Emissions & Fuel Efficiency Study

Georgia Ports Authority Diesel Vehicle Fleet
Garden City, Georgia
June 21, 2010
WPC Project No. ES107005

Prepared for:
Georgia Ports Authority
Garden City, Georgia

Prepared by:
WPC, A Terracon Company
Savannah, Georgia

June 21, 2010

Georgia Ports Authority
2 Main Street
Garden City, Georgia 31408

Attn: Mr. Wilson Tillotson, P.E.

Re: Emissions & Fuel Efficiency Study
Georgia Ports Authority Diesel Vehicle Fleet
Garden City, Georgia
WPC Project Number: ES107005

Dear Mr. Tillotson:

WPC, Inc. – A Terracon Company (WPC) is pleased to submit the enclosed Emissions & Fuel Efficiency Study for the Georgia Ports Authority Diesel Vehicle Fleet. We appreciate the opportunity to provide this study for you. Please contact us if you have questions regarding this information or if we can provide any other services.

Sincerely,

WPC, Inc. – A Terracon Company

Prepared by:

Joseph R. Ross, Jr., MS, P.E.
Environmental Department Manager

Reviewed by:

William S. Anderson, III, P.E.
Senior Principal

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EMISSIONS & FUEL EFFICIENCY STUDY
GEORGIA PORTS AUTHORITY DIESEL VEHICLE FLEET

Garden City, Georgia
Project No. ES107005
June 21, 2010

EXECUTIVE SUMMARY

WPC, Inc. – A Terracon Company (WPC) in conjunction with Georgia Ports Authority (GPA) performed diesel engine emissions and fuel efficiency monitoring for the diesel vehicle fleet at GPA. The purpose of this study was to determine whether a fuel additive selected by GPA was effective in reducing pollutant emissions and increasing engine fuel efficiency. The result of this study indicates that the fuel additive provided for testing does in fact reduce EPA Criteria Pollutant emissions and improves fuel efficiency.

Beginning in January of 2010, WPC and GPA began conducting baseline monitoring of the diesel vehicle fleet at GPA Garden City Terminal. The diesel vehicle fleet, for the purposes of this study included sixty-four (64) Rubber-Tire Gantry Cranes (RTGs) and forty (40) Jockey Trucks. Baseline monitoring of the fleet consisted of the collection of emissions and fuel consumption data over an approximately four week period. During this period all vehicles utilized low-sulfur diesel fuel as normal. Following this period, the selected fuel additive was added to the GPA fuel storage tanks and the fleet utilized the additive-enhanced fuel for a period of approximately eight weeks to allow effective 'burn-in' of the engine. Following this eight week period, WPC and GPA resumed monitoring activities for a three week period while the fleet vehicles continued to use the additive-enhanced fuel. Emissions and fuel consumption monitoring were conducted separately and concurrently over this period in order to minimize data variance.

For the emissions monitoring, the primary pollutants of concern were the byproducts of incomplete combustion, and more specifically those listed by the EPA as Criteria Pollutants. With complete combustion, the byproducts generated are CO_2 and water; however, this is theoretical in nature. The result of incomplete combustion of diesel fuel is the generation of water, CO_2, CO, NO_X, SO_2, and particulate matter (PM_{10}). Of these CO, NO_2, SO_2, and PM_{10} are Criteria Pollutants, as designated by the EPA. During monitoring of engine emissions, WPC collected data for the combustion byproducts at both engine idle and throttled, or revved, conditions for both the RTGs and Jockey Trucks. The data collected was extrapolated and statistically interpreted using confidence interval determinations in order to produce a predictable data range.

Monitoring of fuel consumption was conducted for the RTG fleet at GPA and consisted of the collection of continuous data related to engine hours of operation and total fuel consumed. The data was then segregated based on the engine model associated with each RTG and then extrapolated. Total fuel consumed and total engine operating hours over each monitoring period were determined and average fuel consumption per hour was calculated. The fuel consumption rate for each engine model was then determined and modeled against the baseline.

Results of the study indicated with a confidence level of 99% that the concentrations of the Criteria Pollutants NO_2, CO, and PM_{10} decreased from the results of baseline testing. Furthermore, this confidence level is maintained for both idle and revved engine states of both RTGs and Jockey Trucks. For both RTGs and Jockey Trucks, the data associated with SO_2 monitoring was inconclusive. Fuel efficiency monitoring indicated that the rate of fuel consumption (Gal/Hr) was reduced by approximately 5% over the testing period. Furthermore, it was also determined that the age and/or model may affect fuel efficiency.

1.0 INTRODUCTION

WPC has completed the Emissions & Fuel Efficiency Study for the Georgia Ports Authority diesel vehicle fleet. The purpose of this study was to determine the effectiveness of a diesel fuel additive in reducing exhaust pollutants and increasing fuel efficiency. In determining this effectiveness WPC and GPA conducted separate, but concurrent testing both before and after the implementation of the fuel additive. The following report has been prepared with the intent of documenting our field procedures, describing our data analysis procedures, and presenting our results and conclusions.

Problem Statement:

Does low-sulfur diesel additive-enhanced fuel produce lower concentrations of combustion byproducts than low-sulfur diesel fuel alone?

AND

Does additive-enhanced diesel fuel reduce engine fuel consumption rates?

Hypothesis:

The GPA selected fuel additive improves engine combustion efficiency, thereby increasing the ratio of complete-to-incomplete combustion, which reduces the formation of incomplete combustion byproducts and reduces fuel consumption.

Project Goals:

Provide GPA with a study that allows for a calculated decision-making process based on sound environmental and economic data for determining whether to incorporate the selected fuel additive on a continuing basis.

2.0 PROJECT BACKGROUND

2.1 Vehicle Specifications

2.1.1 Rubber-Tire Gantry Cranes

GPA is currently equipped with approximately 70 rubber-tire gantry cranes (RTGs) that move along the container stacks. The purpose of the RTGs is to transfer shipping containers from the mobile Jockey Trucks into the stationary container stacks. Movement of the containers is controlled by a single diesel engine on each RTG which energizes the electric container hoist.

The current inventory and specifications of the RTGs at Garden City Terminal is presented below:

GPA Identification	Engine Manufacturer	Engine Model	Engine Age	Engine Horsepower
RTG39 to RTG77	Volvo	Penta D12	2008	449/1800
RTG78 to RTG94	Caterpillar	3406 & 3456	1998 to 2003	475 & 493
RTG95 to RTG110	Cummins	QSX15	2009	665/2100

2.1.2 Jockey Trucks

GPA is currently equipped with approximately 60 Jockey Trucks (Yard Hustlers) that move throughout the Garden City Terminal. The Jockey Trucks are each responsible for moving containers between the Savannah River, the container stacks, and the intermodal facilities. Each Jockey Truck is equipped with a 160hp Cummins diesel engine; however the age of each engine varies.

2.2 Fuel Additive Specifications

For the purpose of the emissions and fuel efficiency study of the diesel vehicle fleet, GPA selected Power Kleen™, manufactured by Hydrotex, as the fuel additive of choice. The key specifications of the selected additive are provided in the following table:

Power Kleen™[1]

Test Description	ASTM No.	Typical Properties
API Gravity		40
Sulfur Content	D-5453	1.4 ppm
Flash Point, TCC °F (°C)	D-56	45 (7.2)
Ash Content, %		none
Lubricity Improvement, BOCLE	D-6078	600-3100 gram load increase
Lubricity Improvement, HFFR	D-6079	10-60 micrometers wear scar red.
Injector Cleanliness		CRC Rating of 5.1 for Cummins L-10 Superior Detergency
Water Tolerance	D-1094	Pass Fuel Clarity, Interface & Water
Stability Test, 180 Min @ 150°C		>80% Filter Pad Reflectance
Shelf Life		Indefinite in sealed container
Color		Blue-Green

[1] Technical Data Sheet, Hydrotex, Power Kleen™, EPA Registered 017120005

Recommended Treatment Ratios

Performance Improvement	Amount of Power Kleen	Treats Amount of Fuel
First Treatment for Injector Clean-Up	1 Gallon	1,000 Gallons
Injector Keep-Clean	1 Gallon	2,200 Gallons

As a general rule, there is a 3-5% decrease in the thermal energy content of fuel for every 10 degree increase in API gravity. This decrease in energy content will result in roughly the same percentage decrease in engine power.[2]

Details regarding the fuel additive utilized have been presented in Appendix IV.

3.0 METHODS AND PROCEDURES

3.1 Emissions Testing

For the purposes of emissions testing, WPC personnel conducted individual research for the purposes of determining the constituents of concern present in diesel fuel exhaust. It was determined that diesel engines do not fully complete the combustion of diesel fuel into CO_2 and water vapor. As a result the incomplete combustion of diesel fuel can most nearly be represented by the following unbalanced equation:

$$C_{12}H_{23}S_{TRACE} + O2 + N2 \rightarrow H_2O + CO + CO_2 + O_2 + NO_X + SO_X + \text{hydrocarbons}$$

From this equation NO_X is created as a result of the fixation of atmospheric nitrogen, however it may also include the conversion of any trace amounts of nitrogen present in the fuel. SO_X is created as a result of the oxidation of the sulfur present within the fuel and is dependent on the sulfur content of the fuel. The presence of CO is a measure of the efficiency of the combustion process, whereas higher CO concentrations typically indicate reduced combustion efficiency. CO_2 and Water are produced as a result of the completion of the combustion process.

In addition to the formation of gaseous byproducts, combustion of diesel fuel also produces particulate matter which results from incombustible fuel components including sulfur. Therefore in order to properly assess the diesel exhaust a full spectrum analysis of both the gaseous compounds and particulate matter was necessary. All emissions monitoring was conducted in accordance with the EPA's Engine Testing Procedures (40 CFR Part 1065). This standard identifies procedures for selection of measurement equipment, engine preparation, and field testing. Based on the technological capabilities of the equipment on the market and need for all testing equipment to be portable, the following components were selected to

[2] Hydrotex

monitor:

- Oxygen (O_2)
- Nitrogen Oxide (NO)
- Nitrogen Dioxide (NO_2)
- Total Nitrogen Oxides (NO_X)
- Carbon Monoxide (CO)
- Carbon Dioxide (CO_2)
- Sulfur Dioxide (SO_2)
- Particulate Matter, < 10μm (PM_{10})

The EPA currently classifies NO_2, CO, SO_2, PM_{10} and $PM_{2.5}$ as Criteria Pollutants for which Ambient Air Quality Standards have been developed. In the case of diesel fuel exhaust, particulate matter can range in size from large particulate (soot) diameter to ultrafine particles capable of penetrating deep into the lungs. PM10 encompasses the entire spectrum and was thereby selected for analysis.

In addition to selecting the proper compounds for measurement, selection of the proper instrumentation was equally important. As testing procedures would be conducted on a mobile basis, not only was it necessary for the instrumentation to be portable but also for there to be as few instruments as possible. Based on currently available technology, no single piece of monitoring equipment was available for monitoring all of the components. As such, the following three pieces of monitoring equipment were selected and are discussed further in Section 3.3.1:

- Testo 350 XL
  - Monitor: O_2, NO, NO_2, NO_X, CO, CO_2, SO_2
- TSI Dusttrak 8530
  - Monitor: PM_{10}
- PhotoVac MicroFID
  - Monitor: Total Hydrocarbons

Detailed equipment specifications are provided in Appendix III.

3.1.1 Testing Equipment

3.1.1.1 Testo 350 XL

The Testo 350 XL is designed for short-term industrial stack gas monitoring, combustion analysis and Flue Gas Monitoring. The readings can be printed on board or saved by PC downloading. A complete Peltier gas preparation unit for controlled condensate removal is also standard.

Specifications:

- Oxygen
  - Range: 0% to 21%
  - Accuracy: 2% of max. volume
- Carbon Monoxide
  - Range: 0 to 10,000 ppm
  - Accuracy: 5 ppm
- Nitrogen Oxide
  - Range: 0 to 3,000 ppm
  - Accuracy: 5 ppm
- Nitrogen Dioxide
  - Range: 0 to 500 ppm
  - Accuracy: 5 ppm
- Sulfur Dioxide
  - Range: 0 to 500 ppm
  - Accuracy: 5 ppm
- Carbon Dioxide
  - Calculated as a % based on % Oxygen and Fuel Type

3.1.1.2 TSI DustTrak 8530

TSI 8530 DustTrak II Aerosol Monitor is a desktop battery-operated, data-logging, light-scattering laser photometer that gives you real-time aerosol mass readings. It uses a sheath air system that isolates the aerosol in the optics chamber to keep the optics clean for improved reliability and low maintenance. It is suitable for clean office settings as well as harsh industrial workplaces, construction and environmental sites, and other outdoor applications. The DustTrak II Aerosol Monitor measures aerosol contaminants such as dust, smoke, fumes, and mists.

Specifications:

- Particulate Matter
  - Measures: PM_1, $PM_{2.5}$ and PM_{10} non-concurrently
  - Range: 0.001 to 150.0 mg/m^3
  - Accuracy: 5% based on flow

3.1.1.3 Photovac MicroFID

A small and lightweight FID (Flame Ionization Detector) with built-in datalogging, the Photovac MicroFID allows trouble-free measurement of soil gases when the response-factor consistency of a FID is mandatory, or when methane must be included in the total reading.

Specifications:

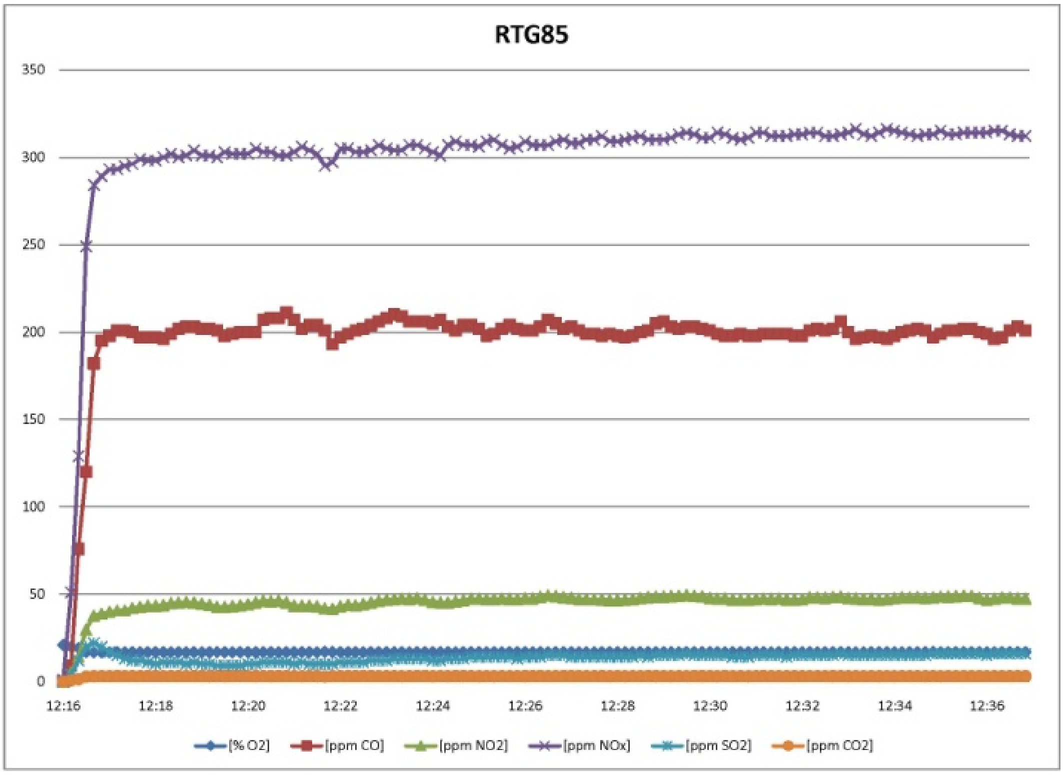
- Total VOCs
    - Range: 0.1 to 50,000 ppm as methane equivalents
    - Accuracy: 0.5 ppm methane

