Air Toxic Emissions from In-use Nonroad Diesel Equipment

Final Report

EPA United States Environmental Protection Agency

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Final Report

Compliance Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

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ABSTRACT: This report summarizes results of emission tests that measured regulated and select unregulated or "toxic" emissions on four different nonroad diesel engines removed from "in-use" pieces of nonroad equipment chosen from categories defined by EPA. This study ran 8-mode steady-state and hot-start transient cycle emission tests using the same two fuels per engine. A Deere 6068T was tested from a 1996 model Deere 670B Motor Grader, a Cummins M11C was tested from a 1998 model Case 9050B Excavator, a Caterpillar 3196 was tested from a 2001 model Challenger 95E Agricultural Tractor, and a Cummins ISB190 was tested from a 2001 model Gradall XL3100 Telescoping Boom Excavator. Each was tested using a low sulfur (390 ppm) emissions grade Type-2D diesel fuel, and a high sulfur (2,570 ppm) Nonroad-2D diesel fuel. Steady-state testing included the ISO Type-C1 test. Transient cycles used for toxic emissions testing were the US on-highway federal test procedure (FTP) cycle, and a nonroad equipment duty cycle based on typical backhoe loader (BHL) activities. Regulated emissions were measured for total hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NO_x), and particulate matter (PM). Gaseous and liquid sampling techniques were used to quantify unregulated emission levels of nitrous oxide (N_2O), ammonia, aldehydes, sulfate, and C_1 through C_{12} hydrocarbon species. Of particular interest to EPA were benzene, styrene, 1,3-butadiene, ethylbenzene, n-hexane, toluene, and xylene. Additional particulate samples were analyzed to quantify elemental inorganic manganese, lead, nickel, arsenic, and chromium levels. Further particulate samples were collected using 20-inch by 20-inch Pallflex T60A20 media in series with polyurethane foam (PUF) XAD traps to quantify 16 polynuclear aromatic hydrocarbon (PAH) compounds and seven nitro-PAH compounds for each test using both fuels per engine.

KEY WORDS / DESCRIPTORS: Engines, diesel, in-use, nonroad, cycle, emissions, toxics, polynuclear aromatic, nitro, PAH, NPAH, aldehydes, HC speciation

FOREWORD

This report contains results from emission tests on four different in-use nonroad diesel engines using two fuels. This project was performed by the Department of Emissions Research, in the Automotive Products and Emissions Research Division (currently known as the Department of Engine and Emissions Research, in the Engine, Emissions, and Vehicle Research Division) of Southwest Research Institute (SwRI). This report documents work performed by SwRI in response to EPA Work Assignment No. 3-04, under EPA Contract No. 68-C-98-158. The goal of this study was to quantify regulated and numerous unregulated or "toxic" emissions over limited steady-state and transient cycle operations. Fuels used in testing were an emissions grade Type-2D and a Nonroad-2D diesel. The various pieces of equipment and their engines were selected largely at random based on power rating and model year categories defined by EPA. Each piece of nonroad equipment was obtained from a different leasing agency, with engines removed for use in testing either by SwRI or the applicable leasing agency.

The EPA work assignment manager was Mr. Kent M. Helmer. The SwRI program manager was Mr. Terry L. Ullman, Manager of the Heavy-Duty Technology Assessment Section, and project leader was Mr. Michael E. Starr, Senior Research Engineer in the Department of Engine and Emissions Research. Other SwRI personnel making significant contributions were Dr. Lawrence R. Smith and Mr. E. Robert Fanick in the Light-Duty and Unregulated Emissions Section of the Department of Engine and Emissions Research, with Dr. Joseph Pan, Principal Scientist in the Petroleum Products Research Department, and Ms. Shraddha Quarderer and Mr. Michael Dammann of the Analytical and Environmental Chemistry Department. The engine removals and test cell installations were coordinated by Mr. Ernie Krueger, Assistant Manager, and Mr. Keith Echtle, Supervisor, along with technical staff of Mr. Lawrence Hibbs, Mr. William Valuk, and Mr. Jose Sosa.

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I. INTRODUCTION

The United States Environmental Protection Agency (EPA) continues to quantify diesel engine exhaust emissions from engines used in nonroad equipment. This report covers work performed on an EPA work assignment that tested four different engines removed from pieces of in-use nonroad equipment. Each engine was mounted in a dynamometer test cell and operated over a variety of steady-state conditions, and several transient duty cycles using the same two fuels per engine. The regulated emissions measured for each test included total hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NO_X), and total particulate matter. In addition, under this work assignment, numerous samples were gathered and analyzed using special sampling techniques and related hardware to quantify levels for specific unregulated emissions, or "toxics." Descriptions of sampling methods are outlined in this report.

Testing for each engine included sampling at the eight modes of an ISO Type-C1 emissions test, and over two different transient cycles. Cycles used in testing each engine were the on-highway federal test procedure (FTP) cycle and the nonroad backhoe loader (BHL) cycle, developed in EPA Work Assignment 1-08, under EPA Contract 68-C5-0076. In addition, the composite SAT nonroad duty cycle was used to provide EPA further baseline information over that new cycle on each engine using 2D fuel. All planned emissions testing was completed without incident, and this report contains the results obtained in this work.

II. TEST ENGINES AND FUELS

Four different diesel engines were obtained from different pieces of "in-use" nonroad equipment, and each engine was run in a dynamometer test cell to generate samples for quantifying regulated and selected unregulated emission levels using two different diesel fuels. Engines were selected with approval of the EPA work assignment manager based on categories defined by EPA. Two of the four engines were removed from their host pieces of equipment by SwRI, and two were removed by separate equipment service facilities and delivered to SwRI for use in testing. Engine power ratings ranged from 160 to 420 horsepower. The two different fuels used in emissions testing were a low sulfur, emissions grade Type-2D diesel fuel, and a high sulfur Nonroad-2D diesel fuel.

A. Four Different "In-Use" Nonroad Engines

The four different engines tested represent a cross-section of nonroad applications. Table 1 identifies the in-use engines selected for use in this work, and describes their power ratings. Engines were emissions tested over transient conditions using a control strategy developed for commanding dynamometer and throttle control for each engine over the on-highway FTP cycle. Minimal tuning subsequently improved transient control and cycle performance for testing over the BHL and/or SAT nonroad cycles.

Each engine tested was an in-line, six cylinder diesel engine equipped with charge air cooling. The in-use engines selected and tested were a 160 hp Deere 6068T from a 1996 Deere 670B motor grader (SN: DW670BX558161), a 270 hp Cummins M11C from a 1997 Case 9050B excavator (SN: EAC0501182), a 420 hp Caterpillar 3196 from a 2001 Challenger 95E agricultural tractor (SN:6KS00968), and a 194 hp Cummins ISB190 engine from a 2001 Gradall XL3100 telescoping boom excavator (SN: 0311319). The ISB190 is emissions certified for on-highway operation, so that piece of equipment can routinely travel on city streets to move between work sites.

TABLE 1. FOUR DIFFERENT IN-USE TEST ENGINES

Engine Model	Engine Serial Number	Hour Meter	Engine Control	Disp., liters	Rated Condition		Torque Peak	
					hp	rpm	lb-ft	rpm
Deere 6068T	553496	2,289	Mechanical	6.8	160	2200	475	1350
Cummins M11C	34872033	4,107	Mechanical	10.7	270	1700	950	1300
Caterpillar 3196	6AR02540	416	Electronic	10.0	420	2100	1370	1400
Cummins ISB190	46109691	868	Electronic	5.9	190	2300	503	1400

Figure 1 shows the Deere 670B motor grader as it arrived at SwRI, and Figure 2 shows the torque map for its 6068T engine. The Cummins M11C engine is shown in Figure 3, and its torque map is given as Figure 4. The Caterpillar 3196 tractor engine is shown in Figure 5, and its torque map is given as Figure 6. Similarly, Figure 7 is the Cummins ISB190 engine mounted in the test cell, with its torque map shown in Figure 8.

