEW Point DEG F	49.72	49.86	49.95	49.95	49.90	49.96	50.10	50.05
Grains Water (H2O) per lb dry air	54.63	54.90	55.07	55.08	54.99	55.09	55.37	55.25
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	890.73	756.84	624.16	380.34	922.27	792.44	612.71	266.13
FINAL EXHAUST TEMP	807.70	702.29	582.88	378.05	780.22	702.23	562.65	289.99
Coolant Temperature IN DEG F	161.68	161.10	163.00	165.00	160.33	158.92	162.53	161.78
Coolant Temperature OUT DEG F	174.50	171.36	170.03	169.56	172.78	169.26	169.99	165.45
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.64	13.09	10.68	7.75	7.49	6.22	5.31	1.98
Exhaust Restriction (mmHg)	6.27	4.89	3.18	1.57	4.99	3.30	1.38	0.31
Exhaust Restriction (inH2O)	3.36	2.62	1.70	0.84	2.67	1.77	0.74	0.17
EXHAUST FLOW LB/HR	1022.38	904.49	787.64	628.62	633.49	554.71	490.01	222.60
FUEL /AIR RATIO	0.04	0.03	0.03	0.01	0.05	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.90	0.91	0.93	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.60	6.30	5.20	2.70	9.39	7.87	6.00	1.77
CO PPM DRY	118.98	95.14	72.03	120.85	81.19	58.87	67.22	126.46
NOX PPM DRY	635.47	472.75	351.85	125.49	953.47	808.16	550.03	183.71
NO PPM DRY	608.46	454.52	331.45	109.22	932.08	769.85	521.42	159.44
NO2 PPM DRY	27.01	18.24	20.40	16.27	21.39	38.31	28.61	24.27
%O2								
NO WET	557.98	421.99	311.24	105.27	837.90	703.80	486.28	155.18
NO2 WET	24.77	16.94	19.15	15.68	19.23	35.01	26.68	23.62
CO2 WET	6.88	5.85	4.88	2.60	8.44	7.19	5.60	1.72
CO WET	0.0109	0.0088	0.0068	0.0116	0.0073	0.0054	0.0063	0.0123
G	0.0009	0.0016	0.0023	0.0038	-0.0002	0.0007	0.0019	0.0044
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0021	-0.0025	-0.0035
HUM&TEM CORR FACTOR	1.0342	1.0330	1.0313	1.0283	1.0361	1.0357	1.0350	1.0441
NO CORR	539.55	408.52	301.80	102.38	808.75	679.54	469.83	148.63
NO2 CORR	23.95	16.40	18.57	15.25	18.56	33.80	25.78	22.63
GAS EMISSIONS								
NO GR/HR	259.27	173.66	111.74	30.25	240.79	177.17	108.20	15.55
NO2 GR/HR	17.62	10.71	10.52	6.90	8.46	13.52	9.09	3.63
CO2 GR/HR	48449.12	36452.19	26498.33	11261.61	36824.16	27484.58	18892.16	2638.30
CO GR/HR	48.84	34.97	23.31	32.04	20.25	13.09	13.46	12.01
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4809	3221	2073	561	4467	3286	2007	288
NO2 CFM 5 ppm	1066	648	636	418	512	818	550	219
CO2 CFM 5000 ppm	3052	2296	1669	709	2320	1732	1190	166
CO CFM 50 ppm	485	348	232	318	201	130	134	119
NOX ppm - wet EURO, EPA, ISO	582.8	438.9	330.4	120.9	857.1	738.8	513.0	178.8
NOX ppm(corr) EURO,EPA,ISO	563.5	424.9	320.4	117.6	827.3	713.3	495.6	171.3
NOX GR/HR EURO, EPA, ISO	414.8	276.7	181.7	53.2	377.3	284.9	174.9	27.4
NOX cfm EURO, EPA, ISO	5018.5	3348.2	2198.2	644.2	4565.2	3447.2	2116.5	332.1

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/28/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-10 biodeisel, Engine Only, gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.7	2500.7	2500.9	2498.8	1800.0	1800.3	1800.0	992.3
TORQUE lbft	174.0	130.0	90.0	19.9	203.5	154.9	99.9	7.1
HORSEPOWER	82.8	61.9	42.8	9.5	69.7	53.1	34.2	1.3
Barometric Pressure INHG	28.57	28.57	28.57	28.57	28.57	28.58	28.58	28.58
Laminar flow air temp DEG F	58.65	58.81	59.05	58.99	59.06	59.00	59.06	59.04
Laminar flow diff pressure in. of H2O	4.40	3.90	3.40	2.74	2.71	2.41	2.13	0.99
Laminar Flow cfm	223.89	198.93	173.97	140.49	138.88	123.55	109.53	50.99
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	66.41	67.00	67.00	67.00	68.00	69.00	69.00	71.00
Boost/Air In Manifold (degF)	302.02	247.36	194.00	128.63	221.25	177.06	135.95	87.50
Altitude Barrel Pressure (inHg)	28.55	28.54	28.53	28.54	28.54	28.54	28.54	28.54
Altitude (ft)	1291	1296	1304	1295	1300	1300	1300	1294
Intake AIR Consumption lbs/hr	977.67	868.06	758.53	612.64	605.64	538.97	477.79	222.47
LAB FACTOR-NA	1.022	1.023	1.023	1.023	1.024	1.025	1.025	1.027
LAB FACTOR-TURBO	0.995	0.998	0.996	0.997	1.000	1.002	1.003	1.007
Intake Air Temperature DEG F	66.41	67.00	67.00	67.00	68.00	69.00	69.00	71.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	302.02	247.36	194.00	128.63	221.25	177.06	135.95	87.50
Boost air Pressure (@manifold) psi	20.70	15.06	9.80	3.65	12.29	8.00	4.37	0.08
FUEL Temperature DEG F	91.97	92.08	91.94	91.95	91.02	90.63	89.95	87.00
FUEL Cunsumption lbs/hr	37.59	28.10	19.99	8.05	29.33	21.84	13.88	1.69
DEW Point DEG F	49.60	49.72	49.70	49.70	49.70	49.66	49.69	49.70
Grains Water (H2O) per lb dry air	54.41	54.63	54.58	54.54	54.53	54.47	54.50	54.54
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	891.55	757.13	624.52	375.75	929.09	800.13	610.23	253.80
FINAL EXHAUST TEMP	808.73	701.50	582.30	370.83	788.72	709.09	560.20	274.80
Coolant Temperature IN DEG F	161.359375	161.60938	163	165	161.21875	158.48438	162.89063	161.5625
Coolant Temperature OUT DEG F	174	171.78125	170.0625	169.125	174	169	170	165
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.64	13.11	10.68	7.74	7.54	6.29	5.31	1.97
Exhaust Restriction (mmHg)	6.25	4.91	3.17	1.53	4.98	3.35	1.31	0.34
Exhaust Restriction (inH2O)	3.35	2.63	1.70	0.82	2.66	1.79	0.70	0.18
EXHAUST FLOW LB/HR	1015.26	896.15	778.52	620.69	634.97	560.81	491.66	224.15
FUEL /AIR RATIO	0.0385	0.0324	0.0263	0.0131	0.0484	0.0405	0.0290	0.0076
J CONVER	0.9161	0.9275	0.9387	0.9634	0.8974	0.9122	0.9337	0.9738
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.5	6.3	5.2	2.7	9.4	7.9	6.0	1.8
CO PPM DRY	124.7	101.5	78.3	129.7	90.4	63.2	70.5	136.0
NOX PPM DRY	636.6	469.0	350.6	124.7	946.1	817.1	546.2	184.1
NO PPM DRY	608.0	456.6	327.6	108.6	926.8	772.4	518.9	159.2
NO2 PPM DRY	28.6	12.4	23.0	16.1	19.3	44.7	27.3	24.9
%O2								
NO WET	557.0165	423.5150	307.5601	104.5964	831.6989	704.5979	484.5013	155.0640
NO2 WET	26.2241	11.4976	21.5466	15.5294	17.3288	40.7889	25.4723	24.2057
CO2 WET	6.8710	5.8430	4.8813	2.5953	8.4092	7.2353	5.6021	1.7377
CO WET	0.0114	0.0094	0.0074	0.0125	0.0081	0.0058	0.0066	0.0132
G	0.0008	0.0015	0.0022	0.0038	-0.0003	0.0006	0.0019	0.0044
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0020	-0.0025	-0.0035
HUM&TEM CORR FACTOR	1.0345	1.0329	1.0315	1.0282	1.0370	1.0366	1.0362	1.0444
NO CORR	538.4350	410.0067	298.1740	101.7310	801.9975	679.7169	467.5552	148.4732
NO2 CORR	25.3493	11.1309	20.8890	15.1040	16.7100	39.3486	24.5813	23.1769
GAS EMISSIONS								
NO GR/HR	256.93	172.69	109.10	29.68	239.35	179.16	108.04	15.64
NO2 GR/HR	18.53	7.18	11.71	6.75	7.64	15.89	8.70	3.74
CO2 GR/HR	48063.40	36077.55	26183.46	11098.73	36789.97	27956.76	18977.62	2683.70
CO GR/HR	50.81	36.94	25.07	33.96	22.56	14.16	14.18	13.00
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4766	3203	2024	551	4440	3323	2004	290
NO2 CFM 5 ppm	1121	434	708	408	462	961	526	226
CO2 CFM 5000 ppm	3028	2273	1650	699	2318	1761	1196	189
CO CFM 50 ppm	505	367	249	338	224	141	141	129
NOX ppm - wet EURO, EPA, ISO	583.24	435.01	329.11	120.13	849.03	745.39	509.97	179.27
NOX ppm(corr) EURO,EPA,ISO	563.78	421.14	319.06	116.84	818.71	719.07	492.14	171.65
NOX GR/HR EURO, EPA, ISO	412.12	271.73	178.85	52.21	374.30	290.34	174.22	27.70
NOX cfm EURO, EPA, ISO	4986	3288	2164	632	4528	3513	2108	335
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	11.97	13.73	10.11	7.73	8.70	7.50	6.26	1.51
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.79	2.06	1.52	0.77	0.87	0.75	0.63	0.23
Weighted HP	12.420	9.282	6.426	0.949	6.975	5.308	3.424	0.201