3.1.2 Testing Procedures

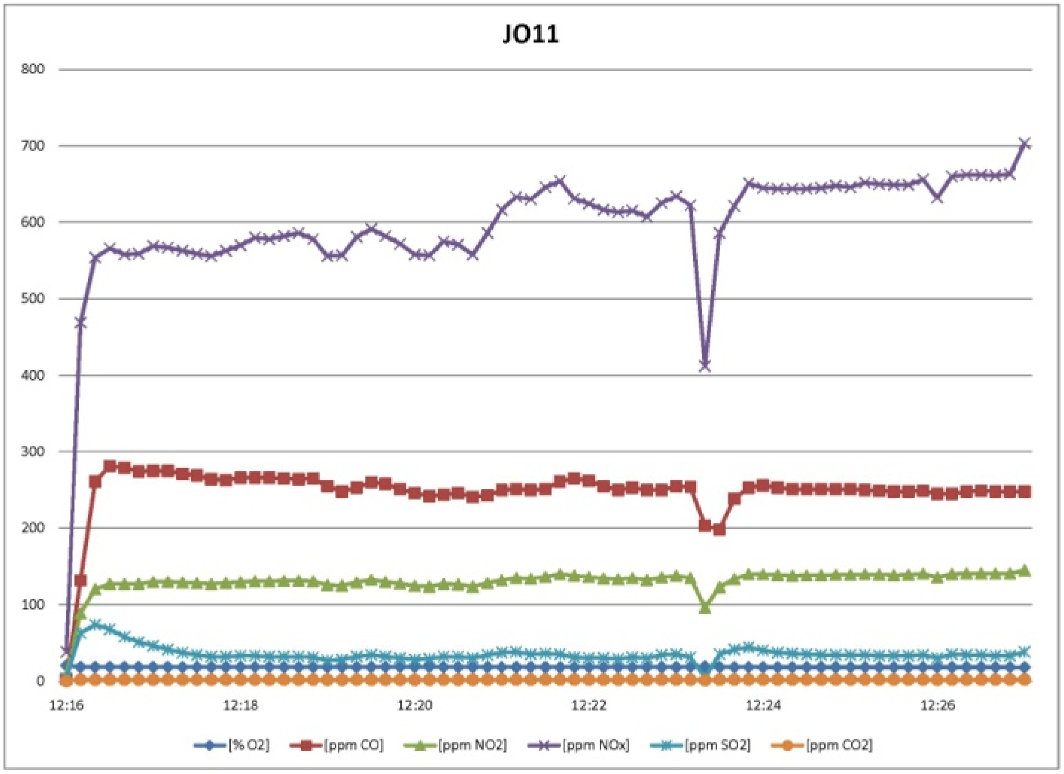
Testing of diesel exhaust emissions was conducted by WPC for the fleet of RTGs and Jockey Trucks. Because emission rates vary as a result of engine revolutions and power required, WPC completed testing for each engine at both an idle and throttled/revved engine revolution, where possible. As a result of the inherent design of several RTGs, as mentioned in Section 2.1, engine revving was not possible unless the crane was in the process of raising/lowering a container.

Prior to beginning the baseline testing of the RTGs and Jockey Trucks, WPC conducted emissions testing of one RTG and one Jockey Truck. The purpose of this initial test was twofold: first, to understand the volatility of the data collected and second, to determine the appropriate length of testing for each vehicle.

Prior to testing, each engine was turned on and allowed to run at an idle rate for a period of approximately 30 minutes to allow for proper heating of the engine. Each of the three pieces of monitoring equipment were turned on and set to log data on 10 second intervals. Their inlet piping/tubing were then placed directly into the center of the exhaust flow located at the apex of the exhaust pipe for the RTG and Jockey Truck, respectively. With the monitoring equipment running, the tests were allowed to proceed for a period of approximately thirty minutes. Following completion of the tests, the data collected was downloaded and plotted on a concentration versus time scale, as shown in Graph 3.1.2.A and Graph 3.1.2.B.



Graph 3.1.2.A – Plot of Concentration vs. Time for RTG 85



Graph 3.1.2.B – Plot of Concentration vs. Time for Jockey Truck 11

As can be seen by the concentration vs. time plots presented, with the exception of NO_X concentrations for JO-11, the concentration levels stabilize to near constant levels after approximately 1.5 minutes. And for the most part, SO2 concentrations were the last component to stabilize. Utilizing this initial information, the test length was set to last between 5 and 7 minutes for all subsequent baseline and additive testing.

3.1.2.1 Baseline Testing Procedures

Full-scale baseline testing of the RTGs and Jockey Trucks at GPA began on January 27th, 2010 and continued through February 17, 2010. Because of the operation of Garden City Terminal on a 24/7 basis, coordination with shipping schedules was necessary to ensure that this study did not interfere with operation of GPA. As a result, testing of the RTGs on-site was conducted during a short window of time at night between work shifts. Following completion of the work shift, the RTG operator would leave the RTG parked and running in order to maintain the engine temperature.

For each RTG test, WPC personnel ascended in a JLG man-lift to the engine exhaust outlet at the top of each RTG. For dual speed RTGs, the engine was initially set at a revved speed of approximately 2800 RPM. Each of the three pieces of monitoring equipment were turned on and set to log data on 10 second intervals. Their inlet piping/tubing were then placed directly into the center of the exhaust flow located at the apex of the exhaust pipe. With the monitoring equipment running, the tests were allowed to proceed for a period of approximately five to seven minutes. Following completion of the test, the engine, if capable, would be set to the lower idle speed (approximately 800 RPM) and the test would be repeated. Once testing had been completed for the RTG, the man-lift was lowered and moved to the next waiting RTG where the procedure was repeated. On average, between 5 and 8 RTGs could be tested each evening.

Jockey Truck testing was completed in one full day on February 20, 2010. For testing purposes, a batch of Jockey Trucks were turned on and allowed to sit idle while testing began, in order to heat the engines. All of the Jockey Trucks were capable of having their RPM programmed and therefore every Jockey Truck was monitored at both an idle (800 RPM) and revved (1800 RPM) speed. Prior to monitoring, each of the three pieces of monitoring equipment were turned on and set to log data on 10 second intervals. Their inlet piping/tubing were then placed directly into the center of the exhaust flow located at the apex of the exhaust pipe. With the monitoring equipment running, the tests were allowed to proceed for a period of approximately five to seven minutes. For each Jockey Truck, the idle speed test was conducted first followed by the revved test.

During the baseline testing procedures, a series of malfunctions occurred with the Photovac MicroFID during the data collection procedures. The MicroFID operates by measuring combustible vapors through the use of a controlled hydrogen flame. However, when this flame comes in contact with moisture the flame extinguishes and the equipment ceases to measure data. The manufacturer of this equipment provided a carbon filter in order to remove moisture from the incoming air flow; however, use of this filter was ineffective. In an effort to resolve the issues, WPC spent a significant allotment of time troubleshooting the equipment and discussing the malfunctions with the equipment vendors and manufacturers. The result of the diagnosis was that the exhaust stream contained too great of moisture content for the proper use of the equipment. As such, use of the MicroFID was discontinued after the baseline testing was completed.

3.1.2.2 Additive Testing Procedures

Following completion of the baseline testing, the selected fuel additive was added to the GPA fuel supply with every fuel drop. Both the RTGs and the Jockey Trucks were allowed to run for a period of approximately eight weeks in order to allow the additive's cleaning processes to function fully. This eight week period was effectively called the 'burn-in' period since during this time, the additive is effectively cleaning the engine of deposits. Testing of the RTGs and Jockey Trucks with the additive-enhanced diesel fuel began on April 20, 2010 and continued through May 7, 2010. The testing procedures described in Section 3.1.2.1 were completed in the exact same manner in order to minimize data discrepancies.

3.2 Fuel Efficiency Testing

For the purposes of this study, fuel efficiency testing and monitoring was conducted for the on-site RTGs and Jockey Trucks. Proper measurement and testing activities required the coordination of personnel and careful diligence in monitoring the data logging procedures. The primary modes of data logging for this testing process included maintaining fuel logs and operating logs for each RTG and the fleet of Jockey Trucks.

3.2.1 Fuel Additive Procedures

Bulk fuel is delivered to GPA on an as-needed basis, which is usually at least once per week. Fuel is brought into Garden City Terminal by tanker trucks which typically provide 5,000 gallons to the facility per trip. Based on the recommendations for the use of the selected additive, the fuel additive was amended with the fuel source at a rate of 1 gallon of additive per 1,000 gallons of fuel. Therefore, the total amount of additive used during each fuel drop varied as a result of the total fuel to be delivered. Regardless, the procedure began with measuring out the required additive prior to fuel drop and adding this volume to the empty GPA storage tank. The fuel drop would then proceed and the agitation force of the fuel entering the storage tank would provide sufficient blending of the additive with the fuel.

3.2.2 Measurement Procedures

Monitoring of the RTGs and Jockey Trucks was conducted to determine the average amount of fuel consumed per hour by the engines within the GPA fleet. Baseline testing was conducted using ultra low sulfur diesel fuel under conditions as they existed prior to mixing the fuel additive. Once the baseline had been established, the fuel additive was introduced to the ground tank diesel supply and subsequently consumed by the equipment over the course of eight weeks. After this equalization period was complete, testing resumed by measuring the average amount of fuel consumed per hour by the main engine with the additive.

3.2.2.1 Baseline Testing Procedures

On January 28, 2010, monitoring of the RTG fuel consumption rate began at GPA. The procedure was initiated by moving around to each of 64 RTGs on the property and completely filling each fuel tank and recording the operating meter time on the main engine. This step created the initial conditions for each of the RTGs. For a period of two weeks, ending February 11, 2010, the RTGs were operated normally and were refilled with fuel on an as needed basis.

The fuel volume dispensed to each RTG was recorded on a daily fuel log which was transferred to a tabulated form. Following completion of the two week testing period, each RTG fuel tank was refilled and the operating meter time on the main engine was recorded.

On January 12, monitoring of the Jockey Truck fuel consumption rate began at GPA. The procedure was initiated by measuring the total fuel consumed per day by the 60 Jockey Trucks as a fleet. Fuel consumption data was not available for January 26th and therefore, WPC utilized the average fuel consumption over the remainder of the month (1,132 gallons per day) for this day. The hours of utilization per week for each Jockey Truck was then determined with the assistance of Tyco. For a period of four weeks, the Jockey Trucks were operated normally and were refilled with fuel on an as needed basis. The fuel volume dispensed to each RTG was recorded on a daily fuel log which was transferred to a tabulated form.

3.2.2.2 Additive Testing Procedures

On April 15, 2010, monitoring of the RTG fuel consumption rate at GPA began again for the purpose of determining the effect of the fuel additive on the engine efficiency. The testing procedures described in Section 3.2.2.1 were completed in the exact same manner in order to minimize data discrepancies.

On May 4, 2010, monitoring of the Jockey Truck fuel consumption rate at GPA began again for the purpose of determining the effect of the fuel additive on the engine efficiency. The testing procedures described in Section 3.2.2.1 were completed in the exact same manner in order to minimize data discrepancies.

4.0 DATA ANALYSIS

4.1 Emissions Testing

Upon completion of the emissions monitoring at GPA, the data collected from the Testo 350 XL and the TSI DustTrak were segregated and compiled into two groups: RTGs and Jockey Trucks. Further segregation of the data was performed in order to separate tests conducted at idle speeds from those conducted at revved speeds. The following sections describe the data collected and the analysis performed on the data sets.

4.1.1 RTG Crane Data

Following organization of the data collected from the RTGs, WPC determined that a total of 44 RTGs had been tested during the baseline testing and additive testing phases of the study. Due to scheduling conflicts as a result of normal operations at the port, the 44 RTGs tested were not all the same from the baseline testing to the additive testing phases. Based on the data collected, a total of 31 RTGs were completed both for baseline and additive testing at an idle engine speed. For the revved engine speed, a total of 30 RTGs were completed both for baseline and additive testing.

As previously discussed, initial testing of the RTGs and Jockey Trucks indicated that the data stabilized to near constant values after approximately 1.5 minutes into each test. This first 1.5 minutes represented the time period during which the equipment was replacing clean air with the exhaust air and was not representative of actual conditions. In order to analyze the relevant data from each test, WPC carefully reviewed each data set and truncated the non-constant portion of the data. The arithmetic mean of the remaining data was then found to determine the average concentration. Table 4.1.1.A provides an example of how the non-constant "warm-up" data was truncated (shown in red).

Table 4.1.1.A – Example of Data Truncation and Arithmetic Mean Determination

Date	Time	[% O2]	[ppm CO]	[ppm NO]	[ppm NO2]	[ppm NOx]	[ppm SO2]
2/16/2010	6:50:03 PM	18.74	6	156	21.1	178	14
2/16/2010	6:50:13 PM	18.73	50	168	32.1	200	16
2/16/2010	6:50:23 PM	18.71	129	169	33.7	203	12
2/16/2010	6:50:33 PM	18.70	153	169	34.2	203	10
2/16/2010	6:50:43 PM	18.70	162	169	34.6	204	8
2/16/2010	6:50:53 PM	18.70	168	169	35.0	204	7
2/16/2010	6:51:03 PM	18.70	170	170	35.3	205	7
2/16/2010	6:51:13 PM	18.71	171	170	35.9	206	7
2/16/2010	6:51:23 PM	18.73	173	172	35.7	208	6
2/16/2010	6:51:33 PM	18.72	175	170	36.2	207	6
2/16/2010	6:51:43 PM	18.72	178	171	36.6	207	5
2/16/2010	6:51:53 PM	18.72	178	171	36.4	207	5
2/16/2010	6:52:03 PM	18.71	178	171	36.4	207	5
2/16/2010	6:52:13 PM	18.71	178	172	36.9	209	5
2/16/2010	6:52:23 PM	18.71	181	171	36.6	208	5
2/16/2010	6:52:33 PM	18.70	183	173	36.9	210	5
2/16/2010	6:52:43 PM	18.70	183	174	36.9	211	5
2/16/2010	6:52:53 PM	18.71	181	173	37.1	210	5
2/16/2010	6:53:03 PM	18.70	181	172	37.1	209	4
2/16/2010	6:53:13 PM	18.72	182	172	37.1	209	5
2/16/2010	6:53:23 PM	18.69	183	173	37.3	210	5
2/16/2010	6:53:33 PM	18.69	184	173	37.8	211	5
2/16/2010	6:53:43 PM	18.69	185	172	37.5	210	5
2/16/2010	6:53:53 PM	18.69	186	173	37.5	210	5
2/16/2010	6:54:03 PM	18.69	186	172	37.3	209	4
2/16/2010	6:54:13 PM	18.70	187	172	37.5	209	5
2/16/2010	6:54:23 PM	18.70	186	171	37.5	209	5
2/16/2010	6:54:33 PM	18.67	186	172	37.8	210	4
2/16/2010	6:54:43 PM	18.70	187	172	37.8	210	5
2/16/2010	6:54:53 PM	18.69	187	172	37.5	210	4
2/16/2010	6:55:03 PM	18.68	187	173	37.1	210	4
2/16/2010	6:55:13 PM	18.69	188	174	38.4	213	5
2/16/2010	6:55:23 PM	18.68	190	174	38.4	212	5
averages		18.70	183.70	172.30	37.28	209.57	4.78

This process was continued until an average value for all measured constituents was determined for both the baseline and additive testing.

For an initial comparison of the baseline and additive testing results determined above, the percent change in concentration from the baseline test to the additive test was determined by the following equation:

$$\%\ Change = \frac{Additive - Baseline}{Baseline} \times 100\%$$

The result was that each RTG engine subsequently had an average increase/decrease for the idle and revved tests. Taking the arithmetic mean of this data enabled the determination of an average change in concentration for all of the idle tests and all of the revved tests conducted on RTGs for a particular compound.

With these single values for each compound calculated, a single assumption was made that the data sets for both the idle and revved tests were large enough to be considered normally distributed. Based on this assumption, the standard deviation was then determined. The final analysis included calculating the 95% and 99% confidence interval for each average change in concentration.

Appendix I provides the data summary tables which illustrate the stepwise calculations described above.