FIGURE 1. DEERE 670B MOTOR GRADER AT SwRI

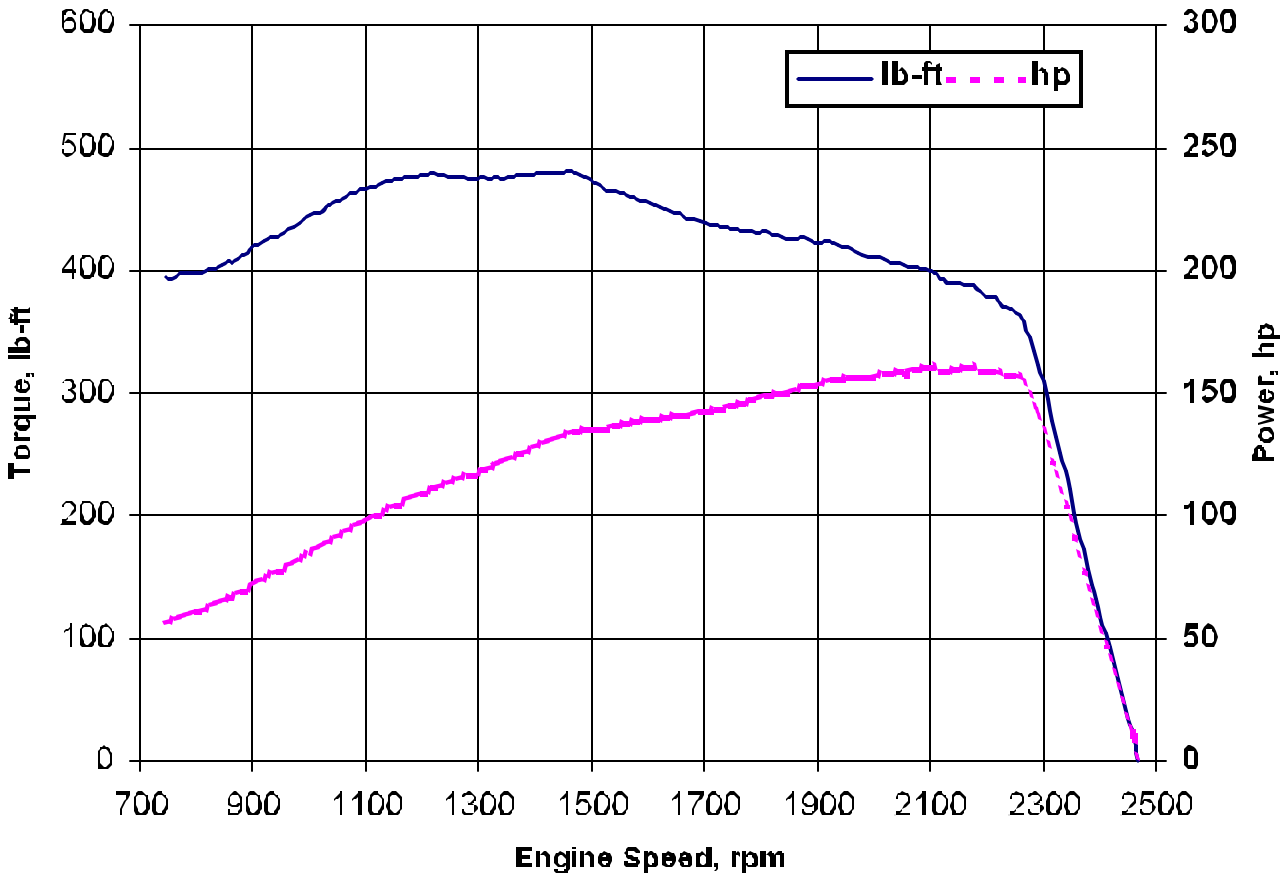


FIGURE 2. TORQUE MAP FOR DEERE 6068T ENGINE

FIGURE 3. CUMMINS M11C ENGINE AS IT ARRIVED AT SwRI

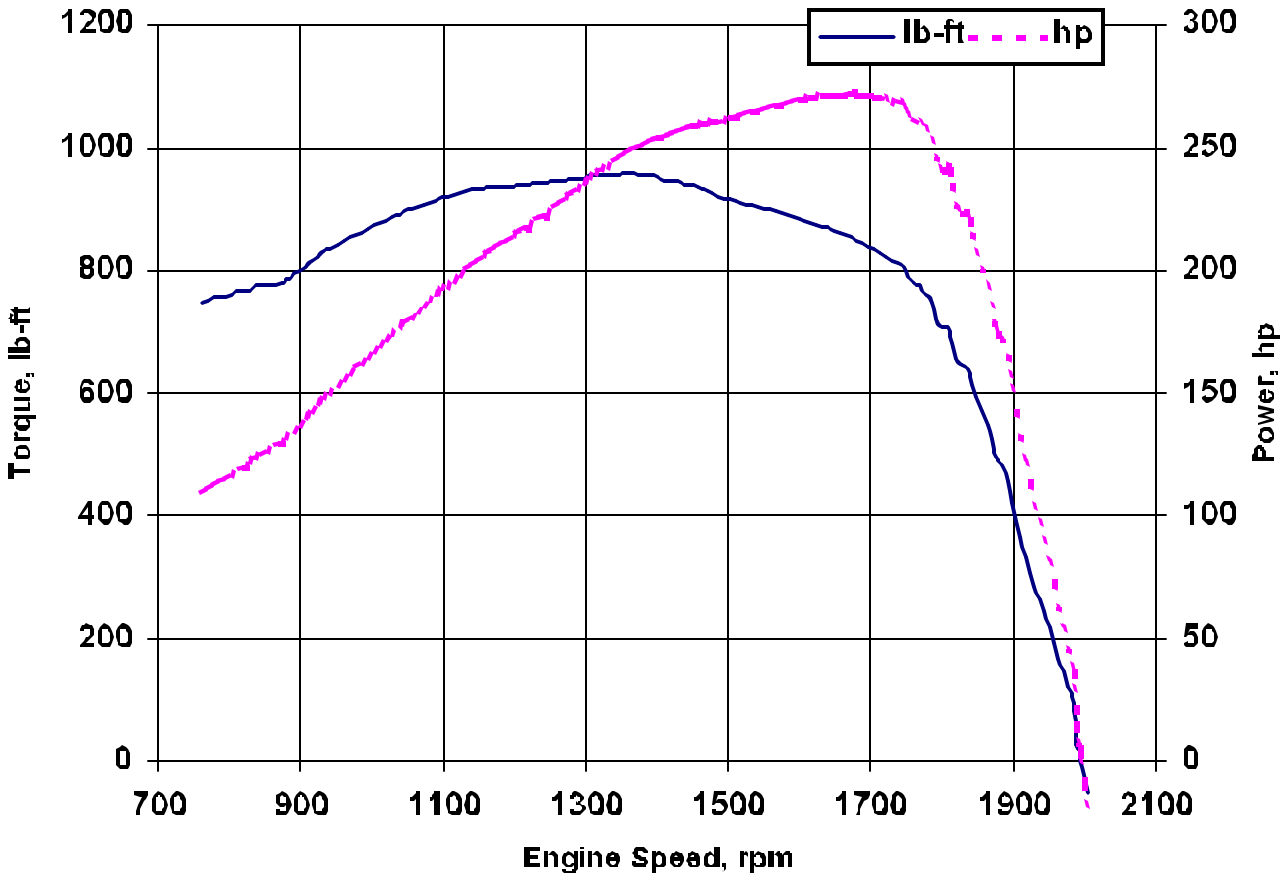


FIGURE 4. TORQUE MAP FOR CUMMINS M11C ENGINE

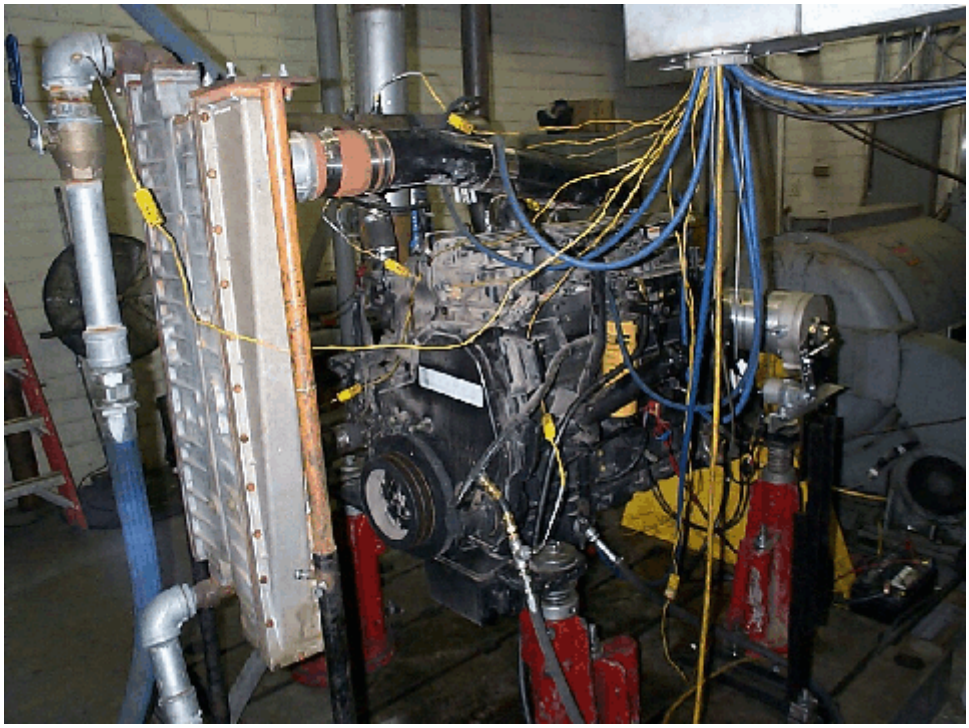


FIGURE 5. CATERPILLAR 3196 ENGINE MOUNTED IN EMISSIONS TEST CELL

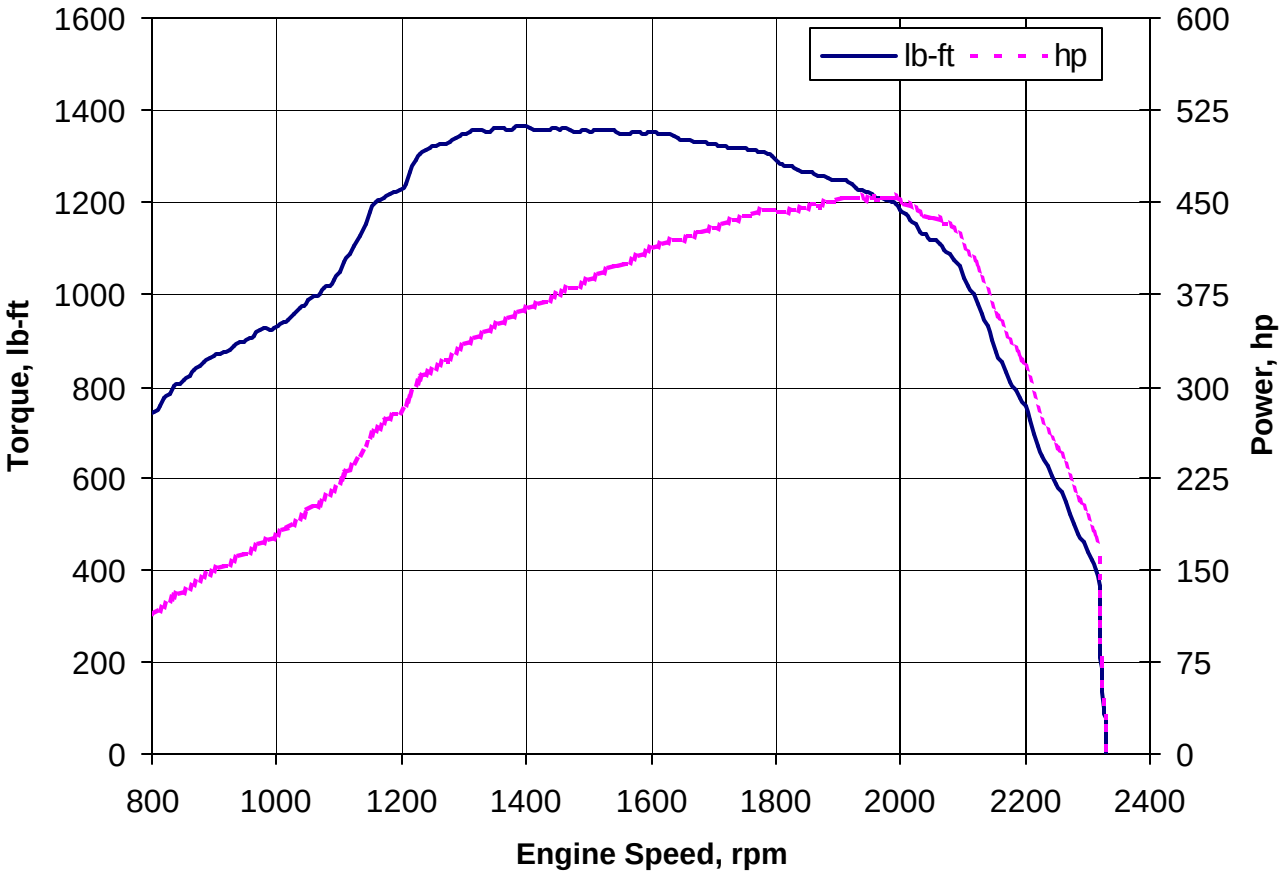


FIGURE 6. TORQUE MAP FOR CATERPILLAR 3196 ENGINE

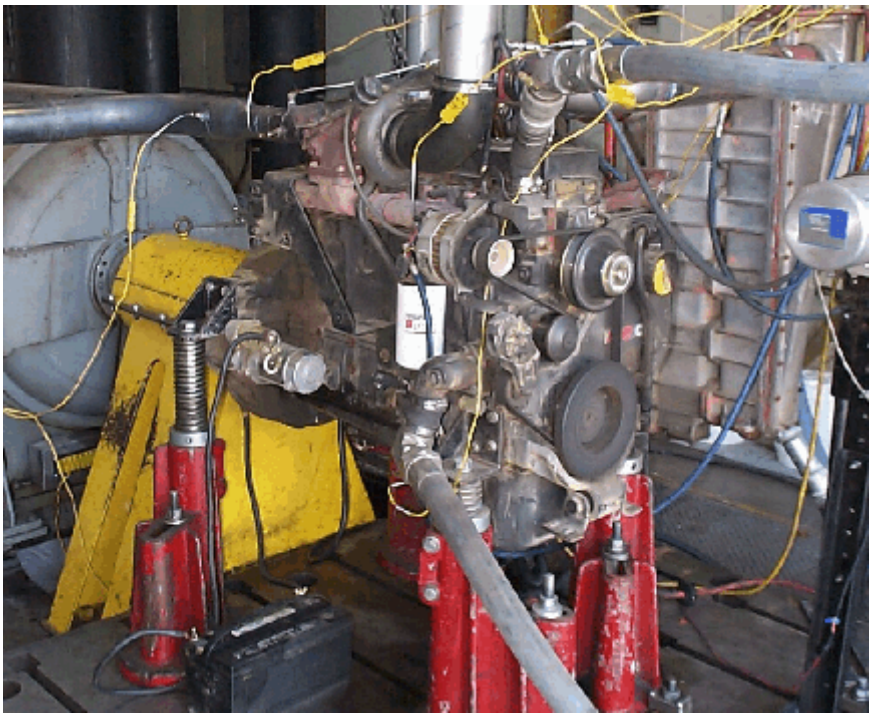


FIGURE 7. CUMMINS ISB190 ENGINE MOUNTED IN EMISSIONS TEST CELL

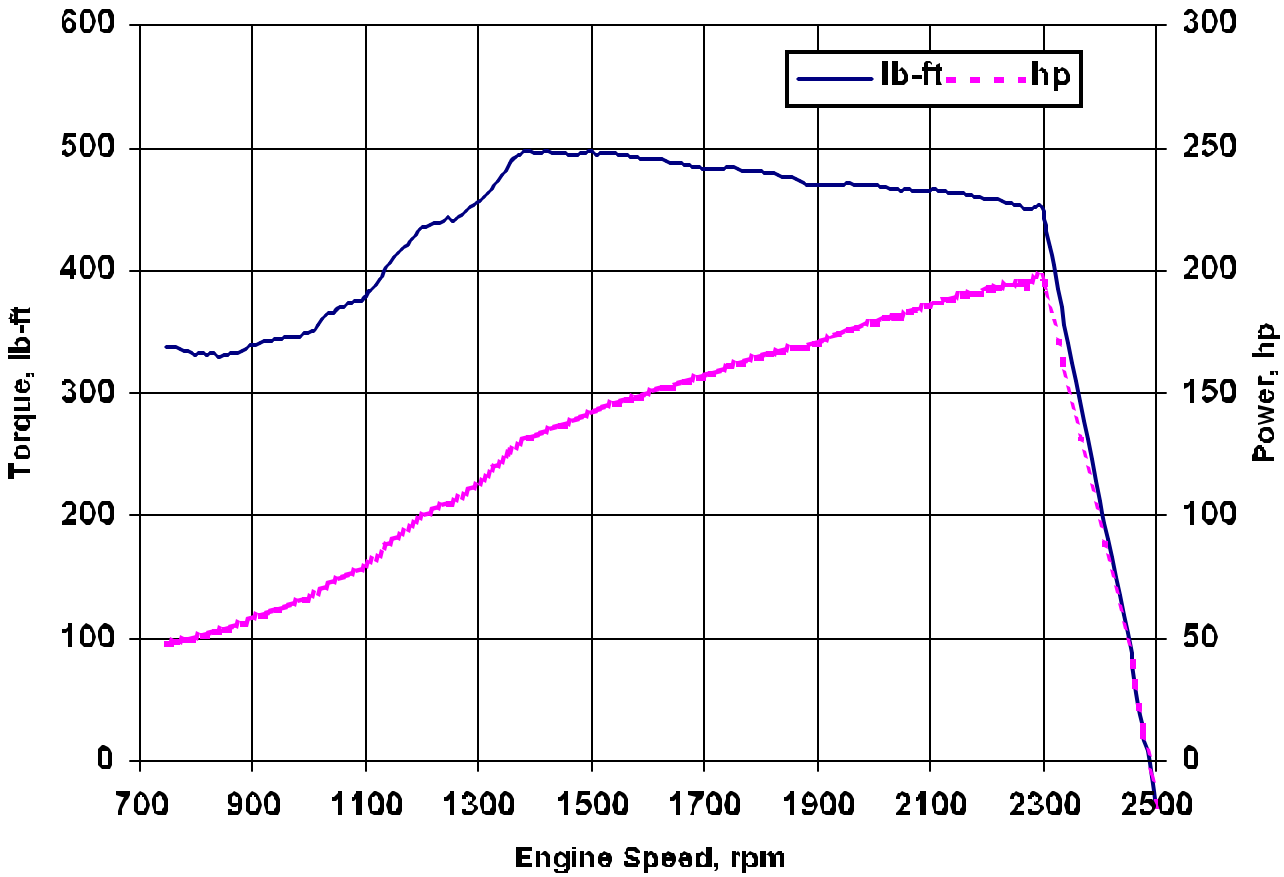


FIGURE 8. TORQUE MAP FOR CUMMINS ISB190 ENGINE

B. Fuels Used in Emissions Testing

The two fuels used in this study were an emissions grade Type-2D diesel fuel, and a high-sulfur Nonroad-2D diesel fuel. These two fuels had similar distillation curves, and similar hydrogen to carbon ratios. However, the 2D fuel had a sulfur level of 390 ppm and an API gravity of 36.1, and the nonroad diesel had 2,570 ppm sulfur and 34.8 API gravity. Table 2 gives selected properties for these fuels. In each case, a thorough fuel change procedure was completed, with new fuel filters and sufficient engine operation to purge the system of any previous fuel prior to emissions testing on the next fuel.

TABLE 2. FUEL PROPERTIES

Test Method	Type-2D Fuel "2D"	High-Sulfur Fuel "NR"
D-2622 Sulfur, ppm	390	2570
D-613 Cetane Number	48.0	46.1
D-1319 Aromatics, %	32.15	30.35
D-1319 Olefins, %	1.8	2.2
D-1319 Saturates, %	66.05	67.45
D-5186 Total Aromatics, %	35.3	31.9
PNA, %	11.10	9.55
D-2500 Cloud Point (˚C)	-16	-16
D-4052 Specific Gravity	0.8444	0.8507
API Gravity	36.1	34.8
D-445 Viscosity (cSt @ 40˚C)	2.515	2.765
D-482 Ash Content, %	< 0.001	< 0.001
D-524 Carbon Residue (10%)	0.085	0.155
D-5291 Carbon (wt%)	86.65	86.15
D-5291 Hydrogen (wt%)	13.08	13.00
D-93 Flash Point (˚F)	143	161
D-4737 Cetane Index	48.2	46.9
D-86 Distillation (˚F)		
IBP	333	353
5%	389	387
10%	409	411
15%	428	429
20%	444	444
30%	468	470
40%	488	492
50%	505	511
60%	523	531
70%	541	552
80%	563	578
90%	594	613
95%	618	641
FBP	639	658
% Recovered	98.0	97.5
% Residue	1.0	1.0
% Loss	1.0	1.5

III. SCOPE OF WORK

The work assignment covered by this report made use of four different engines to obtain comparative emissions information using two different fuels over limited steady-state and transient cycle operations. Emissions testing used full-flow dilution techniques to quantify brake-specific levels of total hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_X), and a double dilution technique was used to quantify particulate matter (PM). In addition, the primary focus of this work assignment was to gather and analyze additional emission samples to quantify selected unregulated or "toxic" emission levels. Table 3 lists the tests conducted under this work assignment on each engine.

TABLE 3. NUMBER OF TESTS PER ENGINE USING DESIGNATED FUELS

Emissions Test Description	Fuel ID	Regulated Emissions [a]	Baseline [b]	Hydrocarbon Speciation [c]	PAH [d]	Nitro-PAH [e]	Metals by ICP [f]
FTP Cycle	2D	2	0	0	0	0	0
BHL Cycle		2	0	0	0	0	0
SAT Cycle		2	0	0	0	0	0
ISO Type C1, 8-Mode		1	1	1	1	1	1
FTP Cycle		2	2	2	2	2	2
BHL Cycle		1	1	1	1	1	1
ISO Type C1, 8-Mode	NR	1	1	1	1	1	1
FTP Cycle		2	2	2	2	2	2
BHL Cycle		1	1	1	1	1	1

Notes:
[a] - Regulated emissions of HC, CO, NO_X, and mass based PM