Weighted Average HP 44.985 HP
Weighted Average PARTICULATE 8.617 GR/HR
0.192 **(GR/HP-HR)**

PARTICULATE INDEX (PI) CFM 5071.142

COMPANY NAME Isuzu
DATE 8/28/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: REG-9000-10 biodeisel, Engine Only, EC/OC sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.0	2498.6	2499.8	2497.9	1800.0	1800.6	1800.5	992.4
TORQUE lbft	173.9	129.8	90.0	20.2	203.0	149.8	100.2	7.2
HORSEPOWER	82.7	61.7	42.8	9.6	69.6	51.4	34.3	1.4
Barometric Pressure INHG	28.58	28.58	28.58	28.57	28.57	28.57	28.58	28.58
Laminar flow air temp DEG F	59.08	59.14	59.53	59.44	59.44	59.57	59.76	59.60
Laminar flow diff pressure in. of H2O	4.47	3.98	3.49	2.82	2.70	2.36	2.12	0.97
Laminar Flow cfm	227.48	202.98	178.32	144.34	138.63	121.37	108.98	50.38
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	67.00	68.00	68.00	68.00	68.66	70.00	70.00	72.00
Boost/Air In Manifold (degF)	302.03	246.56	193.80	130.36	218.27	173.20	136.92	90.91
Altitude Barrel Pressure (inHg)	28.54	28.54	28.54	28.53	28.53	28.53	28.53	28.54
Altitude (ft)	1293	1296	1297	1302	1301	1301	1306	1297
Intake AIR Consumption lbs/hr	992.37	885.17	776.62	628.63	603.80	528.39	474.14	219.31
LAB FACTOR-NA	1.023	1.023	1.024	1.024	1.025	1.027	1.027	1.030
LAB FACTOR-TURBO	0.998	0.999	0.999	0.999	1.002	1.006	1.006	1.011
Intake Air Temperature DEG F	67.00	68.00	68.00	68.00	68.66	70.00	70.00	72.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	302.03	246.56	193.80	130.36	218.27	173.20	136.92	90.91
Boost air Pressure (@manifold) psi	20.63	14.96	9.70	3.69	11.97	7.53	4.34	0.10
FUEL Temperature DEG F	92.94	92.88	92.72	92.08	92.00	91.25	90.23	88.00
FUEL Cunsumption lbs/hr	37.14	27.66	20.14	7.92	28.20	20.22	14.22	1.74
DEW Point DEG F	49.84	50.00	50.20	50.20	50.11	50.25	50.50	50.39
Grains Water (H2O) per lb dry air	54.85	55.18	55.56	55.61	55.46	55.71	56.24	55.96
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	889.92	756.56	623.80	384.92	915.44	784.75	615.19	278.47
FINAL EXHAUST TEMP	806.67	703.08	583.47	385.27	771.72	695.36	565.09	305.19
Coolant Temperature IN DEG F	162	160.59375	163	165	159.4375	159.35938	162.17188	162
Coolant Temperature OUT DEG F	175	170.9375	170	170	171.5625	169.51563	169.98438	165.89063
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.63	13.08	10.68	7.77	7.43	6.15	5.32	1.98
Exhaust Restriction (mmHg)	6.29	4.88	3.20	1.60	5.01	3.25	1.45	0.27
Exhaust Restriction (inH2O)	3.37	2.61	1.71	0.86	2.68	1.74	0.78	0.15
EXHAUST FLOW LB/HR	1029.51	912.83	796.76	636.55	632.00	548.62	488.37	221.05
FUEL /AIR RATIO	0.0374	0.0313	0.0259	0.0126	0.0467	0.0383	0.0300	0.0080
J CONVER	0.9180	0.9294	0.9393	0.9642	0.9005	0.9162	0.9315	0.9728
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.5	6.3	5.2	2.7	9.4	7.8	6.0	1.8
CO PPM DRY	113.3	88.8	65.7	112.0	72.0	54.6	63.9	116.9
NOX PPM DRY	634.3	476.5	353.1	126.3	960.9	799.2	553.9	183.3
NO PPM DRY	608.9	452.4	335.3	109.9	937.4	767.3	523.9	159.6
NO2 PPM DRY	25.4	24.1	17.8	16.4	23.5	31.9	29.9	23.7
%O2								
NO WET	558.9497	420.4642	314.9130	105.9459	844.1090	703.0071	488.0488	155.3047
NO2 WET	23.3103	22.3758	16.7574	15.8282	21.1330	29.2290	27.8935	23.0437
CO2 WET	6.8846	5.8554	4.8843	2.6049	8.4644	7.1462	5.5892	1.7024
CO WET	0.0104	0.0083	0.0062	0.0108	0.0065	0.0050	0.0060	0.0114
G	0.0010	0.0017	0.0023	0.0038	-0.0001	0.0009	0.0018	0.0044
R	-0.0022	-0.0024	-0.0027	-0.0032	-0.0017	-0.0021	-0.0025	-0.0035
HUM&TEM CORR FACTOR	1.0338	1.0330	1.0311	1.0284	1.0351	1.0348	1.0338	1.0438
NO CORR	540.6721	407.0377	305.4236	103.0231	815.4976	679.3627	472.1029	148.7873
NO2 CORR	22.5480	21.6613	16.2526	15.3915	20.4167	28.2459	26.9821	22.0766
GAS EMISSIONS								
NO GR/HR	261.61	174.63	114.37	30.82	242.24	175.17	108.36	15.46
NO2 GR/HR	16.71	14.24	9.32	7.05	9.29	11.16	9.49	3.51
CO2 GR/HR	48834.84	36826.82	26813.20	11424.49	36858.36	27012.41	18806.70	2592.89
CO GR/HR	46.88	32.99	21.54	30.12	17.94	12.01	12.73	11.01
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4853	3239	2122	572	4493	3249	2010	287
NO2 CFM 5 ppm	1011	861	564	427	562	675	574	213
CO2 CFM 5000 ppm	3077	2320	1689	720	2322	1702	1185	163
CO CFM 50 ppm	466	328	214	299	178	119	127	109
NOX ppm - wet EURO, EPA, ISO	582.26	442.84	331.67	121.77	865.24	732.24	515.94	178.35
NOX ppm(corr) EURO,EPA,ISO	563.22	428.70	321.68	118.41	835.91	707.61	499.09	170.86
NOX GR/HR EURO, EPA, ISO	417.48	281.76	184.54	54.27	380.38	279.51	175.49	27.19
NOX cfm EURO, EPA, ISO	5051	3409	2233	657	4602	3382	2123	329