4.1.2 Jockey Truck Data

Following organization of the data collected from the Jockey Trucks, WPC determined that a total of 40 Jockey Trucks had been tested during the baseline testing and additive testing phases of the study. Due to scheduling conflicts as a result of normal operations at the port, the 40 Jockey Trucks tested were not all the same from the baseline testing to the additive testing phases. Based on the data collected, a total of 35 Jockey Trucks were completed both for baseline and additive testing at an idle and revved engine speed.

Interpretation of the Jockey Truck data was significantly more uniform as each vehicle engine had both an idle and a matching revved test. Analysis of the data from the Jockey Trucks was conducted in the same manner as described in Section 4.1.1. Data summary tables are provided in Appendix I.

4.2 Fuel Efficiency Testing

4.2.1 RTG Crane Data

Following organization of the data collected from the RTGs, WPC determined that a total of 64 RTGs had been fuel efficiency tested during the baseline testing and additive testing phases of the study. Due to maintenance activities on two of RTGs, only 62 machines were analyzed during both the baseline testing and additive testing.

Data analysis of the fuel consumption data involved segregating the RTGs based on their engine manufacturer. Subsequently, this also segregated the RTGs based on their engine age, as well. For each engine testing phase the total hours of utilization was determined based on the difference between the time meter reading at the beginning and end of each test phase. The total fuel consumed was measured on a daily basis, the sum of which was deemed to be the total fuel utilization. In order to determine the fuel utilization rate for each individual RTG the following equation was utilized:

$$Fuel\ Utilization\ Rate\ (\frac{Gal}{hr}) = \frac{Total\ Fuel\ Utilized\ (Gal)}{Total\ Hours\ of\ Utilization\ (hr)}$$

The fuel utilization rate for each group of RTGs, based on engine model, was determined by the following equation:

$$Group\ Fuel\ Utilization\ Rate\ \left(\frac{Gal}{hr}\right) = \frac{\sum Total\ Fuel\ Utilized\ by\ Group}{\sum Total\ Hours\ of\ Utilization\ for\ Group}$$

Data summary tables are provided in Appendix II.

4.2.2 Jockey Truck Data

Following organization of the data collected from the Jockey Trucks, WPC determined that a total of 60 Jockey Trucks had been fuel efficiency tested during the baseline testing and additive testing phases of the study. For each engine testing phase the total hours of utilization was determined based on the difference between the time meter reading at the beginning and end of each week. The total fuel consumed was measured on a daily basis, the sum of which was deemed to be the total fuel utilization. In order to determine the fuel utilization rate for each individual Jockey Truck the following equation was utilized:

$$Fuel\ Utilization\ Rate\ (\frac{Gal}{hr}) = \frac{Total\ Fuel\ Utilized\ (Gal)}{Total\ Hours\ of\ Utilization\ (hr)}$$

The fuel utilization rate for the fleet of Jockey Trucks, was determined by the following equation:

$$Group\ Fuel\ Utilization\ Rate\ \left(\frac{Gal}{hr}\right) = \frac{\sum Total\ Fuel\ Utilized\ by\ Group}{\sum Total\ Hours\ of\ Utilization\ for\ Group}$$

Data summary tables are provided in Appendix II.

5.0 RESULTS

5.1 Emissions Testing

5.1.1 RTG Crane Results

5.1.1.1 Idle Speed Testing Results

	Average Increase/ (Decrease)	95% Confidence Interval	99% Confidence Interval
O_2	(1.06%)	±1.12%	±1.48%
NO	14.16%	±13.39%	±17.60%
NO_2	(14.04%)	±5.07%	±6.66%
NO_X	8.47%	±11.46%	±15.06%
CO	(23.54%)	±2.63%	±3.46%
CO_2	9.65%	±8.68%	±11.41%
SO_2	(17.24%)	±24.77%	±32.56%
PM_{10}	(33.42%)	±18.86%	±24.78%

5.1.1.2 Revved Speed Testing Results

	Average Increase/ (Decrease)	95% Confidence Interval	99% Confidence Interval
O_2	(0.14%)	±0.66%	±0.87%
NO	1.20%	±4.17%	±5.48%
NO_2	(10.13%)	±3.82%	±5.01%
NO_X	(1.13%)	±3.76%	±4.94%
CO	(9.00%)	±3.77%	±4.95%
CO_2	1.06%	±3.30%	±4.33%
SO_2	304.10%	±478.76%	±629.20%
PM_{10}	(51.77%)	±11.16%	±14.66%

5.1.2 Jockey Truck Results

5.1.2.1 Idle Speed Testing Results

	Average Increase/ (Decrease)	95% Confidence Interval	99% Confidence Interval
O_2	1.31%	±0.53%	±0.70%
NO	(15.05%)	±4.16%	±5.46%
NO_2	(20.11%)	±5.89%	±7.74%
NO_X	(16.47%)	±4.09%	±5.38%
CO	(28.93%)	±6.69%	±8.80%
CO_2	(-7.71%)	±3.06%	±4.03%
SO_2	210.65%	±182.34%	±239.63%
PM_{10}	(65.29%)	±7.84%	±10.30%

5.1.2.2 Revved Speed Testing Results

	Average Increase/ (Decrease)	95% Confidence Interval	99% Confidence Interval
O_2	1.47%	±0.76%	±1.00%
NO	(23.08%)	±4.08%	±5.37%
NO_2	(19.07%)	±5.95%	±7.82%
NO_X	(22.37%)	±4.19%	±5.50%
CO	(17.32%)	±6.49%	±8.52%
CO_2	(6.33%)	±3.69%	±4.85%
SO_2	(1.63%)	±29.22%	±38.40%
PM_{10}	(71.49%)	±5.16%	±6.78%

5.1.3 Predicted Results vs. Actual Results

Based on laboratory scale testing of the selected fuel additive on a Cummins L10 engine, NOX concentrations were found to decrease by 1.66%, CO concentrations by 19.76%, and PM by 11.08%.[3] Field testing indicated greater decreases in the constituents of concern on average than the laboratory scale tests at an idle engine speed. Results were similar for the revved engine speed with the exception of CO, for which the laboratory result was found to be within the 99% confidence interval for the trial.

5.2 Fuel Efficiency Testing

5.2.1 RTG Crane Results

	Baseline (Gal/Hr)	Post-Additive (Gal/Hr)	Percent Change
Cummins	3.80	3.67	3.42 %
Volvo	5.71	5.41	5.11 %
Caterpillar	4.67	4.14	11.19 %
Entire Fleet	**5.11**	**4.83**	**5.48 %**

5.2.1 Jockey Truck Results

	Baseline (Gal/Hr)	Post-Additive (Gal/Hr)	Percent Change
Entire Fleet	**1.96**	**1.88**	**4.35 %**

5.2.3 Predicted Results vs. Actual Results

Based on the laboratory scale testing of the selected fuel additive, fuel efficiency was found to increase between 4% and 6.5% as compared to standard ultra-low diesel fuels.[4] Compared to the RTG and Jockey Truck fleet, the field results were found to be within the laboratory determined fuel efficiency improvement range.

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[3] Testing performed by the Lubrizol Corporation
[4] Id.

6.0 CONCLUSIONS

WPC and GPA have completed a study of the selected fuel additive and its effect on diesel fuel combustion byproducts and fuel efficiency. The data indicates with strong confidence levels that the selected additive reduced the concentration of EPA Criteria Pollutants in the engine exhaust for RTGs and Jockey Trucks. Based on the testing results, WPC concludes that the greatest decreases in emissions are observed during revved engine tests. Based on the assumption that the data collected represent a normal distribution, WPC concludes that with a confidence level of 99%:

- RTG Cranes
  - The change in NO_2 concentrations lies within a 5.12% and 15.14% decrease from background concentrations.
  - The change in CO concentrations lies within a 4.05% and 13.95% decrease from background concentrations.
  - The change in PM_{10} concentrations lies within a 37.11% and 66.43% decrease from background concentrations.
- Jockey Trucks
  - The change in NO_2 concentrations lies within an 11.25% and 26.89% decrease from background concentrations.
  - The change in CO concentrations lies within an 8.80% and 25.84% decrease from background concentrations.
  - The change in PM_{10} concentrations lies within a 64.71% and 78.27% decrease from background concentrations.

With respect to fuel efficiency, WPC concludes that the greatest decrease in fuel consumption was experienced by the Caterpillar engines (11.16%). Furthermore, these engines are also the oldest engines in the fleet. Overall, WPC concludes that additive-enriched fuel consumption was reduced over the entire RTG fleet by 5.48% when compared with baseline fuel consumption. Similarly, WPC concludes that additive-enriched fuel consumption was reduced over the entire Jockey Truck fleet by 4.35% when compared with baseline fuel consumption.

Overall, SO2 concentrations were found to be highly variable from the baseline to post-additive testing with concentrations increasing and decreasing across the broad range of engines. The source of SO2 in engine emissions is directly related to the sulfur content of the fuel utilized, which in this case was ultra-low sulfur diesel (<15 ppm sulfur). Although the results of this test with relation to SO2 reduction are inconclusive, the low sulfur content of the fuel inherently indicates that current sulfur emissions are in-line with EPA requirements regardless of the presence/absence of the fuel additive.

7.0 LIMITATIONS

The purpose of this study was to determine whether the addition of a fuel additive to the diesel fuel supply at GPA would decrease emissions and increase fuel efficiency. As such, there were limitations in the scope of the study which may or may not impact the results observed. Specifically, the following variables were not addressed in relating baseline data to post-additive data:

- Air Temperature/Humidity
- Exhaust Temperature
- Variation in Diesel Fuel Supply
- Total Daily Engine Run-Time
- Length of the 'Burn-In' Period

Based on the purpose and objectives of this study, the limitations described herein do not alter the conclusions of the study.

APPENDIX I

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 40	Idle	1/27/2020	18.93	163	44	207	168	1.51	19	22.4
		4/22/2010	18.86	161	34	195	117	1.56	12	4.77
			-0.37%	-1.23%	-22.73%	-5.80%	-30.36%	3.48%	-36.84%	-78.71%
	Revved	1/27/2010	17.02	224	58	282	196	2.94	18	56.6
		4/22/2010	16.95	217	46	263	157	2.99	7	31.3
			-0.41%	-3.13%	-20.69%	-6.74%	-19.90%	1.79%	-61.11%	-44.70%
RTG 41	Idle	2/17/2010	18.74	164	41	205	202	1.65	5	13.7
		4/22/2010	17.92	276	47	323	138	2.26	7	6.43
			-4.38%	68.29%	14.63%	57.56%	-31.68%	37.27%	40.00%	-53.07%
	Revved	2/17/2010	17.10	230	48	278	186	2.88	1.39	54.5
		4/22/2010	17.12	224	50	274	175	2.86	5.58	34.5
			0.12%	-2.61%	4.17%	-1.44%	-5.91%	-0.52%	301.44%	-36.70%
RTG 42	Idle	1/28/2010	18.67	180	52	232	212	1.70	21.79	7.08
		4/21/2010	17.34	340	50	390	128	2.70	5.84	2.95
			-7.12%	88.89%	-3.85%	68.10%	-39.62%	58.59%	-73.20%	-58.33%
	Revved	1/28/2010	16.93	231	63	294	220	3.01	20.17	119
		4/21/2010	16.68	240	48	288	179	3.19	6.14	22.6
			-1.48%	3.90%	-23.81%	-2.04%	-18.64%	6.23%	-69.56%	-81.01%
RTG 43	Idle	2/1/2010	17.72	278	58	336	171	2.41	15.00	2.33
		4/21/2010	18.83	164	37	201	133	1.58	14.52	6.21
			6.26%	-41.01%	-36.21%	-40.18%	-22.22%	-34.47%	-3.20%	166.52%
	Revved	2/1/2010	17.43	188	51	239	167	2.63	16.76	62.1
		4/21/2010	16.86	227	47	274	159	3.06	12.29	27.9
			-3.27%	20.74%	-7.84%	14.64%	-4.79%	16.24%	-26.67%	-55.07%
RTG 48	Idle	1/28/2010	17.20	366	68	434	167	2.80	12.41	5.12
		4/20/2010	17.38	337	54	391	142	2.67	3.15	
			1.05%	-7.92%	-20.59%	-9.91%	-14.97%	-4.81%	-74.62%	-100.00%
	Revved	1/28/2010	17.08	222	59	281	204	2.89	18.39	112
		4/20/2010	17.09	218	49	267	171	2.89	8.66	
			0.06%	-1.80%	-16.95%	-4.98%	-16.18%	-0.26%	-52.91%	-100.00%
RTG 49	Idle	2/1/2010	17.92	256	55	311	182	2.26	13.00	7.33
		4/21/2010	17.25	352	51	403	119	2.77	10.26	6.47
			-3.74%	37.50%	-7.27%	29.58%	-34.62%	22.19%	-21.08%	-11.73%
	Revved	2/1/2010	17.17	202	53	255	187	2.83	15.93	106
		4/21/2010	16.95	224	49	273	170	2.99	10.71	30.3
			-1.28%	10.89%	-7.55%	7.06%	-9.09%	5.84%	-32.77%	-71.42%

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 50	Idle	2/3/2010	17.93	270	54	324	168	2.26	13.14	17.40
		4/26/2010	17.34	317	46	363	111	2.70	4.12	7.03
			-3.29%	17.41%	-14.81%	12.04%	-33.93%	19.60%	-68.65%	-59.60%
	Revved	2/3/2010	17.01	221	46	267	203	2.95	11.08	145
		4/26/2010	16.86	212	46	258	166	3.06	5.38	35.2
			-0.88%	-4.07%	0.00%	-3.37%	-18.23%	3.82%	-51.44%	-75.72%
RTG 51	Idle	2/1/2010	17.87	282	52	334	132	2.30	9.63	10.20
		4/21/2010	17.35	341	46	387	95	2.69	4.92	5.48
			-2.91%	20.92%	-11.54%	15.87%	-28.03%	16.94%	-48.91%	-46.27%
	Revved	2/3/2010	17.25	203	44	247	160	2.77	10.75	134
		4/21/2010	17.00	228	45	273	145	2.95	5.59	23.5
			-1.45%	12.32%	2.27%	10.53%	-9.38%	6.78%	-48.00%	-82.46%
RTG 52	Idle	2/1/2010	17.21	352	67	419	168	2.80	6.69	10.80
		4/21/2010	17.93	270	47	317	142	2.26	17.96	7.18
			4.18%	-23.30%	-29.85%	-24.34%	-15.48%	-19.30%	168.46%	-33.52%
	Revved	2/3/2010	18.25	153	37	190	131	2.02	12.66	142
		4/21/2010	17.44	206	46	252	155	2.62	15.57	33.4
			-4.44%	34.64%	24.32%	32.63%	18.32%	30.11%	22.99%	-76.48%
RTG 53	Idle	2/16/2010	18.67	163	41	204	192	1.70	4.96	20.10
		4/27/2010	18.30	221	41	262	153	1.98	15.04	12.6
			-1.98%	35.58%	0.00%	28.43%	-20.31%	16.30%	203.23%	-37.31%
	Revved	2/16/2010	16.96	218	51	269	189	2.98	0.18	98.7
		4/27/2010	17.10	210	47	257	172	2.88	12.23	45.7
			0.83%	-3.67%	-7.84%	-4.46%	-8.99%	-3.52%	6694.44%	-53.70%
RTG 54	Idle	2/3/2010	18.85	147	47	194	203	1.57	18.77	21.70
		4/27/2010	18.98	144	38	182	171	1.47	11.04	6.63
			0.69%	-2.04%	-19.15%	-6.19%	-15.76%	-6.22%	-41.18%	-69.45%
	Revved	2/3/2010	17.51	199	50	249	182	2.57	13.17	138
		4/27/2010	17.16	216	49	265	186	2.83	7.00	37.00
			-2.00%	8.54%	-2.00%	6.43%	2.20%	10.20%	-46.85%	-73.19%
RTG 56	Idle	1/27/2010	18.81	195	49	244	207	1.60	18.14	20.80
		4/27/2010	18.43	202	39	241	142	1.88	6.68	5.88
			-2.02%	3.59%	-20.41%	-1.23%	-31.40%	17.84%	-63.18%	-71.73%
	Revved	1/27/2010	17.17	216	49	265	168	2.83	13.32	52
		4/27/2010	16.96	201	45	246	178	2.98	1.71	48.20
			-1.22%	-6.94%	-8.16%	-7.17%	5.95%	5.57%	-87.16%	-7.31%