[b] - Baseline measures aldehydes, ammonia, N_2O, and sulfate
[c] - HC Speciation refers to C_1 through C_{12} hydrocarbon
[d] - Sixteen PAH compounds analyzed by combining PM and gas phase samples
[e] - Seven Nitro-PAH compounds analyzed by combining PM and gas phase samples
[f] - Metals by ICP refers to elemental inorganic ion analyses: lead, manganese, nickel, arsenic, chromium

A. Steady-State Emissions Testing

Engines were tested over the eight-mode ISO Type-C1 emissions test to establish regulated and selected unregulated emission levels using both low and high sulfur diesel fuels. Table 4 identifies the sequence for running the eight operating conditions of a C1 test. Sampling systems were prepared for running the C1 test to collect emission samples for use in quantifying the various selected unregulated emissions. Calibration and sampling methods adhered to test procedures in the Code of Federal Regulations (CFR), Part 89, and generally satisfied ISO 8178-1 guidelines.

TABLE 4. SEQUENCE OF EIGHT ISO TYPE-C1 STEADY-STATE CONDITIONS

Engine Speed	Percent Load			
	100 %	75 %	50 %	10 %
Rated	1st	2nd	3rd	4th
Intermediate	5th	6th	7th	
Idle	8th, no load applied			

B. Transient Emissions Testing

Testing for each engine included transient cycle emissions measurement using two fuels. Regulated and unregulated emissions were quantified over the on-highway FTP cycle and over a nonroad equipment cycle based on backhoe loader usage, deemed the BHL cycle. The on-highway FTP cycle runs 20 minutes, and the BHL cycle is 16 minutes. In addition, the recently developed nonroad composite SAT cycle was run as part of previewing each engine to accumulate regulated emissions information using 2D fuel.

Each emissions test was run from a hot-start utilizing procedures and sampling processes given in CFR 40, Part 86, Subpart N. Prior to emissions testing, engines were run over a preparatory target cycle (e.g., FTP, BHL, or SAT), followed by a 20-minute, engine-off soak period. Another 20-minute, engine-off soak period separated duplicate runs of the cycle. Transient operation for each engine was controlled using a dynamometer and throttle control strategy established for the given engine. In general, strategies relied on error feedback circuitry to vary throttle position trying to match the measured flywheel torque with the commanded torque value, while the dynamometer controlled engine speed.

Cycle performance and statistical regression values were refined over practice runs of the on-highway FTP cycle. In general, transient control of these four in-use engines largely met or “passed” established cycle validation criteria specified in CFR 40, Part 86, Subpart N, for testing heavy-duty, on-highway diesel engines over the FTP cycle. For each engine, the nonroad BHL (and SAT) cycles were run using a similar control strategy and settings used for the on-highway FTP cycle. However, none of these engines achieved “passing” statistical values over either nonroad cycle tested. Although these settings did not result in passing the on-highway regression criteria when applied to nonroad cycle testing, the repeatability of emission levels from duplicate FTP, BHL, and SAT testing was generally considered good for these nonroad engines. Figures 9, 10, and 11 show the normalized FTP, BHL, and SAT command cycles, respectively.