DPM EC/OC DATA

EC	TWA (ug/m3)	9131	11127	7260	4080	17239	6968	5059	---
OC	TWA (ug/m3)	17269	21786	19500	19116	14717	20843	20049	13562
TC	TWA (ug/m3)	26400	32913	26760	23195	31956	27819	25107	14260

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: Stepan SB-W Biodiesel
Engine: Isuzu 4JG1T
DOC: ECS Purifier A16-011

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.8	2499.7	2499.7	2499.7	1800.0	1800.0	1800.0	991.7
TORQUE lbft	175.19	129.98	89.76	20.17	206.21	155.13	105.00	8.04
HORSEPOWER	83.39	61.86	42.72	9.60	70.67	53.17	35.99	1.52
Barometric Pressure INHG	28.70	28.69	28.69	28.68	28.68	28.68	28.68	28.68
Laminar flow air temp DEG F	60.56	60.54	60.45	60.44	60.54	60.48	60.20	60.12
Laminar flow diff pressure in. of H2O	4.32	3.82	3.32	2.66	2.54	2.21	1.97	0.79
Laminar Flow cfm	220.00	194.99	169.77	136.35	130.42	113.59	101.20	40.77
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	71.07	71.50	71.70	72.15	73.84	75.02	75.00	78.00
Boost/Air In Manifold (degF)	303.89	247.59	196.11	133.91	227.24	180.75	144.88	94.74
Altitude Barrel Pressure (inHg)	28.72	28.71	28.71	28.70	28.71	28.70	28.70	28.70
Altitude (ft)	1128.78	1130.71	1136.38	1140.29	1136.06	1144.19	1141.20	1143.90
Intake AIR Consumption lbs/hr	959.73	850.46	740.57	594.79	568.64	495.29	441.72	177.99
LAB FACTOR-NA	1.023	1.024	1.025	1.025	1.027	1.029	1.029	1.033
LAB FACTOR-TURBO	1.005	1.007	1.007	1.008	1.013	1.017	1.016	1.026
Intake Air Temperature DEG F	71.07	71.50	71.70	72.15	73.84	75.02	75.00	78.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	303.89	247.59	196.11	133.91	227.24	180.75	144.88	94.74
Boost air Pressure (@manifold) psi	20.28	14.55	9.45	3.60	12.11	7.73	4.56	0.09
FUEL Temperature DEG F	93.52	95.47	92.83	92.52	91.98	92.21	92.01	89.95
FUEL Cunsumption lbs/hr	37.10	27.66	19.82	8.25	28.45	20.90	14.45	1.92
DEW Point DEG F	48.84	48.91	48.79	48.70	48.81	48.78	48.36	48.54
Grains Water (H2O) per lb dry air	52.60	52.81	52.55	52.33	52.58	52.54	51.70	52.04
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	902.92	770.19	631.87	386.30	962.14	814.66	641.20	253.42
FINAL EXHAUST TEMP	845.84	729.93	604.46	390.27	854.80	746.44	605.65	275.95
Coolant Temperature IN DEG F	160.50	160.20	162.05	164.00	159.73	157.97	161.95	160.50
Coolant Temperature OUT DEG F	173.50	170.80	170.00	168.80	173.00	168.92	169.85	164.25
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.23	12.74	10.48	7.70	7.43	6.21	5.36	2.03
Exhaust Restriction (mmHg)	20.33	15.02	10.43	5.66	10.54	8.90	5.46	1.25
Exhaust Restriction (inH2O)	10.88	8.04	5.58	3.03	5.64	4.76	2.92	0.67
EXHAUST FLOW LB/HR	996.83	878.12	760.39	603.04	597.09	516.19	456.17	179.91
FUEL /AIR RATIO	0.04	0.03	0.03	0.01	0.05	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.89	0.91	0.93	0.97
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.77	6.50	5.39	2.80	9.80	8.21	6.40	1.90
CO PPM DRY	2.00	0.00	0.00	16.50	1.00	0.00	0.00	112.59
NOX PPM DRY	658.20	483.69	377.67	145.50	990.50	783.87	595.55	231.29
NO PPM DRY	570.80	408.60	333.74	145.85	867.75	623.42	504.64	228.48
NO2 PPM DRY	87.40	75.08	43.92	-0.34	122.75	160.45	90.91	2.81
%O2								
NO WET	522.93	379.01	313.18	140.38	776.53	567.02	468.03	221.25
NO2 WET	80.07	69.64	41.22	-0.33	109.85	145.94	84.32	2.72
CO2 WET	7.12	6.03	5.05	2.70	8.77	7.46	5.93	1.84
CO WET	0.0002	0.0000	0.0000	0.0016	0.0001	0.0000	0.0000	0.0109
G	0.0008	0.0015	0.0022	0.0037	-0.0005	0.0004	0.0015	0.0040
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0016	-0.0019	-0.0024	-0.0033
HUM&TEM CORR FACTOR	1.0422	1.0442	1.0472	1.0544	1.0374	1.0429	1.0520	1.0804
NO CORR	501.77	362.97	299.05	133.14	748.51	543.72	444.90	204.79
NO2 CORR	76.83	66.70	39.36	-0.32	105.88	139.94	80.15	2.52
GAS EMISSIONS								
NO GR/HR	235.08	149.81	106.88	37.74	210.06	131.91	95.39	17.32
NO2 GR/HR	55.14	42.17	21.55	-0.14	45.51	52.01	26.33	0.33
CO2 GR/HR	48882.10	36478.06	26482.98	11210.56	36078.39	26545.49	18642.61	2280.63
CO GR/HR	0.80	0.00	0.00	4.20	0.23	0.00	0.00	8.59
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4361	2779	1983	700	3897	2447	1769	321
NO2 CFM 5 ppm	3336	2551	1303	-8	2753	3146	1593	20
CO2 CFM 5000 ppm	3080	2298	1668	706	2273	1672	1174	144
CO CFM 50 ppm	8	0	0	42	2	0	0	85
NOX ppm - wet EURO, EPA, ISO	603.0	448.7	354.4	140.1	886.4	713.0	552.4	224.0
NOX ppm(corr) EURO,EPA,ISO	578.6	429.7	338.4	132.8	854.4	683.7	525.1	207.3
NOX GR/HR EURO, EPA, ISO	415.3	271.7	185.3	57.7	367.3	254.1	172.4	26.9
NOX cfm EURO, EPA, ISO	5024.2	3286.8	2241.5	697.8	4443.8	3074.0	2086.4	324.9