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 57	Idle	2/3/2010	18.70	168	42	210	180	1.68	17.32	13.50
		4/26/2010	18.70	168	37	205	139	1.68	9.21	3.51
			0.00%	0.00%	-11.90%	-2.38%	-22.78%	0.00%	-46.82%	-74.00%
	Revved	2/3/2010	17.11	209	49	258	184	2.87	13.46	126
		4/26/2010	16.82	222	47	269	173	3.09	2.86	28.80
			-1.69%	6.22%	-4.08%	4.26%	-5.98%	7.57%	-78.75%	-77.14%
RTG 58	Idle	2/16/2010	18.77	150	42	192	231	1.63	8.42	13.10
		4/27/2010	18.96	146	37	183	166	1.48	9.82	5.86
			1.01%	-2.67%	-11.90%	-4.69%	-28.14%	-8.76%	16.63%	-55.27%
	Revved	2/16/2010	16.74	240	51	291	202	3.15	0.40	92.30
		4/27/2010	17.13	204	47	251	189	2.86	6.17	38.40
			2.33%	-15.00%	-7.84%	-13.75%	-6.44%	-9.29%	1442.50%	-58.40%
RTG 59	Idle	2/3/2010	18.21	236	51	287	177	2.05	13.52	29.00
		4/26/2010	17.83	267	46	313	132	2.33	6.73	5.11
			-2.09%	13.14%	-9.80%	9.06%	-25.42%	13.92%	-50.22%	-82.38%
	Revved	2/3/2010	16.79	218	55	273	199	3.11	14.46	144.00
		4/26/2010	16.82	214	47	261	170	3.09	5.64	44.10
			0.18%	-1.83%	-14.55%	-4.40%	-14.57%	-0.72%	-61.00%	-69.38%
RTG 60	Idle	2/3/2010								
		4/27/2010								
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/3/2010								
		4/26/2010								
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
RTG 62	Idle	2/16/2010	18.69	165	41	206	202	1.69	5.92	17.40
		4/27/2010	18.83	167	35	202	145	1.58	11.61	6.67
			0.75%	1.21%	-14.63%	-1.94%	-28.22%	-6.22%	96.11%	-61.67%
	Revved	2/16/2010	16.61	250	55	305	216	3.25	0.00	88.50
		4/27/2010	16.70	244	47	291	189	3.18	7.03	40.10
			0.54%	-2.40%	-14.55%	-4.59%	-12.50%	-2.08%	#DIV/0!	-54.69%
RTG 63	Idle	2/3/2010	17.57	311	66	377	175	2.53	12.71	15.40
		4/26/2010	17.40	306	48	354	128	2.65	5.89	5.86
			-0.97%	-1.61%	-27.27%	-6.10%	-26.86%	5.04%	-53.66%	-61.95%
	Revved	2/3/2010	16.92	214	60	274	201	3.01	17.23	136.00
		4/26/2010	16.96	200	47	247	180	2.98	7.46	39.70
			0.24%	-6.54%	-21.67%	-9.85%	-10.45%	-1.00%	-56.70%	-70.81%

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 65	Idle	1/28/2010	18.93	163	47	210	184	1.51	21.54	6.36
		4/21/2010	17.30	351	52	403	130	2.73	6.81	3.84
			-8.61%	115.34%	10.64%	91.90%	-29.35%	81.09%	-68.38%	-39.62%
	Revved	1/28/2010	16.87	232	63	295	213	3.05	21.28	41.40
		4/21/2010	16.66	238	47	285	176	3.21	7.11	34.50
			-1.24%	2.59%	-25.40%	-3.39%	-17.37%	5.16%	-66.59%	-16.67%
RTG 66	Idle	2/16/2010	18.70	172	37	209	184	1.68	4.78	11.30
		4/27/2010	17.59	297	45	342	139	2.51	4.92	6.99
			-5.94%	72.67%	21.62%	63.64%	-24.46%	49.55%	2.93%	-38.14%
	Revved	2/16/2010	16.61	222	45	267	184	3.25	0.00	66.90
		4/27/2010	17.09	193	44	237	185	2.89	6.83	43.90
			2.89%	-13.06%	-2.22%	-11.24%	0.54%	-11.09%	#DIV/0!	-34.38%
RTG 69	Idle	2/1/2010	18.67	169	47	216	212	1.70	19.93	5.62
		4/21/2010	18.60	179	37	216	145	1.75	9.81	4.72
			-0.37%	5.92%	-21.28%	0.00%	-31.60%	3.08%	-50.78%	-16.01%
	Revved	2/1/2010	16.89	220	53	273	201	3.04	15.50	84.50
		4/21/2010	16.34	250	43	293	161	3.45	1.04	35.90
			-3.26%	13.64%	-18.87%	7.33%	-19.90%	13.58%	-93.29%	-57.51%
RTG 70	Idle	2/1/2010	18.70	167	47	214	181	1.68	17.97	11.40
		4/21/2010	17.67	318	50	368	139	2.45	9.13	6.3
			-5.51%	90.42%	6.38%	71.96%	-23.20%	45.98%	-49.19%	-44.74%
	Revved	2/1/2010	16.85	210	52	262	171	3.07	14.04	108.00
		4/21/2010	16.86	226	50	276	176	3.06	8.39	41.60
			0.06%	7.62%	-3.85%	5.34%	2.92%	-0.24%	-40.24%	-61.48%
RTG 71	Idle	1/28/2010	18.68	190	51	241	199	1.69	20.78	8.11
		4/20/2010	17.95	283	49	332	153	2.24	7.43	
			-3.91%	48.95%	-3.92%	37.76%	-23.12%	32.30%	-64.24%	-100.00%
	Revved	1/28/2010	16.71	251	61	312	209	3.17	16.85	127.00
		4/20/2010	16.73	251	49	300	175	3.16	5.85	
			0.12%	0.00%	-19.67%	-3.85%	-16.27%	-0.47%	-65.28%	-100.00%
RTG 72	Idle	1/28/2010	18.75	166	45	211	188	1.64	19.17	7.61
		4/20/2010	18.87	158	38	196	150	1.55	12.47	
			0.64%	-4.82%	-15.56%	-7.11%	-20.21%	-5.48%	-34.95%	-100.00%
	Revved	1/28/2010	16.75	227	57	284	215	3.14	16.83	124.00
		4/20/2010	17.00	216	49	265	184	2.95	8.63	
			1.49%	-4.85%	-14.04%	-6.69%	-14.42%	-5.97%	-48.72%	-100.00%

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 73	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	1/28/2010								86.40
		4/20/2010								
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	-100.00%
RTG 74	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
RTG 77	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
RTG 79	Idle	2/11/2010	17.76	170	42	212	236	2.38	0.00	126.00
		4/28/2010	17.83	166	36	202	200	2.33	2.96	144
			0.39%	-2.35%	-14.29%	-4.72%	-15.25%	-2.20%	#DIV/0!	14.29%
	Revved									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
RTG 81	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/17/2010	17.65	162	50	212	362	2.47	3.45	73.00
		4/28/2010	17.92	156	37	193	253	2.26	1.85	40.6
			1.53%	-3.70%	-26.00%	-8.96%	-30.11%	-8.21%	-46.38%	-44.38%
RTG 82	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/11/2010	17.27	203	43	246	269	2.75	0.00	137.00
		4/27/2010	17.64	180	42	222	273	2.47	6.12	133
			2.14%	-11.33%	-2.33%	-9.76%	1.49%	-10.08%	#DIV/0!	-2.92%

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 83	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/17/2010	17.68	168	46	214	294	2.44	2.14	150.00
		4/28/2010	17.84	188	41	229	217	2.32	5.38	150
			0.90%	11.90%	-10.87%	7.01%	-26.19%	-4.91%	151.40%	0.00%
RTG 85	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/17/2010	17.59	199	42	241	194	2.51	4.43	150.00
		4/28/2010	17.44	234	40	274	170	2.62	4.30	150.00
			-0.85%	17.59%	-4.76%	13.69%	-12.37%	4.48%	-2.93%	0.00%
RTG 88	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/17/2010	17.27	234	39	273	157	2.75	0.60	150.00
		4/28/2010	17.48	230	34	264	170	2.59	2.27	150.00
			1.22%	-1.71%	-12.82%	-3.30%	8.28%	-5.72%	278.33%	0.00%
RTG 89	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/11/2010	16.89	254	43	297	191	3.04	0.00	150.00
		4/27/2010	17.51	203	36	239	178	2.57	3.21	121.00
			3.67%	-20.08%	-16.28%	-19.53%	-6.81%	-15.31%	#DIV/0!	-19.33%
RTG 94	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
RTG 99	Idle	2/16/2010	18.19	190	38	228	175	2.06	4.56	50.40
		4/26/2010	18.40	139	25	164	143	1.90	2.81	44.3
			1.15%	-26.84%	-34.21%	-28.07%	-18.29%	-7.64%	-38.38%	-12.10%
	Revved									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 101	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved	2/16/2010	18.05	185	35	220	172	2.17	3.83	85.60
		4/26/2010	18.23	163	28	191	163	2.03	5.82	61.30
			1.00%	-11.89%	-20.00%	-13.18%	-5.23%	-6.23%	51.96%	-28.39%
RTG 103	Idle									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Revved									
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
RTG 104	Idle	2/3/2010	18.24	176	41	217	185	2.02	13.12	40.40
		4/26/2010	18.36	156	28	184	152	1.93	4.41	47.7
			0.66%	-11.36%	-31.71%	-15.21%	-17.84%	-4.44%	-66.39%	18.07%
	Revved					0		15.70		
						0		15.70		
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	#DIV/0!	#DIV/0!
RTG 105	Idle	1/27/2010	18.44	141	33	174	158	1.87	12.33	53.00
		4/22/2010	18.40	125	23	148	136	1.90	2.69	72.4
			-0.22%	-11.35%	-30.30%	-14.94%	-13.92%	1.60%	-78.18%	36.60%
	Revved					0		15.70		
						0		15.70		
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	#DIV/0!	#DIV/0!
RTG 107	Idle	2/11/2010	18.18	147	29	176	151	2.07	4.42	54.60
		4/22/2010	18.55	144	28	172	136	1.79	8.00	46.40
			2.04%	-2.04%	-3.45%	-2.27%	-9.93%	-13.41%	81.00%	-15.02%
	Revved					0		15.70		
						0		15.70		
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	#DIV/0!	#DIV/0!
RTG 108	Idle	2/3/2010	18.42	149	39	188	182	1.89	14.42	39.90
		4/26/2010	18.45	143	29	172	147	1.87	4.53	43.20
			0.16%	-4.03%	-25.64%	-8.51%	-19.23%	-1.19%	-68.59%	8.27%
	Revved					0		15.70		
						0		15.70		
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	#DIV/0!	#DIV/0!

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
RTG 109	Idle	2/16/2010	18.41	157	34	191	165	1.90	5.76	52.40
		4/27/2010	18.44	144	28	172	149	1.87	4.81	52.20
			0.16%	-8.28%	-17.65%	-9.95%	-9.70%	-1.19%	-16.49%	-0.38%
	Revved					0		15.70		
						0		15.70		
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	#DIV/0!	#DIV/0!
RTG 110	Idle	2/16/2010	18.34	177	35	212	173	1.95	4.45	50.50
		4/26/2010	18.61	124	25	149	132	1.75	4.07	71.30
			1.47%	-29.94%	-28.57%	-29.72%	-23.70%	-10.38%	-8.54%	41.19%
	Revved					0		15.70		
						0		15.70		
			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	#DIV/0!	#DIV/0!

Rubber-Tire Gantry Crane
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
	Idle Average		-1.06%	14.16%	-14.04%	8.47%	-23.54%	9.65%	-17.24%	-33.42%
	Revved Average		-0.14%	1.20%	-10.13%	-1.13%	-9.00%	1.06%	304.10%	-51.77%
	Idle Std. Dev.		3.19%	38.05%	14.39%	32.56%	7.49%	24.67%	70.38%	53.57%
	Revved Std. Dev.		1.85%	11.66%	10.66%	10.51%	10.53%	9.21%	1337.92%	31.17%
	Idle 95% Confidence		1.12%	13.39%	5.07%	11.46%	2.63%	8.68%	24.77%	18.86%
	Idle 99% Confidence		1.48%	17.60%	6.66%	15.06%	3.46%	11.41%	32.56%	24.78%
	Rev 95% Confidence		0.66%	4.17%	3.82%	3.76%	3.77%	3.30%	478.76%	11.16%
	Rev 99% Confidence		0.87%	5.48%	5.01%	4.94%	4.95%	4.33%	629.20%	14.66%

Jockey Truck
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
JO-02	Idle	2/20/2010	18.11	226	48	274	262	2.12	0.01	11.8
		5/1/2010	18.25	194	31	225	128	2.02	5.92	5.85
			0.77%	-14.16%	-35.42%	-17.88%	-51.15%	-4.95%	59100.00%	-50.42%
	Revved	2/20/2010	17.48	93	36	129	338	2.59	5.54	106
		5/1/2010	17.45	76	23	99	258	2.62	6.35	29.1
			-0.17%	-18.28%	-36.11%	-23.26%	-23.67%	0.87%	14.62%	-72.55%
JO-03	Idle	2/20/2010	17.79	223	46	269	230	2.36	0.01	16
		5/1/2010	18.25	190	33	223	136	2.02	3.81	7.14
			2.59%	-14.80%	-28.26%	-17.10%	-40.87%	-14.60%	38000.00%	-55.38%
	Revved	2/20/2010	17.21	91	30	121	289	2.80	6.19	133
		5/1/2010	17.80	70	22	92	236	2.35	4.44	39.2
			3.43%	-23.08%	-26.67%	-23.97%	-18.34%	-15.82%	-28.27%	-70.53%
JO-04	Idle	2/20/2010	18.29	373	93	466	194	1.99	86.57	21.1
		5/1/2010	18.30	390	87	477	147	1.98	81.07	4.36
			0.05%	4.56%	-6.45%	2.36%	-24.23%	-0.38%	-6.35%	-79.34%
	Revved	2/20/2010	17.08	238	67	305	194	2.89	54.31	108
		5/1/2010	17.55	213	66	279	171	2.54	52.32	25.1
			2.75%	-10.50%	-1.49%	-8.52%	-11.86%	-12.18%	-3.66%	-76.76%
JO-05	Idle	2/20/2010	18.11	425	81	506	150	2.12	79.00	32.90
		5/1/2010	18.34	175	30	205	141	1.95	5.77	3.67
			1.27%	-58.82%	-62.96%	-59.49%	-6.00%	-8.13%	-92.70%	-88.84%
	Revved	2/20/2010	17.41	212	71	283	192	2.65	43.95	81.4
		5/1/2010	17.54	69	22	91	247	2.55	5.71	16.2
			0.75%	-67.45%	-69.01%	-67.84%	28.65%	-3.68%	-87.01%	-80.10%
JO-06	Idle	2/20/2010	17.20	207	67	274	233	2.80	48.35	19.90
		5/1/2010	18.32	171	24	195	119	1.96	0.31	9
			6.51%	-17.39%	-64.18%	-28.83%	-48.93%	-29.95%	-99.36%	-54.77%
	Revved	2/20/2010	17.04	81	31	112	371	2.92	4.30	150
		5/1/2010	17.38	67	21	88	286	2.67	1.85	99.9
			2.00%	-17.28%	-32.26%	-21.43%	-22.91%	-8.72%	-56.98%	-33.40%
JO-07	Idle	2/20/2010	17.95	200	46	246	259	2.24	5.15	14.70
		5/1/2010	18.29	153	35	188	147	1.99	7.92	17.7
			1.89%	-23.50%	-23.91%	-23.58%	-43.24%	-11.37%	53.79%	20.41%
	Revved	2/20/2010	17.19	87	31	118	320	2.81	9.65	121
		5/1/2010	17.32	66	20	86	294	2.71	4.56	25.3
			0.76%	-24.14%	-35.48%	-27.12%	-8.13%	-3.47%	-52.75%	-79.09%