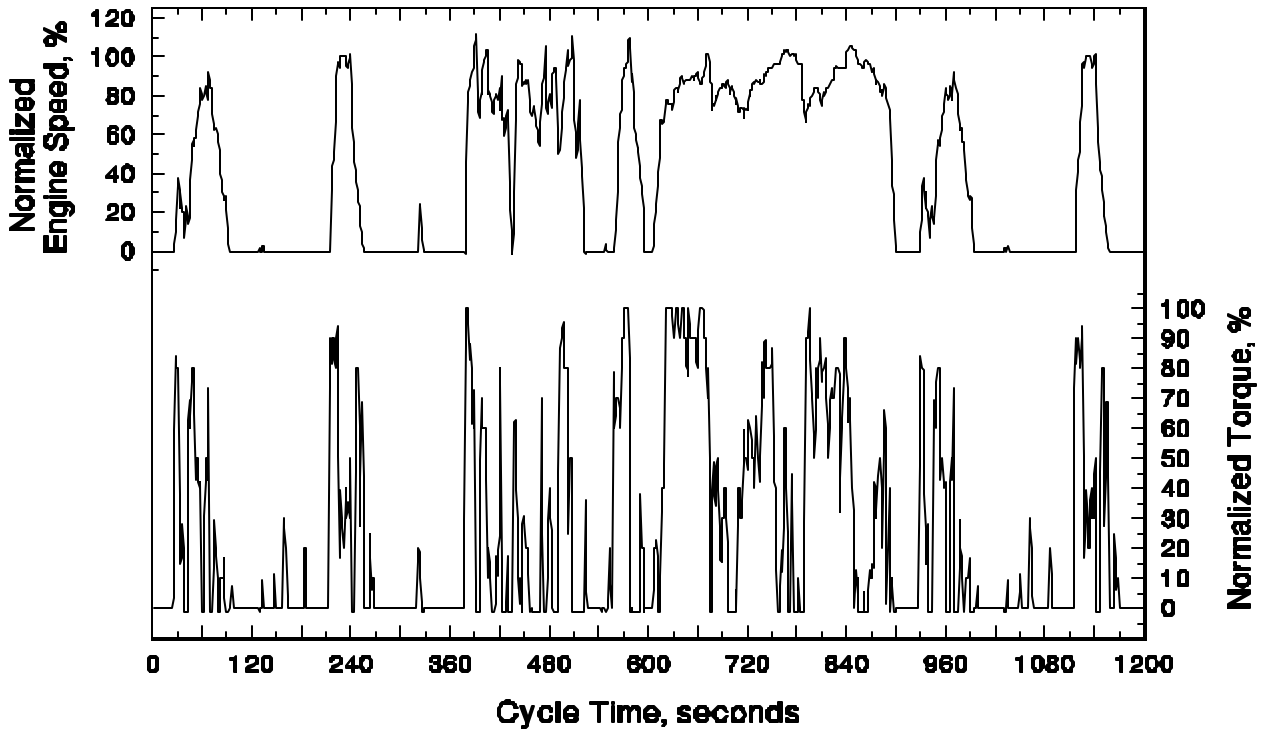


FIGURE 9. NORMALIZED ON-HIGHWAY HEAVY-DUTY FTP CYCLE

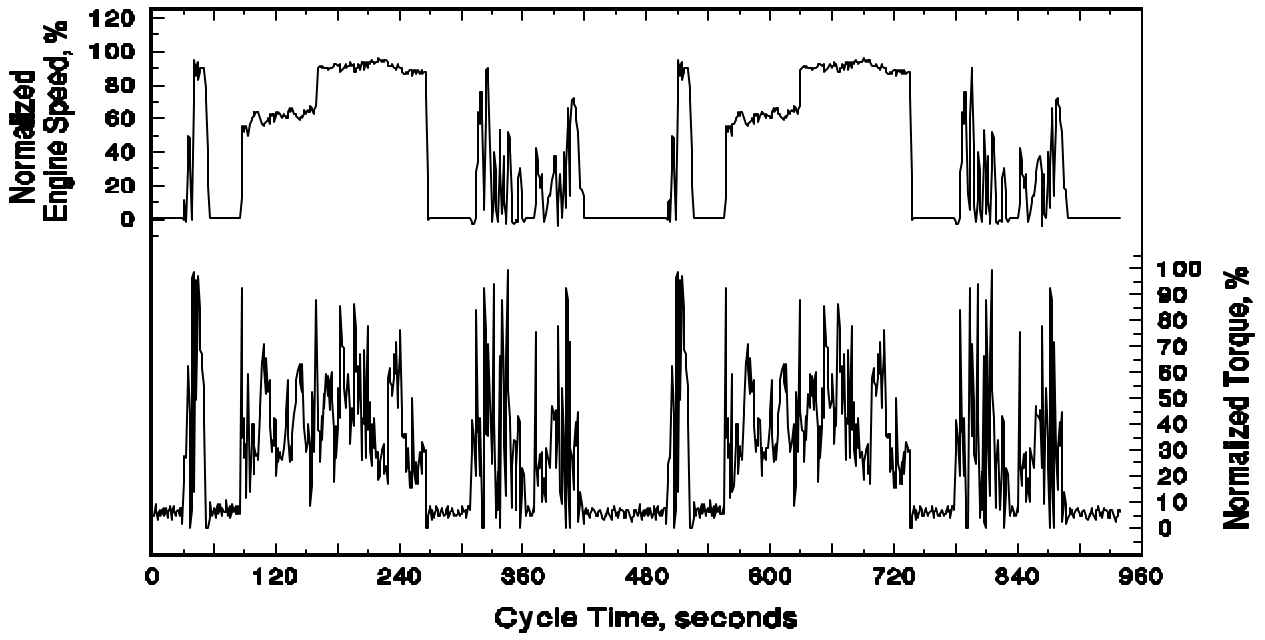


FIGURE 10. NORMALIZED NONROAD BACKHOE LOAD (BHL) CYCLE

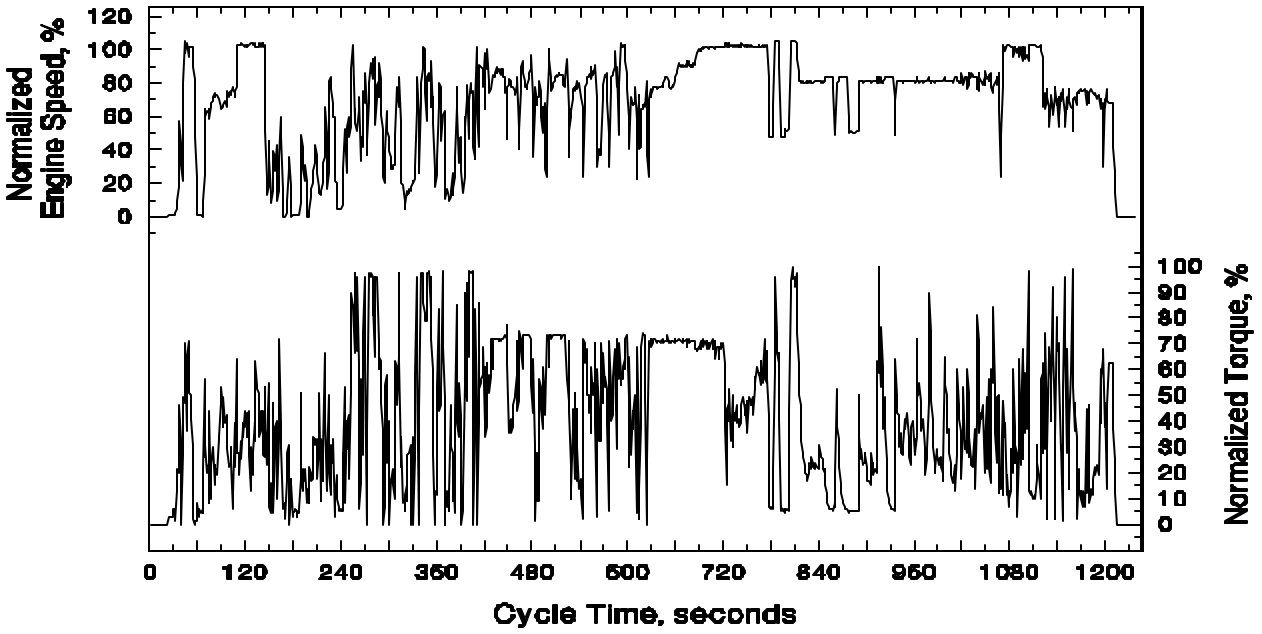


FIGURE 11. NORMALIZED NONROAD COMPOSITE (SAT) CYCLE

C. Toxic Emissions Measurement

Emission measurements not only included regulated emissions of HC, CO, NO_X, and PM levels, but also unregulated emissions of aldehydes, ammonia, nitrous oxide (N_2O), and sulfate. Several hydrocarbon species from C_1 through C_{12} were quantified for each test. Proportional bag samples of dilute exhaust were analyzed via gas chromatography to speciate hydrocarbons from C_1 through C_{12} using a method similar to the Phase II Auto-Oil method. Hydrocarbon species of particular interest to EPA in this work were benzene, 1,3-butadiene, ethylbenzene, n-hexane, styrene, toluene, and xylene.

Sample collection and procedures to determine aldehydes, ammonia, nitrous oxide, and sulfate were the same as those used in a recent EPA work assignment (WA 3-05 under Contract No. 68-C-98-158, originally as WA 2-03 under Contract No. 68-C-98-169), and a "ten engine" study for the California Air Resources Board (CARB) in SwRI Project No. 03316. To quantify sulfate levels, a 40 percent segment or "pie slice" was cut from the 90 millimeter diameter T60A20 Pallflex® filter pair used to quantify total PM, and shaken in a mixture of 60:40 isopropanol and water. The solution was then injected into a Dionex® ion chromatograph equipped with a conductivity detector to measure sulfate levels.

For ammonia and carbonyls, an array of impingers was used during each emissions test to capture gaseous samples of dilute exhaust for later analyses. Ammonia levels were quantified using the same Dionex® instrument setup and calibrated to analyze ammonia samples. Formaldehyde and acetaldehyde were measured using a DNPH technique, as outlined in CFR Title 40, Part 86. A liquid chromatograph was used to quantify aldehydes and ketones captured by the impingers in a 2,4-dinitrophenyl hydrazine (DNPH) solution. Finally, bagged samples of proportionally gathered dilute exhaust were analyzed for N_2O levels using a gas chromatograph equipped with an electron capture detector.

Mass emission rates for lead, manganese, nickel, arsenic, and chromium were determined in the solid phase. Elemental inorganic metals were quantified for particulate captured on Fluoropore® filters using an inductively coupled plasma (ICP) technique to detect the selected elements. The ICP method for analyzing particulate-phase inorganic elements utilized a digestion technique, with PM-laden filters digested in a mixture of nitric and perchloric acid followed by aqua regia. In addition, mercury was sought in the gas phase using an impinger containing a solution of potassium permanganate (K_2MnO_4). Resulting solutions were analyzed by ICP for selected inorganic elements. The instrument was standardized using NIST traceable standard reference materials. Immediately after the standard check sample was run, a blank sample was run to verify the zero setting of standardization. Check samples are required to be within the control limits of 90-110% recovery of the certified value. Absolute value of the check blank was required to be below the reporting limit for the samples. If either condition had not been met, the analysis would be terminated and the instrument re-standardized and re-checked.

Additional PM and gas phase samples were collected to quantify selected polynuclear aromatic hydrocarbons (PAH) and nitro-PAH (n-PAH) compounds. Samples for the measurement of polynuclear aromatic hydrocarbon (PAH) compounds consisted of components from both solid and gaseous phases. Solid particulate phase measurements were made using a single filter sample, while semivolatile, gaseous phase PAH compounds were sampled separately using polyurethane foam (PUF) and XAD collection media located downstream of the particulate phase collection filter. In the interest of economy, EPA requested that the extract of solid phase and extract of gaseous phase particulate samples for a given test be **combined** for one set of analyses, with the combined extract used to quantify both PAH and n-PAH compounds. In this work, both sampling media were extracted, then combined prior to concentrating the samples, and finally, analyzed using a gas chromatograph-mass spectrometer (GC/MS) operated in the selective ion monitoring (SIM) mode. Table 5 gives the measured PAH compounds, and the targeted n-PAH compounds are listed in Table 6.

TABLE 5. LIST OF PAH COMPOUNDS ANALYZED

Benzo(a)anthracene	Acenaphthylene
Benzo(a)pyrene	Anthracene
Benzo(b)fluoranthene	Benzo(ghi)perylene
Benzo(k)fluoranthene	Fluoranthene
Chrysene	Fluorene
Dibenz(a,h)anthracene	Naphthalene
Indeno(1,2,3-cd)pyrene	Phenanthrene
Acenapthene	Pyrene

TABLE 6. LIST OF NITRO-PAH COMPOUNDS ANALYZED

2-Nitro Fluorene	9-Nitro Anthracene
3-Nitro Fluoranthene	1-Nitro Pyrene
6-Nitro Chrysene	Dinitro Pyrenes
6-Nitro Benzo(a)pyrene	

IV. SAMPLING AND APPARATUS

All engine operations under this work assignment were conducted in a transient capable emissions test cell. Regulated emissions sampling systems adhered to procedures and practices given in CFR 40 Parts 86 and 89. Furthermore, the test cell was augmented with auxiliary particulate sampling systems and related sample collection hardware, and calibrated for use in this work.

Special attention was given to methods used for collecting sufficient solid and gas phase particulate samples needed to later quantify PAH and Nitro-PAH compounds. The sample zone of the primary constant volume sampling (CVS) system was modified to include a 2-inch diameter sample probe that routed a portion of the dilute exhaust into an 8-inch diameter auxiliary dilution tunnel. Cell No. 16 added a separate roots blower to provide secondary dilution of primary dilute exhaust in that auxiliary leg. This 8-inch tunnel, as shown in Figure 10, was configured with 47 millimeter diameter filter holders to obtain PM samples on Fluoropore® media for quantifying inorganic elemental metals by ICP. Beyond the 47 mm sample point, a 20-inch by 20-inch square sheet of Pallflex® T60A20 filter media captured solid phase particulate for later use in PAH and Nitro-PAH analyses.

Downstream of that large square filter was a pair of PUF-XAD trapping canisters mounted in parallel for capturing gas phase semi-volitiles for use in PAH and n-PAH analyses. Each PUF trap consisted of two pieces of 4-inch diameter by 1.5-inch thick polyurethane foam disks separated by a thin layer of XAD resin. This resin has a mean pore diameter of 90 angstroms, and a mean surface area of 300 m^2/gram. Figure 12 also shows one of the auxiliary tunnel arrangements with a close-up view of its PUF-XAD traps. As pictured, the dilute exhaust flow is drawn from left to right.

Figure 13 shows a technician handling one of the PUF-XAD traps, and Figures 14 and 15 show examples of 20-by-20-inch and 47 mm diameter PM sampling filters, respectively. The array of 47 mm diameter filter holders can be seen in Figure 12 located 1.5 feet upstream of the 20-by-20 inch square filter holder.