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (Pi) CFM

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/26/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Stepan SB-W Biodiesel fuel; Engine w/ ECS DOC, gravimetric sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.8	2499.8	2499.9	2499.7	1800.0	1800.0	1799.9	992.3
TORQUE lbft	174.8	130.0	89.8	20.3	206.6	155.2	105.0	8.0
HORSEPOWER	83.2	61.9	42.7	9.7	70.8	53.2	36.0	1.5
Barometric Pressure INHG	28.72	28.71	28.70	28.70	28.69	28.69	28.69	28.69
Laminar flow air temp DEG F	60.45	60.27	60.20	60.39	60.85	60.48	60.20	60.65
Laminar flow diff pressure in. of H2O	4.32	3.83	3.33	2.66	2.55	2.21	1.97	0.79
Laminar Flow cfm	220.11	195.46	170.36	136.67	130.74	113.77	101.28	40.90
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	71.00	71.00	71.41	72.00	73.95	75.22	75.00	78.00
Boost/Air In Manifold (degF)	303.28	247.19	196.06	133.72	228.00	181.50	145.11	94.78
Altitude Barrel Pressure (inHg)	28.73	28.73	28.72	28.71	28.72	28.71	28.71	28.71
Altitude (ft)	1112	1119	1127	1132	1125	1136	1135	1138
Intake AIR Consumption lbs/hr	961.15	853.80	744.09	596.45	569.67	496.22	442.21	178.30
LAB FACTOR-NA	1.022	1.023	1.023	1.024	1.027	1.029	1.028	1.033
LAB FACTOR-TURBO	1.003	1.005	1.006	1.007	1.013	1.017	1.015	1.025
Intake Air Temperature DEG F	71.00	71.00	71.41	72.00	73.95	75.22	75.00	78.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	303.28	247.19	196.06	133.72	228.00	181.50	145.11	94.78
Boost air Pressure (@manifold) psi	20.26	14.58	9.49	3.62	12.15	7.77	4.60	0.09
FUEL Temperature DEG F	94.03	97.00	92.47	92.25	91.97	92.31	91.98	89.91
FUEL Cunsumption lbs/hr	36.99	27.47	19.94	8.21	28.63	20.97	14.30	1.89
DEW Point DEG F	48.85	48.57	48.52	48.84	49.11	48.95	48.41	48.67
Grains Water (H2O) per lb dry air	52.59	52.09	51.99	52.57	53.16	52.84	51.81	52.28
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	901.63	768.28	631.08	385.08	962.89	816.66	640.98	256.81
FINAL EXHAUST TEMP	845.03	727.19	601.58	387.56	854.48	748.13	604.91	279.91
Coolant Temperature IN DEG F	161	160.35938	162.09375	164	159.89063	157.48438	161.92188	161
Coolant Temperature OUT DEG F	174	171	170	169	173	168.53125	169.85938	164.5
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.16	12.70	10.47	7.69	7.41	6.20	5.34	2.02
Exhaust Restriction (mmHg)	20.32	15.02	10.43	5.66	10.52	8.91	5.40	1.30
Exhaust Restriction (inH2O)	10.88	8.04	5.58	3.03	5.63	4.77	2.89	0.69
EXHAUST FLOW LB/HR	998.13	881.27	764.03	604.66	598.30	517.19	456.51	180.19
FUEL /AIR RATIO	0.0385	0.0322	0.0268	0.0138	0.0503	0.0423	0.0323	0.0106
J CONVER	0.9165	0.9284	0.9384	0.9627	0.8943	0.9093	0.9281	0.9686
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.7	6.5	5.4	2.8	9.8	8.2	6.4	1.9
CO PPM DRY	2.0	0.0	0.0	21.0	2.0	0.0	0.0	110.1
NOX PPM DRY	657.1	487.5	376.8	145.1	983.8	777.6	597.0	229.0
NO PPM DRY	569.4	415.1	333.8	146.5	873.5	622.6	497.8	226.8
NO2 PPM DRY	87.7	72.4	43.0	-1.4	110.3	155.0	99.2	2.2
%O2								
NO WET	521.8296	385.3871	313.2249	141.0630	781.1969	566.1427	462.0422	219.6930
NO2 WET	80.3687	67.1716	40.3533	-1.3388	98.6781	140.9794	92.0865	2.1068
CO2 WET	7.0912	6.0345	5.0676	2.7016	8.7644	7.4680	5.9312	1.8404
CO WET	0.0002	0.0000	0.0000	0.0020	0.0002	0.0000	0.0000	0.0107
G	0.0008	0.0016	0.0022	0.0037	-0.0005	0.0004	0.0015	0.0041
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0016	-0.0019	-0.0024	-0.0033
HUM&TEM CORR FACTOR	1.0422	1.0452	1.0481	1.0531	1.0363	1.0423	1.0520	1.0798
NO CORR	500.7026	368.7141	298.8635	133.9445	753.8257	543.1699	439.1973	203.4573
NO2 CORR	77.1149	64.2655	38.5031	-1.2712	95.2207	135.2588	87.5334	1.9511
GAS EMISSIONS								
NO GR/HR	234.89	152.72	107.32	38.07	211.98	132.03	94.23	17.23
NO2 GR/HR	55.42	40.78	21.18	-0.55	41.02	50.37	28.77	0.25
CO2 GR/HR	48767.01	36641.20	26676.74	11255.12	36129.38	26611.69	18655.79	2284.88
CO GR/HR	0.80	0.00	0.00	5.35	0.47	0.00	0.00	8.42
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4357	2833	1991	706	3932	2449	1748	320
NO2 CFM 5 ppm	3352	2467	1281	-33	2481	3047	1740	15
CO2 CFM 5000 ppm	3072	2308	1681	709	2276	1677	1175	144
CO CFM 50 ppm	8	0	0	53	5	0	0	84
NOX ppm - wet EURO, EPA, ISO	602.20	452.56	353.58	139.72	879.87	707.12	554.13	221.80
NOX ppm(corr) EURO,EPA,ISO	577.82	432.98	337.37	132.67	849.05	678.43	526.73	205.41
NOX GR/HR EURO, EPA, ISO	415.25	274.73	185.59	57.76	365.75	252.63	173.13	26.65
NOX cfm EURO, EPA, ISO	5024	3324	2245	699	4425	3056	2095	322
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	7.72	7.11	4.55	3.24	6.29	2.89	2.18	0.10
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.16	1.07	0.68	0.32	0.63	0.29	0.22	0.02
Weighted HP	12.482	9.279	6.412	0.968	7.080	5.320	3.599	0.228
Weighted Average HP	45.368 HP							
Weighted Average PARTICULATE	4.382 GR/HR							
	0.097 **(GR/HP-HR)**							
PARTICULATE INDEX (PI) CFM	2578.994							