Jockey Truck
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
JO-09	Idle	2/20/2010	18.36	395	104	499	216	1.93	99.48	19.30
		5/1/2010	18.51	338	98	436	197	1.82	18.77	6.41
			0.82%	-14.43%	-5.77%	-12.63%	-8.80%	-5.81%	-81.13%	-66.79%
	Revved	2/20/2010	17.52	278	74	352	207	2.56	63.19	76.6
		5/1/2010	17.56	200	70	270	203	2.53	21.46	26.3
			0.23%	-28.06%	-5.41%	-23.30%	-1.93%	-1.17%	-66.04%	-65.67%
JO-10*	Idle	2/20/2010	20.59	52	11	63	37	0.26	6.43	18.50
		5/1/2010	18.32	343	86	429	164	1.96	77.07	4.81
			-11.02%	559.62%	681.82%	580.95%	343.24%	648.57%	1098.60%	-74.00%
	Revved	2/20/2010	17.25	203	44	247	160	2.77	10.75	35
		5/1/2010	17.84	218	59	277	143	2.32	48.62	10.7
			3.42%	7.39%	34.09%	12.15%	-10.63%	-15.99%	352.28%	-69.43%
JO-11	Idle	2/20/2010	18.28	451	96	547	188	1.99	15.26	38.10
		5/1/2010	18.42	417	90	507	149	1.89	59.2	4.92
			0.77%	-7.54%	-6.25%	-7.31%	-20.74%	-5.26%	287.94%	-87.09%
	Revved	2/20/2010	17.29	289	68	357	183	2.74	20.95	100
		5/1/2010	17.47	246	63	309	152	2.60	46.32	22.2
			1.04%	-14.88%	-7.35%	-13.45%	-16.94%	-4.93%	121.10%	-77.80%
JO-14	Idle	2/20/2010	18.16	301	93	394	241	2.08	2.45	31.90
		5/1/2010	18.46	223	77	300	158	1.86	56.08	5.83
			1.65%	-25.91%	-17.20%	-23.86%	-34.44%	-10.79%	2188.98%	-81.72%
	Revved	2/20/2010	17.23	195	75	270	269	2.78	8.82	78.3
		5/1/2010	17.54	142	62	204	178	2.55	41.35	24.7
			1.80%	-27.18%	-17.33%	-24.44%	-33.83%	-8.36%	368.82%	-68.45%
JO-15	Idle	2/20/2010	18.15	410	120	530	277	2.09	86.10	43.60
		5/1/2010	18.32	345	104	449	202	1.96	77.88	9.49
			0.94%	-15.85%	-13.33%	-15.28%	-27.08%	-6.09%	-9.55%	-78.23%
	Revved	2/20/2010	16.84	193	93	286	398	3.07	55.57	148
		5/1/2010	17.19	148	73	221	250	2.81	45.35	50.10
			2.08%	-23.32%	-21.51%	-22.73%	-37.19%	-8.54%	-18.39%	-66.15%
JO-16	Idle	2/20/2010	18.34	374	110	484	255	1.95	87.45	37.30
		5/1/2010	18.42	321	105	426	215	1.89	83.28	3.18
			0.44%	-14.17%	-4.55%	-11.98%	-15.69%	-3.08%	-4.77%	-91.47%
	Revved	2/20/2010	17.13	197	83	280	345	2.86	55.92	149
		5/1/2010	17.27	156	73	229	263	2.75	49.73	35.70
			0.82%	-20.81%	-12.05%	-18.21%	-23.77%	-3.67%	-11.07%	-76.04%

Jockey Truck
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
JO-17	Idle	2/20/2010	18.37	351	101	452	221	1.93	84.35	20.80
		5/1/2010	18.53	302	86	388	162	1.81	73.16	4.1
			0.87%	-13.96%	-14.85%	-14.16%	-26.70%	-6.23%	-13.27%	-80.29%
	Revved	2/20/2010	17.27	167	81	248	337	2.75	52.74	68.6
		5/1/2010	17.54	138	61	199	204	2.55	43.15	16.20
			1.56%	-17.37%	-24.69%	-19.76%	-39.47%	-7.36%	-18.18%	-76.38%
JO-20	Idle	2/20/2010	17.90	288	109	397	315	2.28	6.50	55.40
		5/1/2010	18.32	247	70	317	131	1.96	49.2	7.22
			2.35%	-14.24%	-35.78%	-20.15%	-58.41%	-13.82%	656.92%	-86.97%
	Revved	2/20/2010	16.93	144	89	233	504	3.01	16.00	106.00
		5/1/2010	17.43	117	56	173	193	2.63	33.17	12.20
			2.95%	-18.75%	-37.08%	-25.75%	-61.71%	-12.47%	107.31%	-88.49%
JO-21	Idle	2/20/2010	17.82	229	49	278	228	2.34	2.88	8.50
		5/1/2010	18.36	189	32	221	114	1.93	20.06	5.97
			3.03%	-17.47%	-34.69%	-20.50%	-50.00%	-17.31%	596.53%	-29.76%
	Revved	2/20/2010	17.21	85	30	115	295	2.80	9.42	148.00
		5/1/2010	17.45	72	22	94	247	2.62	12.95	36.10
			1.39%	-15.29%	-26.67%	-18.26%	-16.27%	-6.43%	37.47%	-75.61%
JO-22	Idle	2/20/2010	17.73	217	52	269	287	2.41	0.65	16.30
		5/1/2010	18.21	185	31	216	123	2.05	13.08	7.86
			2.71%	-14.75%	-40.38%	-19.70%	-57.14%	-14.95%	1912.31%	-51.78%
	Revved	2/20/2010	17.16	88	35	123	353	2.83	6.43	150.00
		5/1/2010	17.36	72	24	96	266	2.68	10.05	40.50
			1.17%	-18.18%	-31.43%	-21.95%	-24.65%	-5.29%	56.30%	-73.00%
JO-24	Idle	2/20/2010	18.39	319	84	403	176	1.91	71.00	23.40
		5/1/2010	18.52	239	89	328	216	1.81	16.22	6.24
			0.71%	-25.08%	5.95%	-18.61%	22.73%	-5.10%	-77.15%	-73.33%
	Revved	2/20/2010	17.43	199	66	265	211	2.63	48.00	106.00
		5/1/2010	17.68	149	66	215	224	2.44	17.10	17.90
			1.43%	-25.13%	0.00%	-18.87%	6.16%	-7.12%	-64.38%	-83.11%
JO-25	Idle	2/20/2010	18.13	418	104	522	229	2.11	72.89	82.00
		5/1/2010	18.22	393	109	502	225	2.04	9.75	14.9
			0.50%	-5.98%	4.81%	-3.83%	-1.75%	-3.20%	-86.62%	-81.83%
	Revved	2/20/2010	17.30	246	84	330	287	2.73	51.55	129.00
		5/1/2010	17.50	198	96	294	346	2.58	22.04	24.80
			1.16%	-19.51%	14.29%	-10.91%	20.56%	-5.49%	-57.25%	-80.78%

Jockey Truck
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
JO-26	Idle	2/20/2010	17.74	244	52	296	327	2.40	1.53	13.10
		5/1/2010	18.36	160	29	189	137	1.93	8.04	6.88
			3.49%	-34.43%	-44.23%	-36.15%	-58.10%	-19.38%	425.49%	-47.48%
	Revved	2/20/2010	17.13	88	33	121	352	2.86	7.26	145.00
		5/1/2010	17.48	58	20	78	294	2.59	4.50	53.50
			2.04%	-34.09%	-39.39%	-35.54%	-16.48%	-9.19%	-38.02%	-63.10%
JO-28	Idle	2/20/2010	18.47	337	89	426	208	1.85	77.43	20.50
		5/1/2010	18.37	330	89	419	193	1.93	74.72	11.9
			-0.54%	-2.08%	0.00%	-1.64%	-7.21%	4.05%	-3.50%	-41.95%
	Revved	2/20/2010	18.19	130	63	193	279	2.06	37.40	38.50
		5/1/2010	17.33	139	72	211	274	2.71	40.78	22.90
			-4.73%	6.92%	14.29%	9.33%	-1.79%	31.27%	9.04%	-40.52%
JO-30	Idle	2/20/2010	18.73	351	102	453	240	1.66	78.74	29.40
		5/1/2010	18.48	325	76	401	133	1.84	62.8	8.23
			-1.33%	-7.41%	-25.49%	-11.48%	-44.58%	11.31%	-20.24%	-72.01%
	Revved	2/20/2010	16.94	235	58	293	164	3.00	47.96	132.00
		5/1/2010	17.63	158	58	216	162	2.48	41.67	32.80
			4.07%	-32.77%	0.00%	-26.28%	-1.22%	-17.25%	-13.12%	-75.15%
JO-44	Idle	2/20/2010	17.86	238	45	283	231	2.31	2.85	8.87
		5/1/2010	18.22	195	34	229	139	2.04	5.46	5
			2.02%	-18.07%	-24.44%	-19.08%	-39.83%	-11.69%	91.58%	-43.63%
	Revved	2/20/2010	17.25	91	34	125	323	2.77	8.05	102.00
		5/1/2010	17.42	75	23	98	273	2.64	5.05	23.10
			0.99%	-17.58%	-32.35%	-21.60%	-15.48%	-4.61%	-37.27%	-77.35%
JO-46	Idle	2/20/2010	18.32	367	85	452	165	1.96	35.74	83.30
		5/1/2010	18.37	333	84	417	136	1.93	69.74	10.5
			0.27%	-9.26%	-1.18%	-7.74%	-17.58%	-1.91%	95.13%	-87.39%
	Revved	2/20/2010	17.39	173	58	231	192	2.66	39.24	115.00
		5/1/2010	17.21	139	56	195	208	2.80	37.46	77.80
			-1.04%	-19.65%	-3.45%	-15.58%	8.33%	5.07%	-4.54%	-32.35%
JO-47	Idle	2/20/2010	18.39	470	86	556	124	1.91	93.63	37.90
		5/1/2010	18.39	415	83	498	121	1.91	18.46	17
			0.00%	-11.70%	-3.49%	-10.43%	-2.42%	0.00%	-80.28%	-55.15%
	Revved	2/20/2010	17.48	241	59	300	155	2.59	51.00	129.00
		5/1/2010	17.50	183	56	239	153	2.58	24.00	47.90
			0.11%	-24.07%	-5.08%	-20.33%	-1.29%	-0.58%	-52.94%	-62.87%

Jockey Truck
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
JO-51	Idle	2/20/2010	18.26	372	94	466	187	2.01	76.67	55.40
		5/1/2010	18.46	315	88	403	170	1.86	19.96	19.2
			1.10%	-15.32%	-6.38%	-13.52%	-9.09%	-7.46%	-73.97%	-65.34%
	Revved	2/20/2010	17.72	235	81	316	220	2.41	61.00	76.50
		5/1/2010	17.48	189	64	253	189	2.59	21.53	43.80
			-1.35%	-19.57%	-20.99%	-19.94%	-14.09%	7.45%	-64.70%	-42.75%
JO-52	Idle	2/20/2010	18.32	376	91	467	180	1.96	84.43	55.40
		5/1/2010	19.19	247	53	300	80	1.31	47.9	3.79
			4.75%	-34.31%	-41.76%	-35.76%	-55.56%	-33.21%	-43.27%	-93.16%
	Revved	2/20/2010	17.12	221	67	288	219	2.86	50.64	100.00
		5/1/2010	17.82	145	48	193	141	2.34	36.75	13.30
			4.09%	-34.39%	-28.36%	-32.99%	-35.62%	-18.32%	-27.43%	-86.70%
JO-54	Idle	2/20/2010	18.06	455	129	584	287	2.16	0.42	72.50
		5/1/2010	18.65	348	84	432	143	1.72	3.25	7.05
			3.27%	-23.52%	-34.88%	-26.03%	-50.17%	-20.49%	673.81%	-90.28%
	Revved	2/20/2010	17.25	222	83	305	308	2.77	14.83	150.00
		5/1/2010	17.58	151	54	205	169	2.52	13.74	34.60
			1.91%	-31.98%	-34.94%	-32.79%	-45.13%	-8.94%	-7.35%	-76.93%
JO-55	Idle	2/20/2010	18.43	277	83	360	217	1.88	63.61	9.11
		5/1/2010	18.45	289	77	366	160	1.87	20.08	5.21
			0.11%	4.33%	-7.23%	1.67%	-26.27%	-0.80%	-68.43%	-42.81%
	Revved	2/20/2010	17.16	181	58	239	202	2.83	44.26	80.10
		5/1/2010	17.40	153	57	210	196	2.65	21.91	14.10
			1.40%	-15.47%	-1.72%	-12.13%	-2.97%	-6.35%	-50.50%	-82.40%
JO-57	Idle	2/20/2010	18.47	442	94	536	139	1.85	91.35	29.20
		5/1/2010	18.54	388	79	467	127	1.80	35.4	2.77
			0.38%	-12.22%	-15.96%	-12.87%	-8.63%	-2.83%	-61.25%	-90.51%
	Revved	2/20/2010	17.47	254	61	315	183	2.60	56.50	149.00
		5/1/2010	17.51	201	56	257	168	2.57	33.6	2.9
			0.23%	-20.87%	-8.20%	-18.41%	-8.20%	-1.15%	-40.53%	-98.05%
JO-58	Idle	2/20/2010	18.45	472	112	584	204	1.87	95.94	20.50
		5/1/2010	18.60	396	100	496	165	1.75	18.6	6.91
			0.81%	-16.10%	-10.71%	-15.07%	-19.12%	-6.02%	-80.61%	-66.29%
	Revved	2/20/2010	17.45	255	68	323	191	2.62	53.00	99.60
		5/1/2010	17.78	176	58	234	161	2.37	29.18	21.8
			1.89%	-30.98%	-14.71%	-27.55%	-15.71%	-9.46%	-44.94%	-78.11%

Jockey Truck
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
JO-59	Idle	2/20/2010	17.79	225	50	275	261	2.36	3.00	12.00
		5/1/2010	18.26	165	31	196	141	2.01	11.73	9.37
			2.64%	-26.67%	-38.00%	-28.73%	-45.98%	-14.92%	291.00%	-21.92%
	Revved	2/20/2010	17.19	81	30	111	313	2.81	7.39	146.00
		5/1/2010	17.35	67	26	93	263	2.69	10.13	48.4
			0.93%	-17.28%	-13.33%	-16.22%	-15.97%	-4.27%	37.08%	-66.85%
JO-60	Idle	2/20/2010	18.20	429	115	544	238	2.05	92.88	31.60
		5/1/2010	18.13	413	102	515	168	2.11	88.92	4.75
			-0.38%	-3.73%	-11.30%	-5.33%	-29.41%	2.55%	-4.26%	-84.97%
	Revved	2/20/2010	17.24	223	74	297	252	2.77	53.60	150.00
		5/1/2010	17.07	182	59	241	175	2.90	42.81	15.10
			-0.99%	-18.39%	-20.27%	-18.86%	-30.56%	4.59%	-20.13%	-89.93%
JO-61	Idle	2/20/2010	18.50	324	103	427	247	1.83	75.83	17.00
		5/1/2010	18.49	312	80	392	146	1.84	68.42	6.63
			-0.05%	-3.70%	-22.33%	-8.20%	-40.89%	0.41%	-9.77%	-61.00%
	Revved	2/20/2010	17.04	181	76	257	303	2.92	48.75	105.00
		5/1/2010	18.87	84	33	117	110	1.55	25.06	31.10
			10.74%	-53.59%	-56.58%	-54.47%	-63.70%	-46.92%	-48.59%	-70.38%
JO-62	Idle	2/20/2010	18.53	269	90	359	225	1.81	8.39	33.10
		5/1/2010	18.43	301	75	376	134	1.88	65.96	8.13
			-0.54%	11.90%	-16.67%	4.74%	-40.44%	4.15%	686.17%	-75.44%
	Revved	2/20/2010	17.38	170	59	229	214	2.67	13.43	113.00
		5/1/2010	17.55	124	53	177	184	2.54	36.91	13.40
			0.98%	-27.06%	-10.17%	-22.71%	-14.02%	-4.78%	174.83%	-88.14%
JO-64	Idle	2/20/2010	18.10	392	94	486	187	2.13	84.79	18.10
		5/1/2010	18.40	323	81	404	146	1.90	71.12	7.07
			1.66%	-17.60%	-13.83%	-16.87%	-21.93%	-10.56%	-16.12%	-60.94%
	Revved	2/20/2010	17.32	236	67	303	185	2.71	54.42	40.60
		5/1/2010	17.84	193	62	255	150	2.32	48.77	22.80
			3.00%	-18.22%	-7.46%	-15.84%	-18.92%	-14.36%	-10.38%	-43.84%
JO-65	Idle	2/20/2010	18.23	348	114	462	291	2.03	89.82	27.30
		5/1/2010	18.29	301	111	412	283	1.99	21.86	8.91
			0.33%	-13.51%	-2.63%	-10.82%	-2.75%	-2.21%	-75.66%	-67.36%
	Revved	2/20/2010	17.30	170	104	274	510	2.73	58.38	64.50
		5/1/2010	17.66	154	89	243	367	2.46	23.87	11.00
			2.08%	-9.41%	-14.42%	-11.31%	-28.04%	-9.89%	-59.11%	-82.95%