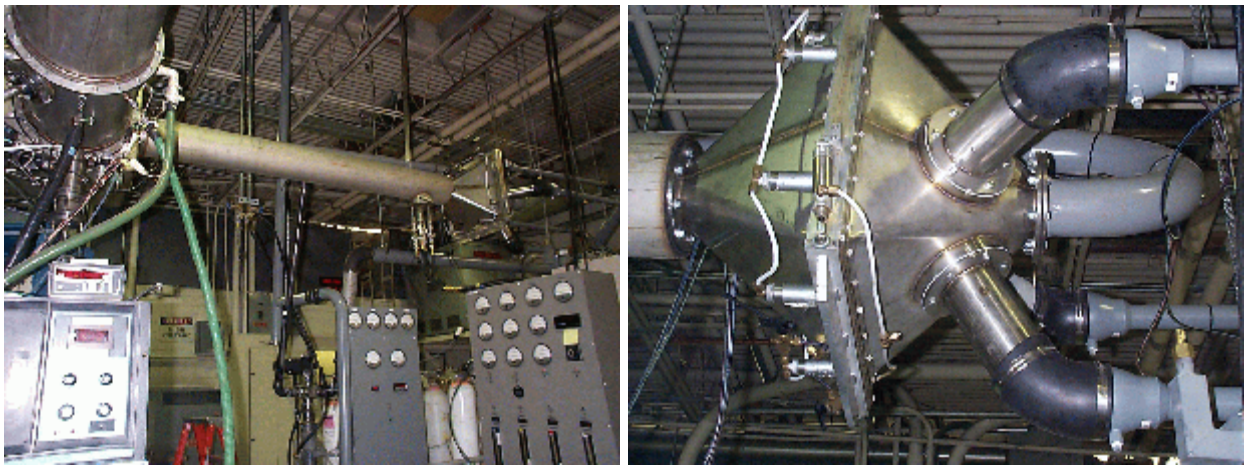


FIGURE 12. SYSTEM USED FOR COLLECTING ADDITIONAL PM SAMPLES

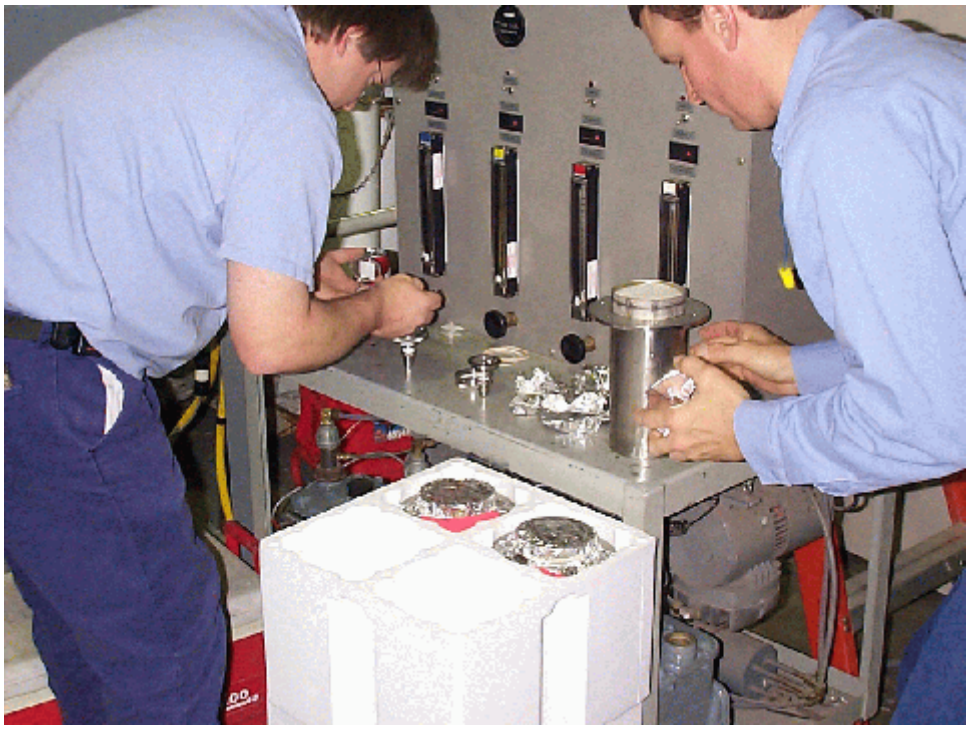


FIGURE 13. TECHNICIANS HANDLING PUF-XAD TRAP AND 47 MM FILTERS

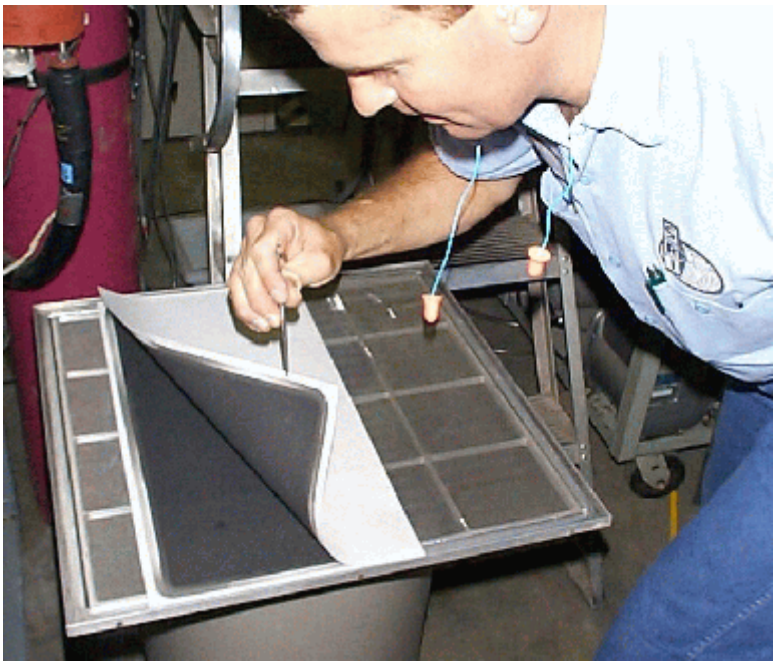


FIGURE 14. TECHNICIAN HANDLING 20×20-INCH PARTICULATE FILTER

FIGURE 15. TECHNICIAN UNLOADING 47 MM DIAMETER FLUOROPORE FILTER

V. REGULATED AND NITROUS OXIDE EMISSION RESULTS

This section of the report tabulates emissions information accumulated on four different nonroad engines operating over various steady-state and transient operations. With the exception of steady-state nitrous oxide (N_2O) emissions, unregulated emissions information is presented separate from regulated emission results in the next section of this report. Regulated emissions measurement adhered to sampling procedures in CFR 40, Parts 86 and 89, and generally satisfied ISO 8178-1 requirements.

To establish each engine's transient emission levels prior to running the core test program, duplicate FTP, BHL, and SAT transient cycle tests were performed to quantify regulated emissions of HC, CO, NO_X, and PM using Type-2D fuel. For the Deere 6068T engine only, levels of nitric oxide (NO) were quantified rather than NO_X for the second preview test over each cycle. Tables 7 through 10 present the regulated emission levels for all transient cycle tests conducted on the four different nonroad engines. Shaded regions in these four summary tables indicate results of the preview tests in which no added chemistry samples were collected. Appendix A contains detailed computer printouts for each transient test of the Deere 6068T engine, with associated graphical summaries of cycle performance and statistical assessment of engine control over the cycle given in Appendix B. Similarly, Appendices C and D give printouts for testing of the Cummins M11C engine, Appendices E and F have printouts for tests on the Caterpillar 3196 engine, and Appendices G and H document the Cummins ISB190 transient cycle emission tests.

Table 11 summarizes the cycle regression statistics for each engine operated over FTP, BHL, and SAT transient cycles. Table 11 shows numerical values of each parameter together with denoting the pass or fail status for each, with an "x" beside any failed parameter. Emissions and cycle performance repeatability were generally good for duplicate transient cycle testing performed on each engine. Engines generally ran the different cycles without problems, and each was able to pass the cycle control criteria for the FTP cycle using both fuels. None of the test engines achieved "passing" statistics over the nonroad cycles run in this work assignment. It should be noted that minimal additional tuning was attempted after a given engine passed the FTP cycle; therefore, subsequent testing over nonroad cycles largely used the engine and dynamometer control strategies established in FTP tuning efforts.

Steady-state testing was largely limited to running an 8-mode Type-C1 (C1) test, with data for eight individual modes on each engine using low and high sulfur diesel fuels. Tables 12 through 15 contain results of each steady-state emissions test on these four different in-use nonroad engines. As expected, all four engines generally had elevated PM levels when using the high sulfur fuel. Composite weighted Type-C1 emission levels were computed for each engine from results obtained using the two different fuels, as shown in Table 16.

TABLE 7. REGULATED EMISSIONS AND N_2O LEVELS MEASURED OVER FTP, BHL, AND SAT TRANSIENT CYCLES ON A 1996 DEERE 6068T ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Toxics Info.	Cycle ID	SwRI Test Name	Hot-Start Transient Emissions, g/hp-hr					N_2O, mg/hp-hr	BSFC, lb/hp-hr	Work, hp-hr	
				HC	CO	NO_x	PM	CO_2			Cycle	Ref.
2D	No	FTP	J02DFTP1	0.832	1.354	10.156	0.269	561	na	0.392	11.60	11.32
	No	FTP	J02DFTP2	0.826	1.451	9.086[a]	0.271	560	na	0.391	11.61	11.32
	FTP Averages			**0.83**	**1.40**	**NA**	**0.27**	**561**	**na**	**0.392**	**11.61**	**11.32**
	No	BHL	J02DBHL1	0.660	2.122	8.543	0.334	577	na	0.404	9.87	9.73
	No	BHL	J02DBHL2	0.649	2.099	7.714[a]	0.312	572	na	0.400	9.96	9.73
	BHL Averages			**0.65**	**2.11**	**NA**	**0.32**	**575**	**na**	**0.402**	**9.92**	**9.73**
	No	SAT	J02DSAT1	0.631	0.889	9.090	0.175	547	na	0.381	19.46	20.00
	No	SAT	J02DSAT2	0.653	0.991	8.084[a]	0.175	537	na	0.374	19.43	20.00
	SAT Averages			**0.64**	**0.94**	**NA**	**0.18**	**542**	**na**	**0.378**	**19.45**	**20.00**
	Yes	FTP	J12DFTP1	0.854	1.628	10.426	0.306	572	4.1	0.400	11.78	11.32
	Yes	FTP	J12DFTP2	0.837	1.565	10.189	0.277	560	4.7	0.391	11.79	11.32
	FTP Averages			**0.85**	**1.60**	**10.31**	**0.29**	**566**	**4.4**	**0.396**	**11.79**	**11.32**
	Yes	BHL	J12DBHL1	0.623	2.187	8.638	0.323	582	4.6	0.407	9.93	9.73
NR	Yes	FTP	J2NRFTP1	0.743	1.512	10.331	0.325	562	5.3	0.393	11.81	11.53
	Yes	FTP	J2NRFTP2	1.129	1.405	10.075	0.318	555	5.5	0.389	11.81	11.53
	FTP Averages			**0.94**	**1.46**	**10.20**	**0.32**	**559**	**5.4**	**0.391**	**11.81**	**11.53**
	Yes	BHL	J2NRBHL1	0.555	2.204	8.708	0.392	581	6.2	0.406	10.14	9.91

Notes:
[a] - Nitric Oxide (NO) was measured rather than NO_x for this test only
Shaded areas show tests run without added chemistry to preview engine performance
FTP - On-highway federal test procedure cycle
BHL - Nonroad equipment duty cycle based on backhoe loader activities
SAT - Composite Nonroad duty cycle developed by EPA
2D - Emissions grade Type-2D (~500 ppm sulfur) diesel fuel
NR - High sulfur (~2,500 ppm) nonroad 2D diesel fuel