PART 7, SUBPART E, CATEGORY B

COMPANY NAME Isuzu
DATE 8/26/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Stepan SB-W Biodiesel fuel; Engine w/ ECS DOC, EC/OC sample

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.8	2499.6	2499.5	2499.8	1800.0	1800.0	1800.0	991.1
TORQUE lbft	175.6	130.0	89.7	20.0	205.8	155.0	105.0	8.1
HORSEPOWER	83.6	61.9	42.7	9.5	70.5	53.1	36.0	1.5
Barometric Pressure INHG	28.68	28.68	28.67	28.67	28.67	28.67	28.67	28.67
Laminar flow air temp DEG F	60.67	60.82	60.69	60.48	60.23	60.49	60.20	59.59
Laminar flow diff pressure in. of H2O	4.32	3.81	3.31	2.65	2.54	2.21	1.97	0.79
Laminar Flow cfm	219.89	194.53	169.18	136.03	130.10	113.41	101.12	40.64
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	71.14	72.00	72.00	72.30	73.72	74.83	75.00	78.00
Boost/Air in Manifold (degF)	304.50	248.00	196.16	134.09	226.48	180.00	144.64	94.70
Altitude Barrel Pressure (inHg)	28.70	28.70	28.70	28.69	28.70	28.69	28.70	28.69
Altitude (ft)	1145	1142	1146	1149	1147	1152	1148	1150
Intake AIR Consumption lbs/hr	958.31	847.12	737.05	593.12	567.61	494.36	441.24	177.68
LAB FACTOR-NA	1.024	1.026	1.026	1.026	1.027	1.029	1.029	1.034
LAB FACTOR-TURBO	1.006	1.009	1.009	1.009	1.012	1.016	1.017	1.026
Intake Air Temperature DEG F	71.14	72.00	72.00	72.30	73.72	74.83	75.00	78.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.50	248.00	196.16	134.09	226.48	180.00	144.64	94.70
Boost air Pressure (@manifold) psi	20.30	14.52	9.40	3.57	12.07	7.68	4.52	0.09
FUEL Temperature DEG F	93.00	93.94	93.19	92.80	92.00	92.11	92.03	90.00
FUEL Cunsumption lbs/hr	37.21	27.85	19.70	8.30	28.27	20.83	14.59	1.95
DEW Point DEG F	48.83	49.26	49.05	48.56	48.50	48.62	48.30	48.40
Grains Water (H2O) per lb dry air	52.62	53.52	53.11	52.10	52.00	52.23	51.59	51.80
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	904.22	772.09	632.66	387.53	961.39	812.67	641.41	250.03
FINAL EXHAUST TEMP	846.66	732.67	607.34	392.98	855.13	744.75	606.39	272.00
Coolant Temperature IN DEG F	160	160.04688	162.015625	164	159.5625	158.45313	161.96875	160
Coolant Temperature OUT DEG F	173	170.60938	170	168.60938	173	169.3125	169.84375	164
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.30	12.78	10.49	7.71	7.45	6.23	5.38	2.05
Exhaust Restriction (mmHg)	20.35	15.02	10.42	5.66	10.57	8.89	5.51	1.21
Exhaust Restriction (inH2O)	10.89	8.04	5.58	3.03	5.66	4.76	2.95	0.65
EXHAUST FLOW LB/HR	995.52	874.97	756.75	601.41	595.87	515.19	455.83	179.63
FUEL /AIR RATIO	0.0388	0.0329	0.0267	0.0140	0.0498	0.0421	0.0331	0.0110
J CONVER	0.9158	0.9267	0.9383	0.9624	0.8954	0.9097	0.9268	0.9680
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.8	6.5	5.4	2.8	9.8	8.2	6.4	1.9
CO PPM DRY	2.0	0.0	0.0	12.0	0.0	0.0	0.0	115.0
NOX PPM DRY	659.3	479.9	378.6	145.9	997.2	790.1	594.0	233.6
NO PPM DRY	572.2	402.1	333.7	145.2	862.0	624.3	511.5	230.2
NO2 PPM DRY	87.1	77.8	44.8	0.7	135.2	165.9	82.6	3.4
%O2								
NO WET	524.0310	372.6364	313.1351	139.7051	771.8639	567.8902	474.0233	222.8016
NO2 WET	79.7730	72.1149	42.0811	0.6767	121.0319	150.8927	76.5526	3.3306
CO2 WET	7.1433	6.0238	5.0421	2.6947	8.7753	7.4596	5.9317	1.8393
CO WET	0.0002	0.0000	0.0000	0.0012	0.0000	0.0000	0.0000	0.0111
G	0.0008	0.0015	0.0022	0.0037	-0.0005	0.0004	0.0015	0.0040
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0016	-0.0019	-0.0023	-0.0033
HUM&TEM CORR FACTOR	1.0422	1.0431	1.0464	1.0556	1.0386	1.0434	1.0520	1.0810
NO CORR	502.8349	357.2337	299.2414	132.3432	743.1961	544.2641	450.5997	206.1147
NO2 CORR	76.5464	69.1340	40.2140	0.6410	116.5366	144.6151	72.7698	3.0812
GAS EMISSIONS								
NO GR/HR	235.27	146.91	106.43	37.41	208.14	131.79	96.54	17.40
NO2 GR/HR	54.87	43.55	21.91	0.28	50.00	53.64	23.88	0.40
CO2 GR/HR	48997.20	36314.92	26289.22	11165.99	36027.40	26479.30	18629.44	2276.37
CO GR/HR	0.80	0.00	0.00	3.04	0.00	0.00	0.00	8.76
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	4364	2725	1974	694	3861	2445	1791	323
NO2 CFM 5 ppm	3319	2635	1325	17	3024	3245	1445	24
CO2 CFM 5000 ppm	3087	2288	1656	703	2270	1668	1174	143
CO CFM 50 ppm	8	0	0	30	0	0	0	87
NOX ppm - wet EURO, EPA, ISO	603.80	444.75	355.22	140.38	892.90	718.78	550.58	226.13
NOX ppm(corr) EURO,EPA,ISO	579.38	426.37	339.46	132.98	859.73	688.88	523.37	209.20
NOX GR/HR EURO, EPA, ISO	415.29	268.60	184.96	57.58	368.85	255.53	171.77	27.06
NOX cfm EURO, EPA, ISO	5024	3250	2238	697	4463	3092	2078	327

DPM EC/OC DATA

EC	TWA (ug/m3)	10149	12256	7379	4425	20853	9469	6261	---
OC	TWA (ug/m3)	5278	6291	7180	7084	4812	7429	6845	3986
TC	TWA (ug/m3)	15427	18546	14559	11509	25657	16898	13098	4244