Jockey Truck
Summary Data Table

Vehicle ID	Engine Rate	Date Measured	Average Percent Oxygen (%)	Average NO Concentration (ppm)	Average NO_2 Concentration (ppm)	Average NO_X Concentration (ppm)	Average CO Concentration (ppm)	Average Percent CO_2 (ppm)	Average SO_2 Concentration (ppm)	PM_{10} Concentration (mg/m^3)
	Idle Average		1.31%	-15.05%	-20.11%	-16.17%	-28.93%	-7.71%	210.65%	-65.29%
	Revved Average		1.47%	-23.08%	-19.07%	-22.37%	-17.32%	-6.33%	-1.63%	-71.49%
	Idle Std. Dev.		1.60%	12.55%	17.78%	12.35%	20.21%	9.25%	534.43%	23.67%
	Revved Std. Dev.		2.30%	12.33%	17.97%	12.64%	19.58%	11.14%	85.63%	15.56%
	Idle 95% Confidence		0.53%	4.16%	5.89%	4.09%	6.69%	3.06%	182.34%	7.84%
	Idle 99% Confidence		0.70%	5.46%	7.74%	5.38%	8.80%	4.03%	239.63%	10.30%
	Rev 95% Confidence		0.76%	4.08%	5.95%	4.19%	6.49%	3.69%	29.22%	5.16%
	Rev 99% Confidence		1.00%	5.37%	7.82%	5.50%	8.52%	4.85%	38.40%	6.78%

APPENDIX II

Georgia Ports Authority
RTG Fleet Fuel Burn Test Results

Baseline Test (1/28/2010 - 2/11/2010)

	RTG_No.	Service Start Date	Total Util. (Hrs.)	Gal./Hr.	Total Fuel (Gals.)
Cummins (variable)	99 - 110	2009	2,003	3.80	7,607
		% of Fleet Total	23%		17%
Volvo (constant)	39 - 77	'07 - '08	5,402	5.71	30,826
		% of Fleet Total	61%		69%
Caterpillar (constant)	78 - 94	'98 - '03	1,398	4.67	6,525
		% of Fleet Total	16%		15%
		Fleet Total	8,803	5.11	44,958

Additive Test (4/15/2010 - 5/8/2010)

	RTG_No.	Service Start Date	Total Util. (Hrs.)	Gal./Hr.	Total Fuel (Gals.)	Net Benefit
Cummins (variable)	99 - 110	2009	3,323	3.67	12,189	3.42%
		% of Fleet Total	23%		17%	
Volvo (constant)	39 - 77	'07 - '08	9,115	5.41	49,356	5.11%
		% of Fleet Total	62%		70%	
Caterpillar (constant)	78 - 94	'98 - '03	2,206	4.14	9,144	11.19%
		% of Fleet Total	15%		13%	
		Fleet Total	14,644	4.83	70,688	5.48%

Georgia Ports Authority
Jockey Truck Fuel Burn Study

Baseline

12-Jan	1,298
13-Jan	1,408
14-Jan	1,315
15-Jan	1,099
16-Jan	1,129
17-Jan	778
18-Jan	1,075
19-Jan	1,202
20-Jan	907
21-Jan	1,296
22-Jan	1,126
23-Jan	1,196
24-Jan	875
25-Jan	893
26-Jan	1,132
27-Jan	1,329
28-Jan	1,442
29-Jan	1,301
30-Jan	1,198
31-Jan	820
1-Feb	1,095
2-Feb	1,025
3-Feb	1,214
4-Feb	1,302
5-Feb	1,336
6-Feb	967
7-Feb	941
8-Feb	998

31,697 GL's
16,156 HR's

Baseline Burn-Rate
1.96 GL/HR

Additive

4-May	1,118
5-May	1,272
6-May	1,098
7-May	1,043
8-May	1,002
9-May	761
10-May	777
11-May	1,108
12-May	1,257
13-May	1,136
14-May	1,337
15-May	1,090
16-May	889
17-May	1,083
18-May	1,237
19-May	1,201
20-May	1,213
21-May	1,044
22-May	1,033
23-May	735
24-May	1,105
25-May	966
26-May	1,236
27-May	1,101
28-May	1,215
29-May	1,148
30-May	829
31-May	1,048
1-Jun	517

30,598 GL's
16,306 HR's

Additive Burn-Rate
1.88 GL/HR

4.35% Benefit

APPENDIX III

US: 1 800-242-3910
UK: +44 (0) 845 270 2707
Singapore: +65 6545-9350
www.ashtead-technology.com

Testo 350 XL Portable Emission Analyzer

Now available on rental or hire from Ashtead Technology the Testo 350 XL. With sample conditioning technology and electrochemical sensors, the Testo 350 XL is designed for short-term industrial stack gas monitoring, combustion analysis and Flue Gas Monitoring. The analyzer measures Oxygen (0 to 25%), Carbon Monoxide (0 to 10,000 ppm), Nitric Oxide (0 to 3,000 ppm), Nitrogen Dioxide (0 to 500 ppm), Sulfur Dioxide (0 to 5,000 ppm) and Temperature (-40 to 2,192 F) and calculates Carbon Dioxide (0 to CO2 max. volume %) and Efficiency (0 to 100%). The readings can be printed on board or saved by PC downloading. A complete Peltier gas preparation unit for controlled condensate removal is also standard.

Key Features

- Touchscreen operation for quick operation and input
- Built-in Printer and Internal Datalogger
- Battery and 240V mains operation
- Analysis unit with datalogging function allows measurement without control unit
- Highly accurate in lower ranges for CO and NO
- Optional outdoor case available on request

Applications

- Adjust industrial burners
- Measure concentrations in crude and clean gas over long periods
- Check the atmosphere of all types of process furnace
- Maintain stationary motors such as block-type thermal power stations
- Measure emissions from diesel engines and generators

Technical Specifications

Title	Value
Power	Rechargeable NiMH battery, up to 2 hours continuous operation or 115 VAC
Oxygen:	Range: 0 to 21% volume Resolution: 0.1% volume Accuracy: 2% of m.v
Carbon Monoxide:	Range: 0 to 10,000ppm (H₂S compensated Resolution: 1ppm Accuracy: 5ppm (0 - 99ppm), 5% m.v (100 - 2,000ppm), 10% m.v (2,001 - 10,000ppm)
Nitrogen Oxide:	Range: 0 to 3,000ppm Resolution: 1ppm Accuracy: 5ppm (0 - 99ppm), 5% m.v (100 - 2,000ppm), 10% m.v (2,001 - 10,000ppm)
Nitorgen Dioxide:	Range: 0 to 500ppm Resolution: 0.1ppm Accuracy: 5ppm (0 - 99ppm), 5% m.v (100 - 500ppm)
Sulphur Dioxide:	Range: 0 to 500ppm Resolution: 0.1ppm Accuracy: 5ppm (0 - 99ppm), 5% m.v (100 - 500ppm)
Temperature:	Range: -40°C to +1,200°C Accuracy: 0.5°C (-40°C to +99°C), 0.5% m.v (+100°C to +1,200°C)
Carbon Dioxide:	Range: 0 to CO₂ max volume % Resolution: 0.1% volume Accuracy: Calculated from Oxygen
Efficiency:	Range: 0 to 100%
Power:	Rechargeable NiMH (2hours operation) or 240V AC mains

Dimensions

Title	(mm)	(inch)	(kg)	(lbs)
	406 x 279 x 101 mm	16" x 11" x 4"	4 kg	9 lbs

US: 1 800-242-3910
UK: +44 (0) 845 270 2707
Singapore: +65 6545-9350
www.ashtead-technology.com

TSI DUSTRAK 8530

The new TSI 8530 DustTrak II Aerosol Monitor is a desktop battery-operated, data-logging, light-scattering laser photometer that gives you real-time aerosol mass readings. It uses a sheath air system that isolates the aerosol in the optics chamber to keep the optics clean for improved reliability and low maintenance.

It is suitable for clean office settings as well as harsh industrial workplaces, construction and environmental sites, and other outdoor applications. The DustTrak II Aerosol Monitor measures aerosol contaminants such as dust, smoke, fumes, and mists.

Key Features

- Measure aerosol concentrations corresponding to PM1, PM2.5, PM10 or Respirable size fractions
- Automatic zeroing (with optional zero module) minimizes the effect of zero drift
- Perform in-line gravimetric analysis for custom reference calibrations
- Aerosol Concentration range 0.001 to 150 mg/m3

Applications

- Industrial/occupational hygiene surveys
- Indoor air quality investigations
- Outdoor environmental monitoring
- Engineering control evaluations
- Remote monitoring / Process monitoring / Emissions monitoring
- Aerosol research studies

Technical Specifications

Title	Value
Sensor type	90° light scattering
Aerosol Concentration Range	0.001 to 150 mg/m3
Resolution	±0.1% of reading or 0.001 mg/m3, whichever is greater
Zero Stability	±0.002 mg/m3 per 24 hours at 10 sec time constant
Flow Rate	3.0 L/min set at factory, 1.40 to 3.0 L/min, user adjustable
Flow Accuracy	±5% of factory set point, internal flow controlled
Temperature Coefficient	+0.001 mg/m3 per °C
Operational Temperature	32 to 120°F (0 to 50°C)
Operational Humidity	0 to 95% RH, non-condensing
Data Logging	5 MB of on-board memory (>60,000 data points) 45 days at 1 minute logging interval
Log internal	User adjustable, 1 second to 1 hour
Analog out	User selectable output, 0 to 5 V or 4 to 20 mA User selectable scaling range
Power	Switching AC power adapter with universal line cord included, 115-240 VAC
Communications	USB (host and device) and Ethernet. Stored data accessible using flash memory drive
Alarm out	Relay or audible buzzer Relay Non-latching MOSFET switch User selectable set point -5% deadband Connector 4-pin, Mini-DIN connectors

Dimensions

Title	(mm)	(inch)	(kg)	(lbs)
Desktop Unit	13.5 x 21.6 x 22.4 cm	5.3 x 8.5 x 8.8 in.	1.6 kg, 2.0 kg -1 battery	3.5 lb, 4.5 lb -1 battery

US: 1 800-242-3910
UK: +44 (0) 845 270 2707
Singapore: +65 6545-9350
www.ashtead-technology.com

Photovac MicroFID - Intrinsically Safe

Flame Ionisation Detector (FID) now available to hire from Ashtead Technology. A small and lightweight FID (Flame Ionisation Detector) with built-in datalogging, the Photovac MicroFID allows trouble-free measurement of soil gases when the response-factor consistency of a FID is mandatory, or when methane must be included in the total reading. The MicroFID is also an appropriate instrument for leak testing, remediation efficiency checks and emergency spill response. UHP hydrogen fuel is available for purchase. Please contact our local office for a quotation for hire/ rental rates.

Key Features

Detect up to 50,000 PPM VOCs including methane

Make EPA Method 21 Fugitive Emissions Monitoring easy with the smallest and lightest FID available, the MicroFID.

Intrinsically Safe Class I, Division 1 Groups A,B,C and D

Technical Specifications

Title	Value
Operating concentration range	0.1 to 50,000 Methane equivalent (two ranges)
Accuracy	Methane (after calibration with zero air and 100PPM Methane span gas): within +/-0.5 PPM or +/- 10% of actual Methane concentration 0.1 to 2,000 PPM range.
Response time	Less than 3 seconds (to 90% FS)
Detection Limit	0.5 PPM Methane
Intrinsic Safety	Class I, Division 1, Groups A, B, C and D
Keypad	16 key silicone with tactile feedback
Display	2 Line, 16 character LCD with alphanumeric and bar graph readouts
Analog output	0 to 1 Volt full scale
Serial output	Continuous concentration modulated tone RS-232
Battery Capacity	15 Hours (snap on replacement), sealed Lead acid battery pack
Hydrogen cylinder discharge time	Greater than 11 hours

Dimensions

Title	(mm)	(inch)	(kg)	(lbs)
MicroFID Unit	435 x 98 x 188 mm	17.1" x 3.85" x 7.4"	3.7 kg	8.1lbs

APPENDIX IV

POWER KLEEN™

Diesel Fuel Improver with NitroGenesis™ Additives

EPA Registered 017120005

Give new life to your diesel fuel system with Power Kleen high nitrogen **NitroGenesis™ Additives.**

NitroGenesis Additives simplify treating all diesel fuels:

- **High Sulfur Diesel Fuel (>500 ppm sulfur)**
- **Low Sulfur Diesel Fuel (<500 ppm sulfur)**
- **Ultra Low Sulfur Diesel Fuel (<15 ppm sulfur)**
- **Biodiesel Blends B2 to B20**

The **NitroGenesis Additives** keep the entire fuel system clean. Powerful nitrogen cleaning molecules start immediately to dissolve existing deposits of carbon, gum and varnish in fuel injectors, lines and tanks and prevent their reformation.

Power Kleen is a multifunctional diesel fuel improver.

- Cleans fuel injectors
- Improves fuel economy
- Restores lost power
- Provides added fuel lubricity
- Prevents fuel system corrosion
- Stabilizes fuels against oxidation aging
- Disperses moisture that enters storage and vehicle tanks by condensation.

Power Kleen with NitroGenesis™ Additives provides the following Economical and Environmental Benefits:

HEUI Injector Clean-up – Hydraulically Actuated Electronic Unit Injectors (HEUI) requires the Superior Performance Cleaning Rating of **Power Kleen** for injector cleanliness as measured in the Cummins L-10 Injector Test.

Reduces the Carbon Footprint of Diesel Engines - Improves combustion with a 4% improvement in fuel economy in scientifically measured laboratory and field tests. Every gallon of fuel saved by reducing fuel consumption reduces approximately 23 pounds of carbon dioxide emissions.

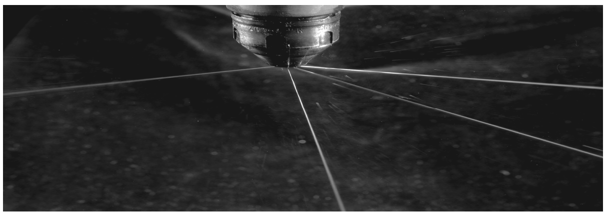
Controls Moisture Without Using Methanol or Ethanol - Prevents fuel system corrosion, filter icing and injector tip fouling.

NOTE: While NOT a biocide, **Power Kleen** changes the pH at the fuel water interface in storage tanks for extra biostatic protection.

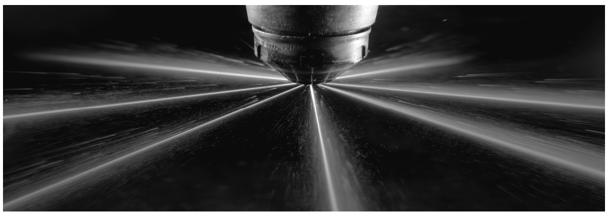
With a Typical 4% Improvement in Fuel Economy, Power Kleen Pays for Itself and Increases Profitability with Fuel Savings.