TABLE 8. REGULATED EMISSION LEVELS MEASURED OVER FTP, BHL, AND SAT TRANSIENT CYCLES ON A 1998 CUMMINS M11C ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Toxic Info.	Cycle ID	SwRI Test Name	Hot-Start Transient Emissions, g/hp-hr					N_2O, mg/hp-hr	BSFC, lb/hp-hr	Work, hp-hr	
				HC	CO	NO_x	PM	CO_2			Cycle	Ref.
2D	No	FTP	M02DXFTP1	0.726	2.683	6.714	0.325	549	na	0.384	19.77	19.34
	No	FTP	M02DXFTP2	0.679	2.569	6.660	0.340	551	na	0.386	19.66	19.34
	FTP Averages			0.70	2.63	6.69	0.33	550	na	0.385	19.72	19.34
	No	BHL	M42DBHL1	0.627	2.488	6.603	0.387	567	na	0.397	16.02	16.11
	No	BHL	M42DBHL2	0.680	2.769	6.519	0.389	568	na	0.398	16.06	16.17
	BHL Averages			0.65	2.63	6.56	0.39	568	na	0.398	16.04	16.14
	No	SAT	M02DXSAT1	0.390	1.194	6.061	0.220	522	na	0.364	34.41	34.60
	No	SAT	M02DXSAT2	0.380	1.177	6.080	0.225	525	na	0.366	34.43	34.60
	SAT Averages			0.39	1.19	6.07	0.22	524	na	0.365	34.42	34.60
	Yes	FTP	M12DFTP3	0.776	2.630	6.589	0.336	539	3.3	0.378	19.89	19.44
	Yes	FTP	M12DFTP4	0.803	2.524	6.419	0.325	535	3.9	0.375	19.86	19.44
	FTP Averages			0.79	2.58	6.50	0.33	537	3.6	0.377	19.88	19.44
	Yes	BHL	M12DBHL1	0.563	2.529	6.702	0.371	568	5.0	0.397	16.10	16.11
NR	Yes	FTP	M2NRFTP1	0.735	2.659	6.523	0.381	545	4.7	0.382	20.01	19.61
	Yes	FTP	M2NRFTP2	0.744	2.673	6.432	0.387	541	4.4	0.379	20.02	19.61
	FTP Averages			0.74	2.67	6.48	0.38	543	4.6	0.381	20.02	19.61
	Yes	BHL	M2NRBHL1	0.615	2.886	6.472	0.433	564	5.7	0.395	16.30	16.34

Notes:

Shaded areas show tests run without added chemistry to preview engine performance
FTP - On-highway federal test procedure cycle
BHL - Nonroad equipment duty cycle based on backhoe loader activities
SAT - Composite Nonroad duty cycle developed by EPA
2D - Emissions grade Type-2D (~500 ppm sulfur) diesel fuel
NR - High sulfur (~2,500 ppm) nonroad 2D diesel fuel

TABLE 9. REGULATED EMISSIONS AND N_2O LEVELS MEASURED OVER FTP, BHL, AND SAT TRANSIENT CYCLES ON A 2001 CATERPILLAR 3196 ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Toxic Info.	Cycle ID	SwRI Test Name	Hot-Start Transient Emissions, g/hp-hr					N_2O, mg/hp-hr	BSFC, lb/hp-hr	Work, hp-hr	
				HC	CO	NO_x	PM	CO_2			Cycle	Ref.
2D	No	FTP	E02DFTP1	0.112	1.523	6.497	0.142	495	na	0.345	31.64	31.24
	No	FTP	E02DFTP2	0.048	1.304	6.442	0.121	494	na	0.344	31.67	31.24
	FTP Averages			0.08	1.41	6.47	0.13	495	na	0.345	31.66	31.24
	No	BHL	E02DBHL1	0.136	1.374	6.410	0.134	509	na	0.354	26.21	24.95
	No	BHL	E02DBHL2	0.141	1.372	6.310	0.114	504	na	0.351	26.25	24.95
	BHL Averages			0.14	1.37	6.36	0.12	507	na	0.353	26.23	24.95
	No	SAT	E02DSAT1	0.105	0.930	5.776	0.093	475	na	0.330	55.01	56.64
	No	SAT	E02DSAT2	0.103	0.889	5.771	0.093	472	na	0.328	55.02	56.64
	SAT Averages			0.10	0.91	5.77	0.09	474	na	0.329	55.02	56.64
	Yes	FTP	E12DFTP1	0.078	1.329	6.331	0.119	501	3.9	0.349	31.62	31.24
	Yes	FTP	E12DFTP2	0.042	1.384	6.325	0.126	494	4.9	0.344	31.56	31.24
	FTP Averages			0.06	1.36	6.33	0.12	498	4.4	0.347	31.59	31.24
	Yes	BHL	E12DBHL1	0.118	1.315	6.419	0.134	500	3.6	0.348	25.99	24.95
NR	Yes	FTP	E2NRFTP1	0.083	1.307	6.285	0.176	495	4.4	0.344	32.04	31.47
	Yes	FTP	E2NRFTP2	0.078	1.355	6.197	0.180	496	4.4	0.345	31.88	31.47
	FTP Averages			0.08	1.33	6.24	0.18	496	4.4	0.345	31.96	31.47
	Yes	BHL	E2NRBHL1	0.088	1.434	6.338	0.186	501	4.1	0.349	26.20	25.09

Notes:

Shaded areas show tests run without added chemistry to preview engine performance
FTP - On-highway federal test procedure cycle
BHL - Nonroad equipment duty cycle based on backhoe loader activities
SAT - Composite Nonroad duty cycle developed by EPA
2D - Emissions grade Type-2D (~500 ppm sulfur) diesel fuel
NR - High sulfur (~2,500 ppm) nonroad 2D diesel fuel

TABLE 10. REGULATED EMISSIONS AND N_2O LEVELS MEASURED OVER FTP, BHL, AND SAT TRANSIENT CYCLES ON A 2001 CUMMINS ISB190 ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Toxic Info.	Cycle ID	SwRI Test Name	Hot-Start Transient Emissions, g/hp-hr					N_2O, mg/hp-hr	BSFC, lb/hp-hr	Work, hp-hr	
				HC	CO	NO_x	PM	CO_2			Cycle	Ref.
2D	**No**	**FTP**	**B02DFTP1**	**0.115**	**1.038**	**4.079**	**0.095**	**590**	**na**	**0.410**	**12.98**	**12.70**
	No	**FTP**	**B02DFTP2**	**0.049**	**1.046**	**4.021**	**0.098**	**593**	**na**	**0.412**	**12.96**	**12.70**
	FTP Averages			**0.08**	**1.04**	**4.05**	**0.10**	**592**	**na**	**0.411**	**12.97**	**12.70**
	No	**BHL**	**B02DBHL1**	**0.126**	**1.262**	**4.399**	**0.098**	**593**	**na**	**0.412**	**10.75**	**10.89**
	No	**BHL**	**B02DBHL2**	**0.088**	**1.250**	**4.467**	**0.099**	**589**	**na**	**0.409**	**10.67**	**10.89**
	BHL Averages			**0.11**	**1.26**	**4.43**	**0.10**	**591**	**na**	**0.411**	**10.71**	**10.89**
	No	**SAT**	**B02DSAT1**	**0.150**	**0.891**	**3.967**	**0.090**	**568**	**na**	**0.394**	**21.12**	**22.58**
	No	**SAT**	**B02DSAT2**	**0.115**	**0.951**	**3.984**	**0.091**	**567**	**na**	**0.394**	**21.14**	**22.58**
	SAT Averages			**0.13**	**0.92**	**3.98**	**0.09**	**568**	**na**	**0.394**	**21.13**	**22.58**
	Yes	FTP	B12DFTP1	0.105	1.042	4.138	0.095	595	3.2	0.414	12.98	12.70
	Yes	FTP	B12DFTP2	0.100	0.947	4.106	0.095	587	--	0.408	12.90	12.70
	FTP Averages			**0.10**	**0.99**	**4.12**	**0.10**	**591**	**3.2**	**0.411**	**12.94**	**12.70**
	Yes	BHL	B12DBHL1	0.143	1.289	4.442	0.096	593	9.7	0.413	10.55	10.89
NR	Yes	FTP	B2NRFTP1	0.034	0.912	3.995	0.152	595	6.0	0.413	13.02	12.76
	Yes	FTP	B2NRFTP2	0.119	0.926	3.977	0.152	592	4.5	0.411	13.08	12.76
	FTP Averages			**0.08**	**0.92**	**3.99**	**0.15**	**594**	**5.3**	**0.412**	**13.05**	**12.76**
	Yes	BHL	B2NRBHL1	0.116	1.190	4.426	0.130	589	7.0	0.410	10.73	10.95

Notes:

Shaded areas show tests run without added chemistry to preview engine performance
FTP - On-highway federal test procedure cycle
BHL - Nonroad equipment duty cycle based on backhoe loader activities
SAT - Composite Nonroad duty cycle developed by EPA
2D - Emissions grade Type-2D (~500 ppm sulfur) diesel fuel
NR - High sulfur (~2,500 ppm) nonroad 2D diesel fuel

TABLE 11. SUMMARY OF PERFORMANCE AND STATISTICAL REGRESSION INFORMATION FOR TESTING FOUR DIFFERENT NONROAD DIESEL ENGINES OVER SELECTED TRANSIENT CYCLES USING TWO FUELS

Engine	Toxics Info.	Cycle ID	SwRI Test Number	Fuel	Pass or Fail?	Work % Dif.	Hot-Start Transient Cycle Validation and Statistical Regression Results													
							Speed					Torque					Power			
							SE	M	R2	B	Pts.	SE	M	R2	B	Pts.	SE	M	R2	B	Pts.
Deere 6068T	No	FTP	J02DFTP1	2D	Pass	2.46	15	1.006	0.9992	1	1174	8	0.99	0.9197	-1	1009	7	1	0.9497	-0.9	1009
	No	FTP	J02DFTP2	2D	Pass	2.53	15	1.007	0.9992	-1	1174	8	0.98	0.9214	0	1012	7	1	0.9506	-0.8	1012
	No	BHL	J02DBHL1	2D	Fail	1.48	24	1.007	0.9982	0	915	16 x	0.92	0.5756 x	8	930	13 x	0.99	0.7426	0.9	930
	No	BHL	J02DBHL2	2D	Fail	2.4	26	1.007	0.9979	1	915	16 x	0.93	0.5785 x	9	932	13 x	0.99	0.7417 x	1.1	932
	No	SAT	J02DSAT1	2D	Fail	-2.67	20	1.003	0.9974	11	1213	14 x	0.97	0.6898 x	-3	1223	14 x	1.01	0.7545 x	-2.4	1223
	No	SAT	J02DSAT2	2D	Fail	-2.84	20	1.003	0.9974	11	1213	14 x	0.97	0.6914 x	-4	1224	14 x	1.01	0.756 x	-2.7	1224
	Yes	FTP	J12DFTP1	2D	Pass	4.09	16	1.007	0.9992	-2	1174	9	1.01	0.9170	-2	1002	7	1.02	0.9489	-1.2	1002
	Yes	FTP	J12DFTP2	2D	Fail	4.14	30	1.003	0.997	4	1174	10	1.01	0.8993	-3	1008	9 x	1.01	0.9236	-1.2	1008
	Yes	BHL	J12DBHL1	2D	Fail	2.12	22	1.008	0.9985	-4	915	16 x	0.92	0.5716 x	10	935	13 x	0.99	0.7439 x	1.1	935
	Yes	FTP	J2NRFTP1	NR	Pass	2.39	15	1.006	0.9992	3	1174	8	0.99	0.9203	-2	1003	7	1	0.9494	-1.1	1003
	Yes	FTP	J2NRFTP2	NR	Pass	2.39	18	1.004	0.9989	6	1174	9	0.99	0.9197	-2	1001	7	1	0.9433	-1.2	1001
	Yes	BHL	J2NRBHL1	NR	Fail	2.28	24	1.008	0.9981	1	915	16 x	0.92	0.5818 x	9	932	13 x	1	0.7491 x	0.9	932
Cummins M11C	No	FTP	M02DXFTP1	2D	Pass	2.23	20	0.992	0.9968	-1	1174	6	0.96	0.9589	10	1011	5	0.97	0.9758	0.8	1011
	No	FTP	M02DXFTP2	2D	Pass	1.65	30	0.988	0.9925	4	1174	8	0.95	0.9382	8	1015	7	0.96	0.9475	0.6	1015
	No	BHL	M42DBHL1	2D	Fail	-0.95	21	1.017	0.9971	-40	915	13	0.91	0.6921 x	13	940	10 x	0.96	0.8029 x	1.5	940
	No	BHL	M42DBHL2	2D	Fail	-0.66	29	1.014	0.9947	-36	915	13	0.93	0.6815 x	10	938	11 x	0.96	0.788 x	1.2	938
	No	SAT	M02DXSAT1	2D	Fail	-0.54	19	0.999	0.9948	-12	1213	11	0.99	0.8345 x	-1	1219	10 x	1.01	0.8737 x	-2.6	1219
	No	SAT	M02DXSAT2	2D	Fail	-0.48	22	0.999	0.993	-12	1213	11	1	0.8312 x	-3	1221	10 x	1	0.8671 x	-2.2	1221
	Yes	FTP	M12DFTP3	2D	Pass	2.28	22	0.991	0.9959	1	1174	6	0.96	0.9622	10	1014	5	0.97	0.9768	0.8	1014
	Yes	FTP	M12DFTP4	2D	Pass	2.17	21	0.991	0.9961	1	1174	6	0.96	0.9622	10	1013	5	0.97	0.9769	0.9	1013
	Yes	BHL	M12DBHL1	2D	Fail	-0.06	26	1.011	0.9957	-31	915	13	0.9	0.6774 x	20 x	932	11 x	0.94	0.7886 x	2.5	932
	Yes	FTP	M2NRFTP1	NR	Pass	2.01	21	1.001	0.9962	-14	1174	6	0.96	0.9632	8	1013	5	0.97	0.9778	0.6	1013
	Yes	FTP	M2NRFTP2	NR	Pass	2.04	21	1.001	0.9961	-15	1174	6	0.96	0.9612	10	1013	5	0.97	0.9768	0.9	1013
	Yes	BHL	M2NRBHL1	NR	Fail	-0.6	44	1.009	0.9871	-30	915	14 x	0.91	0.6568 x	16 x	940	12 x	0.93	0.7519 x	3.4	940
On-Highway FTP Hot-Start Limits:						-15 to 5	0 to 100	0.97 to 1.03	0.97 to 1.00	-50 to 50	NA	0 to 13	0.83 to 1.03	0.88 to 1.00	-15 to 15	NA	0 to 8	0.89 to 1.03	0.91 to 1.00	-5 to 5	NA