Fuel Test Data on Isuzu 4JT1T Engine

Fuel: Stepan SB-W Biodiesel
Engine: Isuzu 4JG1T
DOC: NONE

COMPANY NAME Isuzu
DATE
ENGINE MODEL Isuzu 4JG1T
COMMENTS: AVERAGE DATA

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.5	2499.5	2499.6	2499.1	1800.2	1800.0	1800.0	997.3
TORQUE lbft	176.87	134.80	90.07	20.02	207.47	155.00	105.10	5.52
HORSEPOWER	84.18	64.15	42.87	9.53	71.11	53.12	36.02	1.05
Barometric Pressure INHG	28.65	28.65	28.65	28.65	28.65	28.64	28.64	28.64
Laminar flow air temp DEG F	58.98	58.95	59.05	59.21	59.29	59.15	59.17	59.12
Laminar flow diff pressure in. of H2O	4.36	3.93	3.39	2.73	2.64	2.31	2.06	0.91
Laminar Flow cfm	221.99	200.64	173.11	139.80	135.58	118.55	105.76	47.15
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.00	68.00	68.00	68.00	69.00	70.00	70.00	72.39
Boost/Air In Manifold (degF)	304.24	252.82	194.70	130.51	224.17	177.62	139.50	89.14
Altitude Barrel Pressure (inHg)	28.58	28.58	28.58	28.58	28.58	28.58	28.57	28.57
Altitude (ft)	1257.43	1258.55	1260.74	1256.34	1255.38	1262.49	1263.33	1266.21
Intake AIR Consumption lbs/hr	971.39	878.05	757.17	611.14	592.52	518.20	462.29	206.10
LAB FACTOR-NA	1.021	1.021	1.021	1.021	1.022	1.024	1.024	1.027
LAB FACTOR-TURBO	0.998	0.998	0.998	0.998	1.000	1.004	1.003	1.010
Intake Air Temperature DEG F	68.00	68.00	68.00	68.00	69.00	70.00	70.00	72.39
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.24	252.82	194.70	130.51	224.17	177.62	139.50	89.14
Boost air Pressure (@manifold) psi	20.72	15.55	9.74	3.71	12.51	8.00	4.63	0.10
FUEL Temperature DEG F	93.57	92.20	92.30	91.55	89.99	87.67	86.16	85.60
FUEL Cunsumption lbs/hr	37.57	28.62	19.98	8.21	28.50	20.92	14.41	1.26
DEW Point DEG F	49.09	48.85	49.08	49.32	49.47	49.49	49.40	49.45
Grains Water (H2O) per lb dry air	53.17	52.73	53.16	53.65	53.96	54.02	53.81	53.98
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	895.59	769.13	627.60	384.05	938.09	800.74	632.13	247.95
FINAL EXHAUST TEMP	818.24	713.04	588.35	383.20	801.27	711.40	576.31	271.24
Coolant Temperature IN DEG F	161.50	160.79	162.00	163.84	158.76	159.29	161.98	160.34
Coolant Temperature OUT DEG F	174.50	171.02	170.00	168.02	171.80	169.77	169.67	164.00
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.50	13.24	10.61	7.71	7.55	6.24	5.37	1.96
Exhaust Restriction (mmHg)	6.14	4.87	3.06	1.57	4.78	3.35	1.71	0.35
Exhaust Restriction (inH2O)	3.29	2.60	1.64	0.84	2.56	1.79	0.92	0.19
EXHAUST FLOW LB/HR	1008.96	906.67	777.15	619.36	621.02	539.13	476.71	207.35
FUEL /AIR RATIO	0.04	0.03	0.03	0.01	0.05	0.04	0.03	0.01
J CONVER	0.92	0.93	0.94	0.96	0.90	0.91	0.93	0.98
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.68	6.50	5.29	2.76	9.60	8.01	6.30	1.72
CO PPM DRY	102.90	85.63	63.45	164.04	89.90	54.14	61.47	181.06
NOX PPM DRY	713.70	533.28	384.41	141.06	1040.30	871.72	629.18	194.23
NO PPM DRY	689.79	511.32	367.45	125.80	1010.44	836.34	606.67	166.16
NO2 PPM DRY	23.91	21.96	16.96	15.26	29.86	35.38	22.51	29.07
%O2								
NO WET	631.83	474.23	345.02	121.16	907.56	763.25	564.12	161.32
NO2 WET	21.90	20.37	15.93	14.69	26.82	32.29	20.93	28.39
CO2 WET	7.03	6.03	4.97	2.66	8.62	7.31	5.86	1.68
CO WET	0.0094	0.0079	0.0060	0.0158	0.0081	0.0049	0.0067	0.0177
G	0.0008	0.0015	0.0022	0.0037	-0.0003	0.0006	0.0017	0.0046
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0020	-0.0024	-0.0035
HUM&TEM CORR FACTOR	1.0385	1.0390	1.0375	1.0348	1.0377	1.0381	1.0397	1.0530
NO CORR	608.42	456.43	332.55	117.07	874.62	735.21	542.59	153.19
NO2 CORR	21.08	19.60	15.35	14.20	25.85	31.10	20.14	26.95
GAS EMISSIONS								
NO GR/HR	288.52	194.50	121.47	34.08	255.29	186.30	121.57	14.93
NO2 GR/HR	15.31	12.80	8.59	6.33	11.56	12.07	6.91	4.03
CO2 GR/HR	48871.44	37659.48	26619.19	11359.65	36894.17	27162.13	19241.14	2406.26
CO GR/HR	41.65	31.54	20.28	42.86	21.96	11.67	11.93	16.06
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	5352	3608	2253	632	4736	3456	2255	277
NO2 CFM 5 ppm	926	774	520	383	699	730	418	244
CO2 CFM 5000 ppm	3079	2373	1677	716	2324	1711	1212	152
CO CFM 50 ppm	414	313	202	426	218	116	119	160
NOX ppm - wet EURO, EPA, ISO	653.7	494.6	360.9	135.8	934.4	795.5	585.1	189.7
NOX ppm(corr) EURO,EPA,ISO	629.5	476.0	347.9	131.3	900.5	766.3	562.7	180.1
NOX GR/HR EURO, EPA, ISO	457.3	310.8	194.7	58.5	402.6	297.5	193.1	26.9
NOX cfm EURO, EPA, ISO	5532.7	3759.7	2355.2	708.3	4871.4	3598.9	2336.8	325.4

PARTICULATE EMISSIONS
Modal Particulate emission (gr/hr)
weight factor
Weighted Particulate (gr/hr)
Weighted HP
Weighted Average HP
Weighted Average PARTICULATE