FUEL SYSTEM PERFORMANCE FEATURES

Diesel Injector Clean-Up	Diesel Injector Keep-Clean	Fuel Storage Stability
Rust & Corrosion Protection	Increase Fuel Lubricity	Moisture Control
Reduces Your Carbon Footprint	Biostatic Protection	



Untreated Fuel Spray Pattern



Power Kleen Treated Fuel Spray Pattern

Power Kleen diesel fuel additive complies with the federal low sulfur content requirements for use in diesel motor vehicles and nonroad engines using Ultra Low Sulfur Diesel fuel.

POWER KLEEN™

Diesel Fuel Improver with NitroGenesis™ Additives

TEST DESCRIPTION	ASTM NO.	TYPICAL PROPERTIES
API Gravity		40
Sulfur Content	D-5453	1.4 ppm
Flash Point, TCC °F (°C)	D-56	45 (7.2)
Ash Content, %		None
Lubricity Improvement Scuffing/Load BOCLE	D-6078	600-3100 gram load increase
Lubricity Improvement, HFRR	D-6079	10-60 micrometers wear scar reduction
Injector Cleanliness, Cummins L-10 Cat 1K Reference Fuel		CRC Rating of 5.1 for Cummins L-10 Superior Detergency
Water Tolerance	D-1094	Pass Fuel Clarity, Interface & Water
Stability Test, 180 minute @ 150°C		>80% Filter Pad Reflectance
Shelf Life		Indefinite in sealed container
Color		Blue-Green

RECOMMENDED TREATMENT RATIOS

Performance Improvement	Amount of Power Kleen		Treats Amount of Fuel	
	Storage tanks	(Vehicle tanks)	Storage tanks	(Vehicle tanks)
First Treatment for Injector Clean-Up	1 gallon	(12 oz.)	1,000 gallons	(100 gal.)
Injector Keep-Clean Improved Storage Stability Improved Lubricity Corrosion Protection Maintain Upper Cylinder Area Cleanliness	1 gallon	(12 oz.)	2,200 gallons	(200 gal.)
Emergency Diesel Generator Standby – Fuel Storage	1 gallon		500 gallons	

Quick Clean-Up of Injectors & Fuel System Prior to Emission Testing

Vehicle tank	1 gallon	100 gallons

WARRANTY:

When properly stored and used in accordance with instructions, any material not satisfactory will be replaced with any product in our line on a dollar for dollar basis provided the account is paid in full when due and Hydrotex is notified in writing within 12 months of the date of the order by the customer.

Form No. TDS 021-0609

Hydrotex® is a manufacturer and distributor of unique high performance lubricant and fuel improver solutions. As an employee owned company, we help our customers save energy, limit pollution, improve operational reliability and improve safety for employees and families. Our products and services leverage over 70 years of innovation resulting in superior lubrication solutions and high touch customer service.

MATERIAL SAFETY DATA SHEET

MSDS NUMBER: F-05
PART NUMBER: 21-0
PRODUCT NAME: POWER KLEEN
CAS NUMBER: - -0
CHEMICAL NAME: Mixture CHEMTREC EMERGENCY RESPONSE # 800-424-9300

SECTION I

MANUFACTURER: Hydrotex

ADDRESS: 12920 Senlac Drive
Farmers Branch, TX 75234

EMERGENCY TELEPHONE NUMBER: (800)424-9300

INFORMATION TELEPHONE NUMBER: (972)389-8500

DATE PREPARED: 05/19/09

HMIS RATINGS:
HEALTH: 1
FIRE: 3
REACTIVITY: 0
PERSONAL PROTECTION: G

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              /\
     HEALTH /  \ FIRE
          1 /    \ 3
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  SPEC. HAZ.\  / REACT.
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SECTION II - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

CAS NUMBER	HAZARDOUS COMPONENT	NTP	IARC	SUB-PART/Z	SARA 313	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED	PERCENT
8012-95-1	Oil mist, mineral	N	N	Y	N	5mg/m3	5mg/m3		
64742-47-8	Aliphatic Hydrocarbons	N	N	N	N	400 ppm	400 ppm		
108-88-3	Toluene	N	N	Y	Y	200 ppm	50 ppm		

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING POINT	180 Deg F.	SPECIFIC GRAVITY (H2O = 1)	0.85000
VAPOR PRESSURE (mm Hg.)	<10	MELTING POINT	NA
VAPOR DENSITY (AIR = 1)	>1	EVAPORATION RATE (Butyl Acetate = 1)	ND

SOLUBILITY IN WATER: slight

APPEARANCE AND ODOR: Dark Blue Liquid with Solvent Odor

OTHER INFORMATION: This product contains ingredients in the hazardous categories labeled under delayed health, fire. It does contain an ingredient reportable under Section 313 of SARA Title III.

All components of this material are on the US TSCA Inventory.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 45 deg F. TCC

FLAMMABLE LIMITS: LEL: ND UEL: ND

EXTINGUISHING MEDIA: Halon, Dry Chemical, Foam, CO2 and Water mist or Fog

SPECIAL FIRE FIGHTING PROCEDURES: Cool containers exposed to heat with water
Avoid breathing smoke or vapors

UNUSUAL FIRE FIGHTING PROCEDURES: Expansion of overheated containers may cause explosion hazard.

SECTION V - REACTIVITY DATA

STABILITY: Stable

INCOMPATIBILITY (MATERIALS TO AVOID): Strong Oxidizers
Avoid Open Flame

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: Oxides of Nitrogen, Carbon Monoxide , Carbon dioxide

HAZARDOUS POLYMERIZATION: Will not occur

SECTION VI - HEALTH HAZARD DATA

ROUTE(S) OF ENTRY: Eyes
Skin
Ingestion
Inhalation

HEALTH HAZARDS (ACUTE AND CHRONIC): Acute: Eyes-Irritation Ingestion-Cathartic Effect
Chronic: Skin-Irritation,Dermatitis Inhalation-Dizziness,Narcosis

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SIGNS AND SYMPTOMS OF EXPOSURE: Eye contact: May cause temporary irritation and redness. No permanent injury expected

Skin contact: Frequent or prolonged contact may irritate and cause dermatitis. Occasional brief contact will not result in significant irritation. Skin contact may aggravate an existing dermatitis condition.

Inhalation: High vapor concentrations(greater than 1,000 ppm) may be irritating to respiratory passages. Prolonged exposure may cause headaches, dizziness, nausea, or narcosis.

Ingestion: May result in nausea, vomiting, or catharsis. Harmful if aspirated into the lungs during ingestion or vomiting.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: NI

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

Skin Contact: Wash thoroughly with soap and water. Remove contaminated clothing and launder before reuse.

Inhalation: Remove affected person to fresh air. If symptoms persist, seek medical attention.

Ingestion: If Carthartic effect persists, seek medical attention. Do not induce vomiting.

OTHER HEALTH WARNINGS: NI

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Ventilate area if ventilation inadequate. Remove sources of ignition. Contain spills with dikes or absorbents to prevent migration and entry into sewers or streams. Take up small spills with absorbents. Large spills may be taken up with pump or vacuum. Use non-flammable absorbents for residue.

WASTE DISPOSAL METHOD: Dispose of recovered material or absorbent material as an industrial waste in a manner acceptable to good waste management practice and in compliance with applicable local, state and federal regulations.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Where contact is likely, long sleeves and chemical resistant gloves. Where eye contact may occur, wear safety glasses with side shields. Where concentrations in air may exceed stated limits and there is inadequate ventilation, NIOSH/MSHA approved organic vapor respirators may be neccessary. Mechanical ventilation recommended in case of spills in confined areas to maintain concentrations below exposure levels.

OTHER PRECAUTIONS: Exposure to liquids, vapors, mists or fumes should be minimized.

SECTION VIII - CONTROL MEASURES

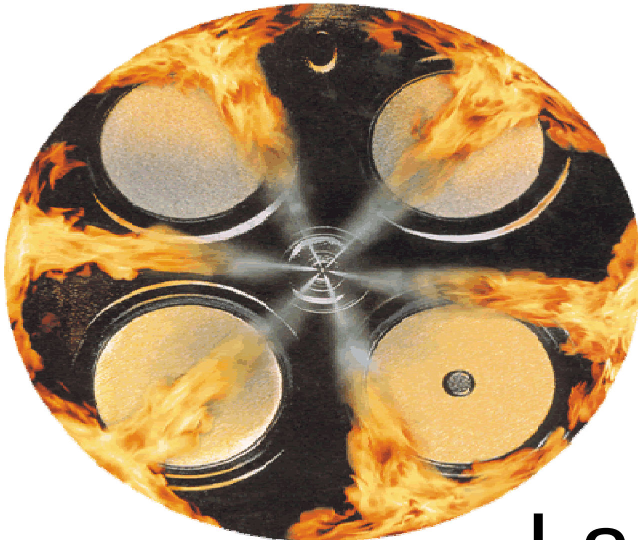
VENTILATION REQUIREMENTS: Adequate ventilation to maintain a level of concentration below exposure limits.

PERSONAL PROTECTIVE EQUIPMENT: Longs sleeves, Chemical Resistant Gloves, Safety Glasses with side shields, NIOSH/MSHA approved organic vapor respirator in areas of inadequate ventilation.

SECTION IX - ADDITIONAL INFORMATION

ADDITIONAL MANUFACTURER WARNINGS: This material safety data sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in this data sheet which we received from sources outside our company. We believe that information to be correct but cannot guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. No warranty is made, either express or implied.

OTHER PRECAUTIONS AND COMMENTS: Department of Transportation:
Shipping Name: Flammable liquids, NOS (2-propanol, petroleum distillate)
Hazard Class: 3
DOT ID No. : UN1993
Packing Group II



Power Kleen
Laboratory Testing

Hydrotex
Your Lubrication Solution Partners®

Power Kleen Testing

Southwest Research Institute engineers use the Cummins L-10 diesel injector deposit test to evaluate fuels and fuel additives. This procedure is the only US injector deposit test for direct-injection diesel engines

Power Kleen Cummins L-10 Injector Test

Test Parameters

Base Fuel:	Commercial No. 2 Diesel
Test Conditions:	2 L-10 Cummins Engines Paired One Engine Driving and One Engine Driven Alternating 15 Second Driving/Driven Cycle @ 2300 RPM/50-60 Hp
Duration:	125 Hours
Performance Criteria:	Percent Flow Loss CRC Visual Cleanliness Rating Scale 1 to 100 (1 is perfectly clean)

Results	% Flow Loss	CRC Rating
Untreated Fuel	11.2	35
Fuel with Power Kleen	1.1	6

Fuel treated with Power Kleen keeps injectors clean and in like new condition

Power Kleen Testing

Untreated Fuel | **Treated with Power Kleen**

Fuel Injector Cleanliness
Cummins L-10
Injector Pintles

You can see the difference with NitroGenesis™ high nitrogen dispersant additives

Power Kleen Testing

Benefits Measured in Laboratory Engine Tests

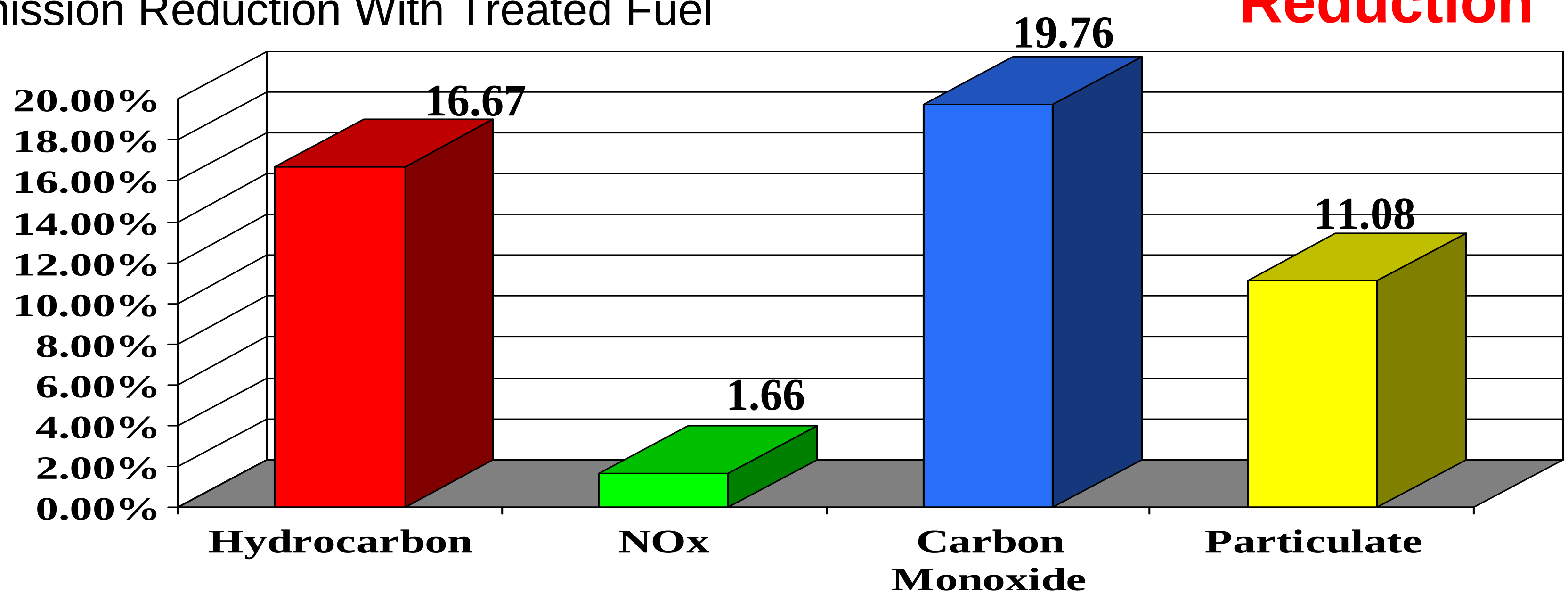
- **4% To 6.5% Average fuel economy increase**
- **12% Average reduction of emissions**
- 2.5% Average engine torque increase
- 2.5% Average horsepower improvement
- Improved fuel lubricity
- Improved fuel storage stability
- Fuel system rust & corrosion protection

Power Kleen Testing

Composite FTP Emissions (Commercial Fuel)