TABLE 11 (CONT'D). SUMMARY OF PERFORMANCE AND STATISTICAL REGRESSION INFORMATION FOR TESTING FOUR DIFFERENT NONROAD DIESEL ENGINES OVER SELECTED TRANSIENT CYCLES USING TWO FUELS

Engine	Toxics Info.	Cycle ID	SwRI Test Number	Fuel	Pass or Fail?	Work % Dif.	Hot-Start Transient Cycle Validation and Statistical Regression Results														
							Speed					Torque					Power				
							SE	M	R2	B	Pts.	SE	M	R2	B	Pts.	SE	M	R2	B	Pts.
Caterpillar 3196	No	FTP	E02DFTP1	2D	Pass	1.3	25	0.998	0.9976	6	1174	7	0.97	0.9430	1	973	6	1	0.9659	-2.7	973
	No	FTP	E02DFTP2	2D	Pass	1.4	25	0.997	0.9976	6	1174	7	0.97	0.9453	3	975	6	0.99	0.9658	-2.1	975
	No	BHL	E02DBHL1	2D	Fail	5.03 x	83	1.006	0.9760	4	915	10	1.01	0.7878 x	0	788	8	1.03	0.8529 x	0.6	788
	No	BHL	E02DBHL2	2D	Fail	5.21 x	127 x	0.99	0.9443 x	27	915	9	1	0.7966 x	9	802	9 x	1.01	0.8356 x	4	802
	No	SAT	E02DSAT1	2D	Fail	-2.86	46	1.003	0.9802	-2	1213	9	0.99	0.8647 x	-10	1178	8	1.01	0.8959 x	-5.4 x	1178
	No	SAT	E02DSAT2	2D	Fail	-2.85	46	1.003	0.9799	-2	1213	9	0.98	0.8626 x	-7	1183	9 x	1	0.895 x	-4.9	1183
	Yes	FTP	E12DFTP1	2D	Pass	1.22	25	0.998	0.9975	5	1174	7	0.98	0.9448	-4	972	6	1	0.9663	-3.5	972
	Yes	FTP	E12DFTP2	2D	Pass	1.03	25	0.998	0.9976	5	1174	7	0.98	0.9457	-6	976	6	1	0.9657	-3.7	976
	Yes	BHL	E12DBHL1	2D	Fail	4.14	83	1.006	0.976	3	915	9	0.99	0.7887 x	7	793	8	1.01	0.8543 x	1.8	793
	Yes	FTP	E2NRFTP1	NR	Pass	1.8	25	0.998	0.9975	5	1174	7	0.98	0.9474	1	965	6	1	0.9669	-2.7	965
	Yes	FTP	E2NRFTP2	NR	Pass	1.3	25	0.997	0.9975	6	1174	7	0.97	0.9423	-1	965	6	0.99	0.9645	-2.8	965
	Yes	BHL	E2NRBHL1	NR	Fail	4.42	121 x	0.991	0.9489 x	26	915	9	0.98	0.7979 x	12	798	9 x	1	0.8397 x	4.1	798
Cummins ISB190	No	FTP	B02DFTP1	2D	Pass	2.23	17	0.99	0.9991	10	1174	7	0.97	0.9435	1	1006	6	0.99	0.9628	-0.3	1006
	No	FTP	B02DFTP2	2D	Pass	2	15	0.99	0.9994	11	1174	7	0.97	0.9418	0	1009	6	0.99	0.9609	-0.5	1009
	No	BHL	B02DBHL1	2D	Fail	-1.31	23	0.993	0.9984	7	915	10	0.89	0.7654 x	9	918	7	0.93	0.8789 x	2.5	918
	No	BHL	B02DBHL2	2D	Fail	-2.1	23	0.992	0.9984	7	915	10	0.88	0.7664 x	9	918	7	0.92	0.8797 x	2.4	918
	No	SAT	B02DSAT1	2D	Fail	-6.48	19	0.988	0.9978	15	1213	10	0.87	0.8105 x	11	1229	9 x	0.9	0.8587 x	2.4	1229
	No	SAT	B02DSAT2	2D	Fail	-6.39	21	0.989	0.9972	14	1213	10	0.87	0.806 x	10	1229	9 x	0.9	0.8582 x	2.2	1229
	Yes	FTP	B12DFTP1	2D	Pass	2.2	14	0.989	0.9994	12	1174	7	0.97	0.9413	0	1004	6	0.99	0.9521	-0.5	1004
	Yes	FTP	B12DFTP2	2D	Pass	2.18	20	0.988	0.9988	14	1174	8	0.97	0.9343	0	1004	7	0.98	0.9465	-0.5	1004
	Yes	BHL	B12DBHL1	2D	Fail	-3.14	23	0.993	0.9983	6	915	10	0.86	0.7576 x	10	918	8	0.91	0.8661 x	2.7	918
	Yes	FTP	B2NRFTP1	NR	Pass	2.05	13	0.991	0.9995	10	1174	7	0.97	0.9414	1	1007	6	0.99	0.9549	-0.5	1007
	Yes	FTP	B2NRFTP2	NR	Pass	2.52	29	0.99	0.9976	12	1174	8	0.96	0.9376	3	1006	6	0.98	0.9594	0.0	1006
	Yes	BHL	B2NRBHL1	NR	Fail	-2.03	19	0.993	0.9989	7	915	10	0.89	0.7917 x	7	924	7	0.93	0.8838 x	2.4	924
On-Highway FTP Hot-Start Limits:						-15 to 5	0 to 100	0.97 to 1.03	0.97 to 1.00	-50 to 50	NA	0 to 13	0.83 to 1.03	0.88 to 1.00	-15 to 15	NA	0 to 8	0.89 to 1.03	0.91 to 1.00	-5 to 5	NA

TABLE 12. RESULTS OF STEADY-STATE ISO TYPE-C1 TESTING ON A 1996 DEERE 6068T ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Emissions Rate, grams per hour				N_2O, mg/hr	Brake-Specific Emissions, g/hp-hr				N_2O, mg/hp-hr	Fuel Rate, lb/hr		BSFC, lb/hp-hr	Engine Speed, rpm	Torque, lb-ft	Power, hp
				HC	CO	NOx	PM		HC	CO	NOx	PM		Calc.	Meas.				
2D	Mode-1	J12DU8B	100R100	26.67	105.68	2049.47	21.47	1260	0.168	0.667	12.944	0.136	8.0	52.38	54.4	0.331	2200	377	158.0
2D	Mode-2	J12DU8B	100R075	28.11	42.40	1136.13	15.31	946	0.237	0.357	9.560	0.129	8.0	42.2	41.5	0.355	2200	282	118.0
2D	Mode-3	J12DU8B	100R050	40.68	59.29	522.32	19.61	199	0.506	0.738	6.639	0.244	2.5	30.80	31.3	0.383	2200	189	79.5
2D	Mode-4	J12DU8B	100R010	67.73	116.12	127.84	9.49	0	4.034	6.916	7.615	0.565	0.0	13.57	12.8	0.808	2200	39	16.5
2D	Mode-5	J12DU8B	060R100	21.17	261.84	1267.09	65.04	799	0.171	2.119	10.255	0.526	6.5	41.20	41.9	0.333	1350	480	123.0
2D	Mode-6	J12DU8B	060R075	26.08	31.53	983.82	16.91	365	0.278	0.336	10.494	0.180	3.9	30.74	30.7	0.328	1350	363	93.0
2D	Mode-7	J12DU8B	060R050	26.45	27.19	560.97	9.34	235	0.415	0.427	8.801	0.147	3.7	21.09	20.8	0.331	1350	246	63.5
2D	Mode-8	J12DU8B	100I000	15.93	30.83	45.65	2.98	45	na	na	na	na	na	2.92	1.7	8.121	900	0	0.0
2D	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.37	0.96	10.35	0.229	6.1	na	na	na	na	na	82.9
NR	Mode-1	J2NRU8E	100R100	21.15	107.33	2089.42	27.54	4216	0.132	0.669	13.033	0.172	26.3	53.00	55.3	0.331	2200	385	161.0
NR	Mode-2	J2NRU8E	100R075	24.74	36.83	1211.27	19.05	3107	0.203	0.303	9.955	0.157	25.5	42.77	42.7	0.351	2200	290	121.5
NR	Mode-3	J2NRU8E	100R050	40.69	60.03	547.71	23.62	956	0.495	0.730	6.661	0.287	11.6	31.47	31.3	0.383	2200	193	81.5
NR	Mode-4	J2NRU8E	100R010	64.03	114.77	135.42	11.48	344	3.293	5.902	6.964	0.591	17.7	14.00	13.7	0.720	2200	44	18.5
NR	Mode-5	J2NRU8E	060R100	19.25	309.62	1253.42	68.33	3122	0.157	2.527	10.260	0.558	25.5	41.76	41.4	0.341	1350	476	122.0
NR	Mode-6	J2NRU8E	060R075	26.43	28.66	1003.36	20.53	1897	0.286	0.310	10.866	0.222	20.6	30.51	30.0	0.330	1350	359	92.5
NR	Mode-7	J2NRU8E	060R050	25.89	25.97	589.34	43.96	793	0.420	0.421	9.552	0.712	12.9	20.96	19.4	0.340	1350	238	61.0
NR	Mode-8	J2NRU8E	100I000	15.89	36.37	51.29	3.50	113	na	na	na	na	na	0.96	1.60	na	780	0.0	0.0
NR	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.34	1.00	10.51	0.303	22.3	na	na	na	na	na	84.0