PARTICULATE INDEX (PI) CFM

COMPANY NAME Isuzu
DATE 8/26/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Stepan SB-W Biodiesel fuel; Eng ·e only, gravimetric sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	**2499.5**	**2499.1**	**2499.5**	**2499.1**	**1800.2**	**1800.3**	**1800.3**	**997.2**
TORQUE lbft	**176.5**	**134.9**	**90.0**	**19.7**	**208.0**	**154.9**	**105.1**	**5.8**
HORSEPOWER	**84.0**	**64.2**	**42.8**	**9.4**	**71.3**	**53.1**	**36.0**	**1.1**
Barometric Pressure INHG	**28.66**	**28.65**	**28.65**	**28.66**	**28.66**	**28.66**	**28.66**	**28.65**
Laminar flow air temp DEG F	**59.16**	**59.00**	**59.10**	**59.29**	**59.48**	**59.03**	**59.05**	**59.07**
Laminar flow diff pressure in. of H2O	**4.36**	**3.93**	**3.39**	**2.73**	**2.65**	**2.31**	**2.06**	**0.92**
Laminar Flow cfm	**222.24**	**200.71**	**173.11**	**139.88**	**135.91**	**118.44**	**105.93**	**47.41**
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.00	68.00	68.00	68.00	69.00	70.00	70.00	72.78
Boost/Air In Manifold (degF)	304.36	252.80	194.58	130.52	224.14	177.47	139.50	89.80
Altitude Barrel Pressure (inHg)	28.59	28.58	28.58	28.59	28.59	28.59	28.59	28.58
Altitude (ft)	1253	1258	1262	1251	1244	1247	1251	1255
Intake AIR Consumption lbs/hr	**972.17**	**878.37**	**757.20**	**611.57**	**593.93**	**518.23**	**463.54**	**207.41**
LAB FACTOR-NA	**1.021**	**1.021**	**1.021**	**1.021**	**1.022**	**1.024**	**1.024**	**1.027**
LAB FACTOR-TURBO	**0.998**	**0.997**	**0.998**	**0.998**	**1.000**	**1.004**	**1.003**	**1.010**
Intake Air Temperature DEG F	**68.00**	**68.00**	**68.00**	**68.00**	**69.00**	**70.00**	**70.00**	**72.78**
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	**304.36**	**252.80**	**194.58**	**130.52**	**224.14**	**177.47**	**139.50**	**89.80**
Boost air Pressure (@manifold) psi	**20.68**	**15.53**	**9.71**	**3.70**	**12.52**	**7.97**	**4.61**	**0.10**
FUEL Temperature DEG F	**89.95**	**91.95**	**92.02**	**91.09**	**89.98**	**87.34**	**86.30**	**84.25**
FUEL Cunsumption lbs/hr	**37.47**	**28.54**	**19.87**	**8.24**	**28.67**	**20.95**	**14.38**	**1.48**
DEW Point DEG F	**49.20**	**48.81**	**48.97**	**49.25**	**49.54**	**49.45**	**49.10**	**49.20**
Grains Water (H2O) per lb dry air	**53.39**	**52.67**	**52.93**	**53.50**	**54.09**	**53.89**	**53.18**	**53.45**
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	894.73	768.88	626.31	384.34	934.72	798.39	631.28	252.27
FINAL EXHAUST TEMP	818.98	713.88	587.39	384.23	797.36	709.95	575.69	275.69
Coolant Temperature IN DEG F	162	160.57813	162	163.96875	158.40625	159.5	161.96875	160.53125
Coolant Temperature OUT DEG F	175	171	170	168.01563	171.5	170	169.39063	164
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.49	13.23	10.60	7.70	7.59	6.23	5.36	1.95
Exhaust Restriction (mmHg)	6.10	4.84	3.05	1.60	4.86	3.32	1.66	0.36
Exhaust Restriction (inH2O)	3.27	2.59	1.63	0.86	2.60	1.78	0.89	0.19
EXHAUST FLOW LB/HR	1009.64	906.91	777.07	619.82	622.60	539.18	477.92	208.89
FUEL /AIR RATIO	0.0385	0.0325	0.0262	0.0135	0.0483	0.0404	0.0310	0.0071
J CONVER	0.9162	0.9277	0.9393	0.9630	0.8978	0.9125	0.9303	0.9749
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	**7.7**	**6.5**	**5.3**	**2.8**	**9.6**	**8.0**	**6.3**	**1.7**
CO PPM DRY	**102.6**	**86.4**	**64.7**	**166.0**	**91.0**	**54.5**	**61.9**	**175.7**
NOX PPM DRY	**711.7**	**537.4**	**385.0**	**142.5**	**1049.4**	**869.7**	**635.1**	**200.4**
NO PPM DRY	**693.5**	**510.8**	**368.3**	**128.0**	**1016.6**	**836.2**	**616.0**	**167.9**
NO2 PPM DRY	18.2	26.6	16.7	14.4	32.8	33.5	19.1	32.5
%O2								
NO WET	635.3571	473.7997	345.9598	123.3090	912.7109	763.0580	573.1029	163.6516
NO2 WET	16.6689	24.6785	15.6801	13.8766	29.4347	30.5555	17.7627	31.6878
CO2 WET	7.0088	6.0298	4.9679	2.6528	8.6191	7.3045	5.8608	1.7046
CO WET	0.0094	0.0080	0.0061	0.0160	0.0082	0.0050	0.0058	0.0171
G	0.0008	0.0015	0.0023	0.0037	-0.0003	0.0006	0.0017	0.0045
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0020	-0.0024	-0.0035
HUM&TEM CORR FACTOR	1.0380	1.0392	1.0381	1.0353	1.0374	1.0384	1.0412	1.0563
NO CORR	612.0867	455.9467	333.2715	119.1031	879.7674	734.8432	550.4118	154.9339
NO2 CORR	16.0584	23.7486	15.1050	13.4032	28.3723	29.4257	17.0595	29.9998
GAS EMISSIONS								
NO GR/HR	290.45	194.35	121.72	34.70	257.44	186.22	123.64	15.21
NO2 GR/HR	11.67	15.51	8.45	5.98	12.72	11.42	5.87	4.51
CO2 GR/HR	48756.35	37677.46	26598.27	11329.01	36973.72	27136.06	19299.11	2453.32
CO GR/HR	41.59	31.84	20.67	43.41	22.29	11.74	12.06	15.67
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	**5388**	**3605**	**2258**	**644**	**4776**	**3454**	**2293**	**282**
NO2 CFM 5 ppm	**706**	**938**	**511**	**362**	**769**	**691**	**355**	**273**
CO2 CFM 5000 ppm	**3072**	**2374**	**1676**	**714**	**2329**	**1710**	**1216**	**155**
CO CFM 50 ppm	**413**	**316**	**205**	**431**	**222**	**117**	**120**	**156**
NOX ppm - wet EURO, EPA, ISO	652.03	498.48	361.64	137.19	942.15	793.61	590.87	195.34
NOX ppm(corr) EURO,EPA,ISO	628.15	479.70	348.38	132.51	908.14	764.27	567.47	184.93
NOX GR/HR EURO, EPA, ISO	456.62	313.23	194.91	59.13	407.09	296.70	195.27	27.81
NOX cfm EURO, EPA, ISO	5525	3790	2358	715	4925	3590	2362	337
PARTICULATE EMISSIONS								
Modal Particulate emission (gr/hr)	10.25	12.52	10.94	8.71	8.87	6.98	7.02	1.71
weight factor	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.15
Weighted Particulate (gr/hr)	1.54	1.88	1.64	0.87	0.89	0.70	0.70	0.26
Weighted HP	12.603	9.626	6.425	0.937	7.129	5.309	3.601	0.165
Weighted Average HP	45.794 HP							
Weighted Average PARTICULATE	8.473 GR/HR							
	0.185 **(GR/HP-HR)**							
PARTICULATE INDEX (PI) CFM	4986.119							