12% Avg. Reduction

Emission Reduction With Treated Fuel

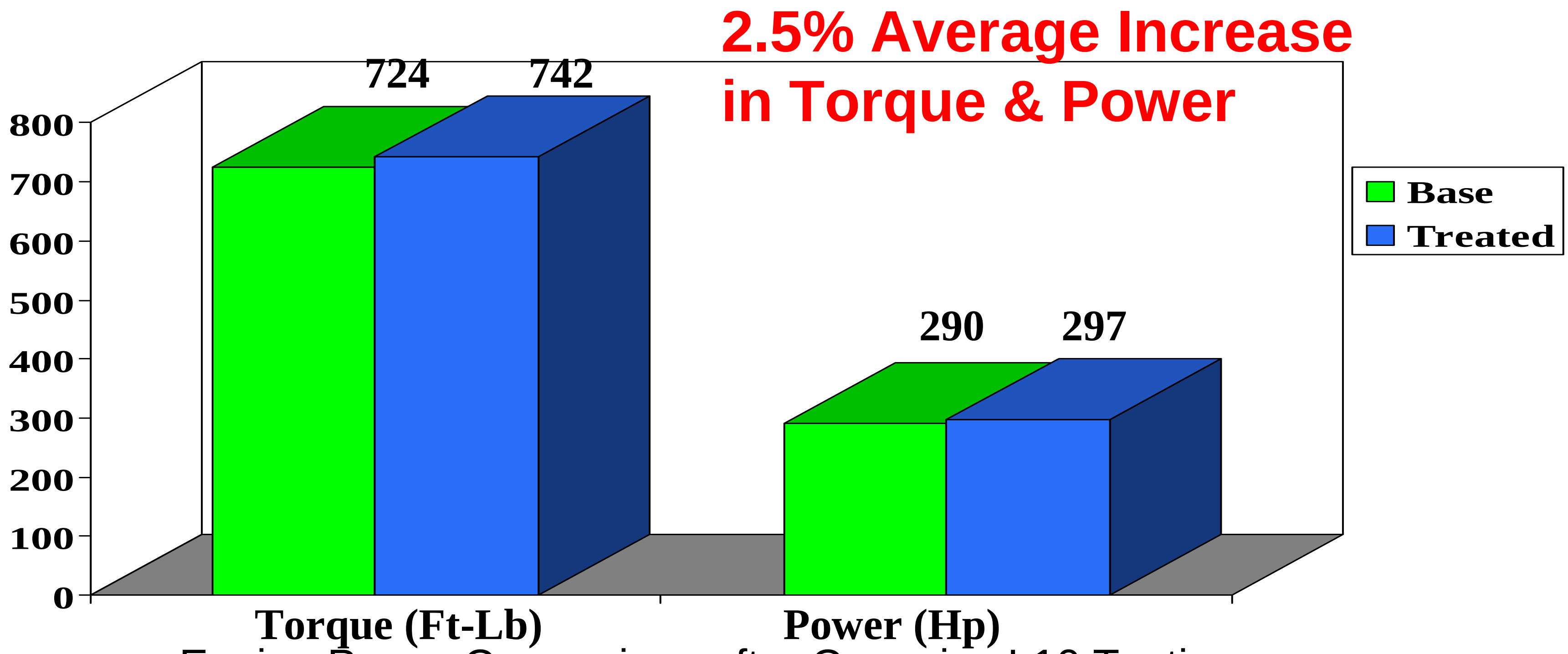


Emission Test Cycle Run After Cummins L10 Test on the Injectors

Testing performed on behalf of Hydrotex, Inc. by the Lubrizol Corporation

Power Kleen Testing

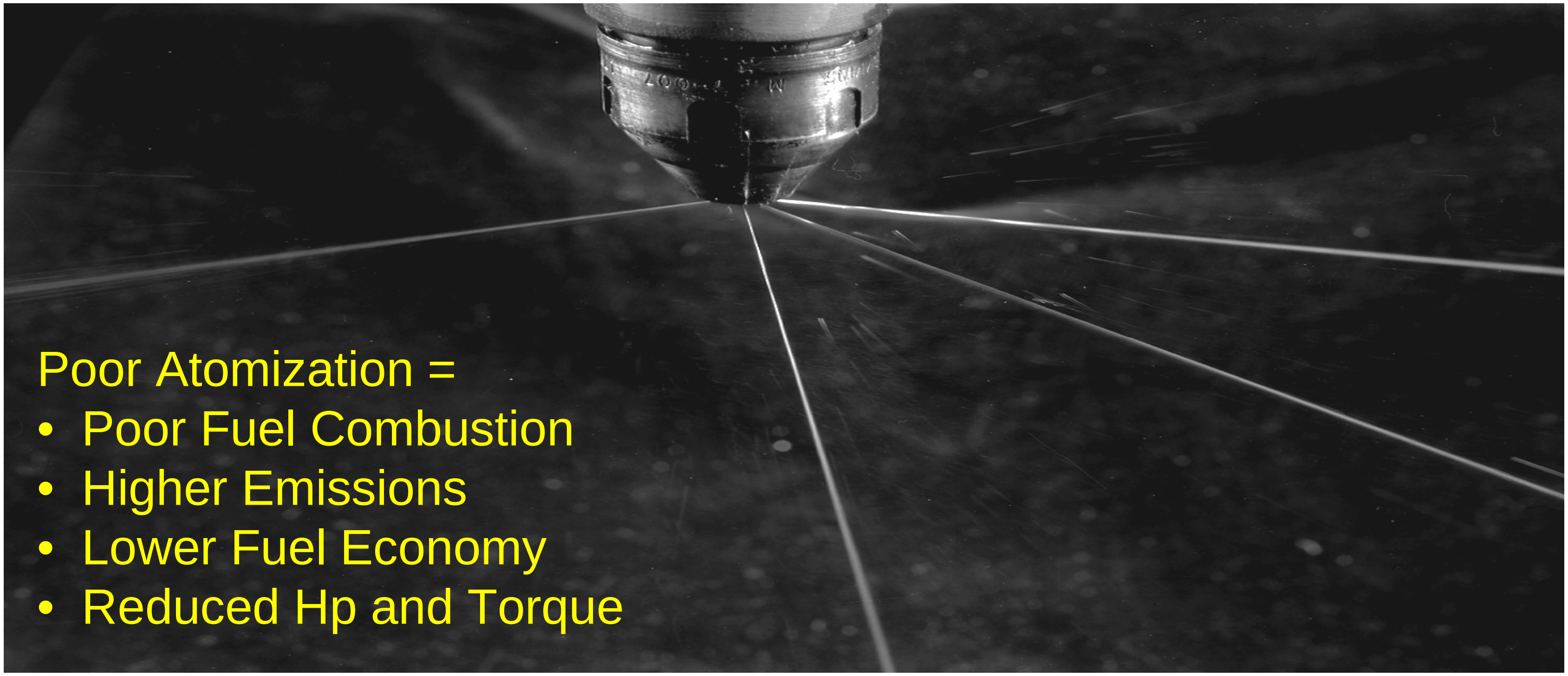
Steady State Engine Performance at Rated Load and Speed



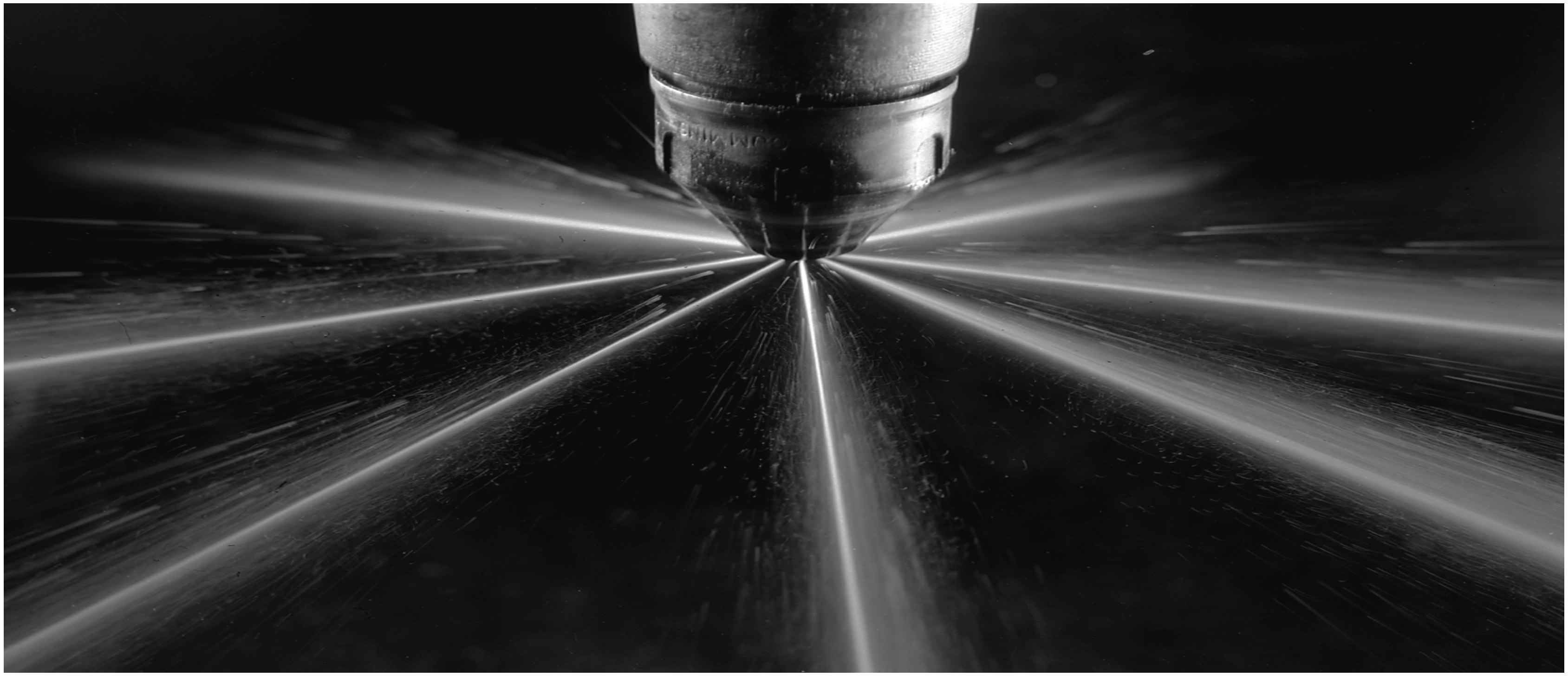
Engine Power Comparison after Cummins L10 Testing

Testing performed on behalf of Hydrotex, Inc. by the Lubrizol Corporation

Dirty Injector - Spray Pattern



Spray Pattern - with Power Kleen



Power Kleen Also

Cleans-Up Piston Ring Belt Area

Engines run cooler, have reduced ring & bore polishing wear and oil drain intervals can be extended with treated fuel

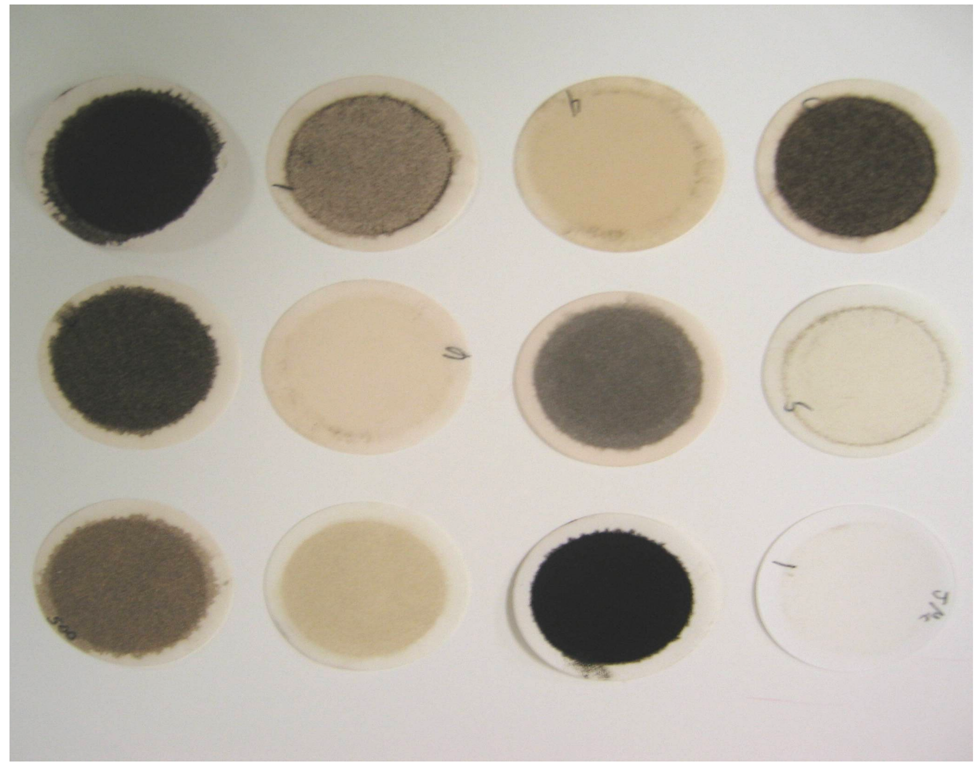
Untreated Fuel | Treated with Power Kleen

Test method: CEC L-12-A-76; lubricant and base fuel in both tests identical

Diesel Fuels Have Different Stability Characteristics

Multiple Nozzle Samples checked for oxidation stability:

Octel F21-61 Millipore filters after filtering 50 ml of diesel fuel after 300°F Accelerated Stability Test conducted in Hydrotex laboratory



ASTM D-2274 Stability Test

Test Parameters

Base Fuel:	Commercial No. 2 Diesel
Temperature:	95 deg. C (203 deg. F)
Test Time:	16 Hours
Test Conditions:	Oxygen Is Bubbled Through the Sample at a Rate of 3 Liters/Hour
Performance Criteria:	Amount of Insolubles and Fuel Color Change

Results	ASTM Color		Filter Insolubles
	Initial	Final	(mg/ 100 ml)
Untreated Fuel	L 0.5	L 1.5	0.69
Fuel with Power Kleen	L 0.5	L 0.5	0.15

Fuel treated with Power Kleen had excellent stability with 78% reduction in fuel insolubles and no change in color

Testing performed on behalf of Hydrotex, Inc. by the Lubrizol Corporation

Power Kleen
Improves Fuel Stability

Insoluble Gums, Varnish and Sludge After Oxidation Aging

Untreated Fuel　　　　Treated Fuel

NACE Rust Test

<u>Test Parameters</u>

Base Fuel:	Depolarized Iso-Octane
Temperature:	37.8 deg. C (100 deg. F)
Water Phase:	Distilled Water
Fuel/Water Contact:	Stir Fuel 30 Minutes, Stop, Introduce Water, Stir 3.5 Hours
Steel Spindle:	Polished, Cold Rolled SAE 1020, 1/2" dia.
Performance Criteria:	Visual Evidence of Rust

<u>Results</u> NACE

	Visual Rating	% Surface Rust
Untreated Fuel	D	50-75%
Fuel with Power Kleen	A	NONE

Power Kleen provides superior anti-corrosion protection to fuel storage tanks and fuel handling systems

Testing performed on behalf of Hydrotex, Inc. by the Lubrizol Corporation

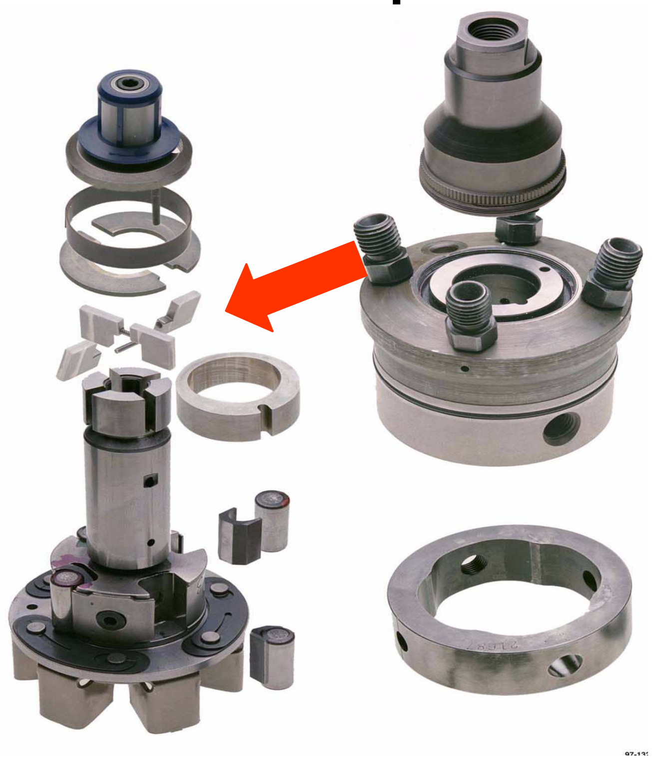
Power Kleen Testing

Rust & Corrosion Protection

Treated Fuel

Untreated Fuel

Power Kleen
Improves Diesel Fuel Lubricity



Poor Fuel Lubricity is the Number One cause of premature fuel pump failure

Low sulfur fuels help reduce emissions but no longer have the lubricity properties to prevent wear in fuel pumps and injectors

Diesel fuel improvers are available to protect rotary vane fuel pumps against wear

Power Kleen Fuel Lubricity

Protect Fuel System Components Against Wear

Stanadyne Rotary Pump Test

Worn Out Pump Vane **Not Good Enough** **Proper Protection**

Power Kleen 1:2000

<u>Results</u> *National Council for Weights and Measures, Engine Manufacturers Association and Truck Maintenance Council requirements for diesel fuel lubricity can be exceeded with Power Kleen fuel improver*