COMPANY NAME Isuzu
DATE 8/26/2008
ENGINE MODEL Isuzu 4JG1T
COMMENTS: Stepan SB-W Biodiesel fuel; Engine only, EC/OC sample

PART 7, SUBPART E, CATEGORY B

TEST DATA / MODE NUMBER	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
RPM	2499.5	2499.8	2499.7	2499.0	1800.2	1799.7	1799.7	997.5
TORQUE lbft	177.2	134.7	90.1	20.4	207.0	155.1	105.1	5.3
HORSEPOWER	84.3	64.1	42.9	9.7	70.9	53.2	36.0	1.0
Barometric Pressure INHG	28.65	28.65	28.64	28.64	28.63	28.63	28.63	28.62
Laminar flow air temp DEG F	58.80	58.89	59.00	59.13	59.09	59.27	59.29	59.18
Laminar flow diff pressure in. of H2O	4.35	3.93	3.39	2.72	2.64	2.31	2.05	0.91
Laminar Flow cfm	221.74	200.57	173.10	139.72	135.24	118.65	105.59	46.89
Altitude Barrel Air (degF)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Air Entering Manifold/Turbo (degF)	68.00	68.00	68.00	68.00	69.00	70.00	70.00	72.00
Boost/Air In Manifold (degF)	304.13	252.84	194.83	130.50	224.20	177.77	139.50	88.48
Altitude Barrel Pressure (inHg)	28.58	28.58	28.58	28.58	28.57	28.56	28.56	28.56
Altitude (ft)	1262	1259	1260	1261	1267	1278	1276	1277
Intake AIR Consumption lbs/hr	970.61	877.74	757.13	610.72	591.11	518.18	461.05	204.79
LAB FACTOR-NA	1.021	1.021	1.021	1.022	1.023	1.025	1.024	1.027
LAB FACTOR-TURBO	0.997	0.998	0.998	0.998	1.001	1.004	1.003	1.009
Intake Air Temperature DEG F	68.00	68.00	68.00	68.00	69.00	70.00	70.00	72.00
TurboCharged Air TemperaturedeF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Turbocharged Air Pressure (psi)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boost Air Temp(@manifold) degF	304.13	252.84	194.83	130.50	224.20	177.77	139.50	88.48
Boost air Pressure (@manifold) psi	20.77	15.57	9.76	3.72	12.50	8.03	4.65	0.10
FUEL Temperature DEG F	97.19	92.44	92.58	92.00	90.00	88.00	86.03	86.95
FUEL Consumption lbs/hr	37.68	28.69	20.09	8.18	28.33	20.89	14.44	1.03
DEW Point DEG F	48.98	48.90	49.18	49.39	49.40	49.54	49.70	49.70
Grains Water (H2O) per lb dry air	52.95	52.80	53.38	53.79	53.84	54.15	54.45	54.51
Oil Temperature DEG F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exhaust Temperature DEG F	896.45	769.39	628.89	383.77	941.47	803.09	632.98	243.64
FINAL EXHAUST TEMP	817.50	712.20	589.31	382.16	805.19	712.84	576.94	266.80
Coolant Temperature IN DEG F	161	161	162	163.70313	159.10938	159.07813	162	160.15625
Coolant Temperature OUT DEG F	174	171.03125	170	168.03125	172.09375	169.54688	169.95313	164
Oil Pressure PSI	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Inlet Restriction ("H2O)	15.50	13.25	10.62	7.72	7.51	6.25	5.39	1.97
Exhaust Restriction (mmHg)	6.19	4.90	3.07	1.55	4.70	3.38	1.77	0.34
Exhaust Restriction (inH2O)	3.31	2.62	1.64	0.83	2.51	1.81	0.95	0.18
EXHAUST FLOW LB/HR	1008.29	906.43	777.23	618.90	619.44	539.07	475.49	205.81
FUEL /AIR RATIO	0.0388	0.0327	0.0265	0.0134	0.0479	0.0403	0.0313	0.0050
J CONVER	0.9158	0.9273	0.9386	0.9631	0.8985	0.9127	0.9294	0.9786
ECH4 % DRY	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO2 % DRY	7.7	6.5	5.3	2.8	9.6	8.0	6.3	1.7
CO PPM DRY	103.2	84.9	62.2	162.1	88.8	53.8	61.0	186.5
NOX PPM DRY	715.7	529.2	383.8	139.7	1031.2	873.8	623.2	188.1
NO PPM DRY	686.1	511.9	366.6	123.6	1004.3	836.5	597.3	162.5
NO2 PPM DRY	29.6	17.3	17.2	16.1	26.9	37.3	25.9	25.6
%O2								
NO WET	628.3021	474.6596	344.0803	119.0019	902.4049	763.4420	555.1444	158.9822
NO2 WET	27.1265	16.0560	16.1737	15.5122	24.2042	34.0261	24.1044	25.0867
CO2 WET	7.0513	6.0272	4.9747	2.6711	8.6259	7.3200	5.8555	1.6637
CO WET	0.0094	0.0079	0.0058	0.0156	0.0080	0.0049	0.0057	0.0182
G	0.0008	0.0015	0.0022	0.0037	-0.0003	0.0006	0.0017	0.0047
R	-0.0021	-0.0024	-0.0026	-0.0032	-0.0017	-0.0020	-0.0024	-0.0036
HUM&TEM CORR FACTOR	1.0389	1.0389	1.0369	1.0344	1.0379	1.0379	1.0381	1.0498
NO CORR	604.7491	456.9040	331.8322	115.0465	869.4823	735.5772	534.7655	151.4469
NO2 CORR	26.1096	15.4554	15.5960	14.9966	23.3212	32.7842	23.2195	23.8976
GAS EMISSIONS								
NO GR/HR	286.59	194.65	121.22	33.46	253.14	186.37	119.51	14.65
NO2 GR/HR	18.95	10.09	8.73	6.68	10.40	12.72	7.95	3.54
CO2 GR/HR	48986.53	37641.50	26640.10	11390.28	36814.62	27188.20	19183.18	2359.19
CO GR/HR	41.72	31.24	19.89	42.31	21.64	11.59	11.81	16.45
VENTILLATION RATES								
PART 7, SUBPART E CATEGORY B								
NO CFM 25 ppm	5316	3611	2249	621	4696	3457	2217	272
NO2 CFM 5 ppm	1147	610	528	404	629	770	481	214
CO2 CFM 5000 ppm	3086	2371	1678	718	2319	1713	1209	149
CO CFM 50 ppm	415	310	198	420	215	115	117	163
NOX ppm - wet EURO, EPA, ISO	655.43	490.72	360.25	134.51	926.61	797.47	579.25	184.07
NOX ppm(corr) EURO,EPA,ISO	630.86	472.36	347.43	130.04	892.80	768.36	557.99	175.34
NOX GR/HR EURO, EPA, ISO	457.98	308.28	194.42	57.95	398.18	298.23	191.03	25.98
NOX cfm EURO, EPA, ISO	5541	3730	2352	701	4817	3608	2311	314

DPM EC/OC DATA

EC	TWA (ug/m3)	11039	14446	8586	5776	18845	9164	6920	---
OC	TWA (ug/m3)	14971	18924	20382	17186	14225	16967	18635	12244
TC	TWA (ug/m3)	26009	33370	28968	22962	33070	26132	25556	12564