TABLE 13. RESULTS OF STEADY-STATE ISO TYPE-C1 TESTING ON A 1998 CUMMINS M11C ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Emissions Rate, grams per hour				N_2O, mg/hr	Brake-Specific Emissions, g/hp-hr				N_2O, mg/hp-hr	Fuel Rate, lb/hr		BSFC, lb/hp-hr	Engine Speed, rpm	Torque, lb-ft	Power, hp
				HC	CO	NOx	PM		HC	CO	NOx	PM		Calc.	Meas.				
2D	Mode-1	M12DU8B	100R100	43.45	67.87	1846.07	19.39	878	0.158	0.246	6.702	0.070	3.2	89.38	89.8	0.324	1700	856	277
2D	Mode-2	M12DU8B	100R075	38.38	63.54	1107.87	19.03	671	0.184	0.304	5.302	0.091	3.2	71.21	73.0	0.341	1700	648	209
2D	Mode-3	M12DU8B	100R050	43.04	69.46	593.57	25.73	487	0.309	0.498	4.257	0.185	3.5	50.18	51.0	0.360	1700	428	141
2D	Mode-4	M12DU8B	100R010	64.20	119.47	373.91	28.35	231	2.215	4.122	12.900	0.978	8.0	16.97	15.0	0.586	1700	86	27
2D	Mode-5	M12DU8B	060R100	27.58	164.70	1703.37	17.20	806	0.115	0.689	7.126	0.072	3.4	75.55	78.0	0.316	1300	970	239
2D	Mode-6	M12DU8B	060R075	18.91	108.66	1004.59	17.48	429	0.106	0.609	5.634	0.098	2.4	58.50	60.0	0.328	1300	727	178
2D	Mode-7	M12DU8B	060R050	30.60	56.69	366.71	23.31	257	0.342	0.634	4.099	0.261	2.9	32.10	32.0	0.359	1300	365	87
2D	Mode-8	M12DU8B	100I000	44.91	60.24	106.64	9.44	207	na	na	na	na	na	3.53	2.6	na	900	0	0
2D	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.27	057	6.07	0.134	3.5	na	na	na	na	na	147.2
NR	Mode-1	M2NRU8E	100R100	43.80	190.03	1833.54	20.29	3829	0.159	0.689	6.646	0.074	13.9	89.54	89.9	0.275	1700	857	278
NR	Mode-2	M2NRU8E	100R075	43.01	69.20	1094.71	26.99	1752	0.207	0.333	5.224	0.130	8.4	69.59	70.8	0.335	1700	645	208
NR	Mode-3	M2NRU8E	100R050	48.08	66.46	591.47	32.35	754	0.345	0.477	4.243	0.232	5.4	50.06	50.7	0.359	1700	430	140
NR	Mode-4	M2NRU8E	100R010	72.32	125.66	354.30	30.46	427	2.591	4.502	12.692	1.091	15.3	16.66	15.0	0.597	1700	87	29
NR	Mode-5	M2NRU8E	060R100	27.07	191.28	1679.27	21.60	3485	0.114	0.804	7.055	0.091	14.6	76.52	79.0	0.321	1300	966	238
NR	Mode-6	M2NRU8E	060R075	20.72	129.31	1003.84	24.28	1765	0.116	0.725	5.625	0.136	9.9	58.84	60.0	0.330	1300	723	178
NR	Mode-7	M2NRU8E	060R050	34.25	65.47	368.30	30.07	220	0.378	0.723	4.067	0.332	2.4	33.02	33.0	0.365	1300	366	90
NR	Mode-8	M2NRU8E	100I000	50.37	69.67	105.87	11.27	83	na	na	na	na	na	3.73	2.5	na	900	0	0
NR	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.29	0.75	5.99	0.165	10.5	na	na	na	na	na	147.4

TABLE 14. RESULTS OF STEADY-STATE ISO TYPE-C1 TESTING ON A 2001 CATERPILLAR 3196 ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Emissions Rate, grams per hour				N_2O, mg/hr	Brake-Specific Emissions, g/hp-hr				N_2O, mg/hp-hr	Fuel Rate, lb/hr		BSFC, lb/hp-hr	Engine Speed, rpm	Torque, lb-ft	Power, hp
				HC	CO	NOx	PM		HC	CO	NOx	PM		Calc.	Meas.				
2D	Mode-1	E12DU8B	100R100	11.14	63.96	3026.83	15.73	1727	0.027	0.155	7.320	0.038	4.2	125.59	131.1	0.304	2100	1044	417
2D	Mode-2	E12DU8B	100R075	19.63	48.81	1855.56	13.99	1403	0.063	0.156	5.919	0.045	4.5	101.12	100.4	0.323	2100	783	313
2D	Mode-3	E12DU8B	100R050	26.15	57.54	978.21	20.07	959	0.125	0.275	4.674	0.096	4.6	71.50	70.8	0.342	2100	523	210
2D	Mode-4	E12DU8B	100R010	44.32	175.85	300.77	24.37	528	1.087	4.315	7.380	0.598	13.0	23.96	23.0	0.588	2100	96	39
2D	Mode-5	E12DU8B	060R100	5.78	1158.43	2001.59	42.30	1399	0.016	3.176	5.487	0.116	3.8	115.40	114.7	0.316	1400	1375	366
2D	Mode-6	E12DU8B	060R075	8.39	174.82	1445.54	11.63	910	0.031	0.637	5.270	0.042	3.3	88.57	86.0	0.323	1400	1039	277
2D	Mode-7	E12DU8B	060R050	5.74	88.82	1018.15	10.79	686	0.031	0.482	5.521	0.059	3.7	60.20	57.4	0.326	1400	692	184
2D	Mode-8	E12DU8B	100I000	4.34	30.11	116.14	6.07	67	na	na	na	na	na	6.06	2.5	2.368	880	0	0
2D	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.07	0.83	6.04	0.076	4.3	na	na	na	na	na	227.5
NR	Mode-1	E2NRU8E	100R100	5.98	79.80	3048.25	35.08	7220	0.014	0.191	7.291	0.084	17.3	126.03	131.8	0.301	2100	1045	417
NR	Mode-2	E2NRU8E	100R075	17.15	49.57	1763.05	31.49	3647	0.055	0.159	5.655	0.101	11.7	99.17	100.6	0.318	2100	785	313
NR	Mode-3	E2NRU8E	100R050	23.85	58.22	961.11	33.00	1329	0.113	0.275	4.544	0.156	6.3	70.45	70.7	0.333	2100	523	210
NR	Mode-4	E2NRU8E	100R010	38.80	178.08	300.20	50.06	662	0.886	4.065	6.853	1.143	15.1	24.76	23.8	0.565	2100	106	43
NR	Mode-5	E2NRU8E	060R100	2.29	1129.61	2004.28	29.42	4729	0.006	3.101	5.502	0.081	13.0	114.53	114.6	0.314	1400	1379	365
NR	Mode-6	E2NRU8E	060R075	4.35	181.16	1421.88	23.29	2644	0.016	0.666	5.229	0.086	9.7	88.02	84.4	0.324	1400	1023	271
NR	Mode-7	E2NRU8E	060R050	5.41	82.96	1013.11	19.18	1142	0.029	0.451	5.513	0.104	6.2	60.60	57.0	0.330	1400	690	184
NR	Mode-8	E2NRU8E	100I000	3.35	36.87	134.86	4.54	137	na	na	na	na	na	3.96	2.8	1.434	880	1	2
NR	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.06	0.84	5.98	0.122	12.2	na	na	na	na	na	227.4

TABLE 15. RESULTS OF STEADY-STATE ISO TYPE-C1 TESTING ON A 2001 CUMMINS ISB190 ENGINE USING LOW AND HIGH SULFUR DIESEL FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Emissions Rate, grams per hour				N_2O, mg/hr	Brake-Specific Emissions, g/hp-hr				N_2O, mg/hp-hr	Fuel Rate, lb/hr		BSFC, lb/hp-hr	Engine Speed, rpm	Torque, lb-ft	Power, hp
				HC	CO	NOx	PM		HC	CO	NOx	PM		Calc.	Meas.				
2D	Mode-1	B12DU8B	100R100	1.61	42.51	772.50	12.80	679	0.008	0.220	4.000	0.066	3.5	69.27	70.4	0.359	2300	443	193.5
2D	Mode-2	B12DU8B	100R075	1.76	50.58	448.52	10.62	488	0.012	0.351	3.110	0.074	3.4	54.08	56.2	0.375	2300	334	146.0
2D	Mode-3	B12DU8B	100R050	10.32	64.64	289.02	8.21	413	0.104	0.651	2.910	0.083	4..2	40.30	40.7	0.406	2300	227	99.5
2D	Mode-4	B12DU8B	100R010	18.57	121.28	184.03	6.37	391	0.937	6.120	9.287	0.322	19.7	13.70	13.8	0.691	2300	45	19.5
2D	Mode-5	B12DU8B	060R100	0.00	36.39	533.21	6.19	216	0.000	0.274	4.020	0.047	1.6	46.21	46.6	0.348	1400	500	133.0
2D	Mode-6	B12DU8B	060R075	0.00	22.41	397.66	4.30	188	0.000	0.221	3.915	0.042	1.9	35.12	35.5	0.346	1400	381	101.5
2D	Mode-7	B12DU8B	060R050	3.59	22.24	294.94	4.33	242	0.052	0.324	4.298	0.063	3.5	24.19	24.1	0.353	1400	257	68.5
2D	Mode-8	B12DU8B	100I000	3.93	25.98	68.68	1.41	90	na	na	na	na	na	2.47	2.1	1.677	875	4	1.0
2D	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.05	0.49	3.85	0.072	3.6	na	na	na	na	na	98.3
NR	Mode-1	B2NRU8E	100R100	0.00	49.13	775.37	19.43	1578	0.000	0.252	3.956	0.100	8.1	70.26	71.0	0.361	2300	447	196.0
NR	Mode-2	B2NRU8E	100R075	1.38	47.74	439.78	18.14	607	0.010	0.335	3.086	0.127	4.3	54.05	56.5	0.379	2300	336	146.5
NR	Mode-3	B2NRU8E	100R050	9.27	67.69	285.85	14.14	624	0.094	0.683	2.885	0.143	6.3	40.04	40.4	0.404	2300	226	99.0
NR	Mode-4	B2NRU8E	100R010	14.81	107.97	188.62	8.69	447	0.674	4.914	8.585	0.396	20.4	14.48	14.2	0.659	2300	44	21.0
NR	Mode-5	B2NRU8E	060R100	0.00	33.01	520.35	9.10	384	0.000	0.248	3.903	0.068	2.9	45.58	47.1	0.342	1400	500	133.5
NR	Mode-6	B2NRU8E	060R075	0.28	20.31	31.14	6.40	366	0.003	0.205	0.315	0.065	3.7	34.27	35.0	0.346	1400	373	99.0
NR	Mode-7	B2NRU8E	060R050	3.13	23.53	283.88	6.04	297	0.047	0.354	4.268	0.091	4.5	22.96	23.2	0.345	1400	251	66.5
NR	Mode-8	B2NRU8E	100I000	0.88	25.32	60.07	1.29	140	na	na	na	na	na	2.12	1.9	2.829	875	3	0.5
NR	ISO Type-C1 Weighted Composite			na	na	na	na	na	0.04	0.48	2.24	0.112	6.0	na	na	na	na	na	98.3

TABLE 16. COMPOSITE WEIGHTED STEADY-STATE EMISSION LEVELS FOR FOUR DIFFERENT IN-USE NONROAD DIESEL ENGINES USING LOW AND HIGH SULFUR DIESEL FUELS

Test Engine	Fuel ID	Test Type	Weighted Transient Emissions, g/hp-hr					BSFC, lb/hp-hr
			HC	CO	NO_X	N_2O	PM	
Deere 6068T	2D	C1	0.37	0.96	10.35	0.006	0.229	0.361
	NR	C1	0.34	1.00	10.51	0.022	0.303	0.359
Cummins M11C	2D	C1	0.27	0.57	6.07	0.004	0.134	0.343
	NR	C1	0.29	0.75	5.99	0.011	0.165	0.342
Caterpillar 3196	2D	C1	0.07	0.83	6.04	0.004	0.076	0.325
	NR	C1	0.06	0.84	5.98	0.012	0.122	0.324
Caterpillar 3408	2D	C1	0.05	0.49	3.85	0.004	0.072	0.375
	NR	C1	0.04	0.48	3.42	0.006	0.112	0.373

Notes:

C1 - ISO Type-C1 weighted emissions computed from individual runs of each mode
2D - Emissions grade Type-2D (~500 ppm sulfur) diesel fuel
NR - High sulfur (~2,500 ppm) nonroad 2D diesel fuel

VI. UNREGULATED EMISSION RESULTS

This section of the report contains results of numerous post-test analyses that document specific unregulated emissions, or "toxic" compounds. Tabulated summaries give results on both a mass and brake-specific basis. In all cases, the resulting emission levels are shown after correcting for background and CVS tunnel blank contributions. Detection limits are shown for tabulated summaries of unregulated emission levels. Null values and "nd" indicate that the emission level was not quantifiable, or its concentration was quantifiable at a level below the minimum detection limit. Any value expressed as "trace" indicates an emission level quantifiable at less than twice the detection limit.

In this section of the report, toxic emission results are tabulated with steady-state results shown at the top of each table and transient cycle results at the bottom. Furthermore, the compounds are grouped for reporting purposes. For example, the sulfate and ammonia levels are tabulated alongside the reported inorganic elements, and PAH compounds are grouped separately from Nitro-PAH compounds. Hydrocarbon speciation information is provided in more detail in Appendices M, N, O, and P for tests on the Deere 6068T, Cummins M11C, Caterpillar 3196, and Cummins ISB190 engines, respectively. The scope of work was identical for all four engines covered by this report section. This report does not assess result reproducibility, because extensive replicate testing was not planned.

A. Toxics Measured for a Deere 6068T

Testing on the Deere 6068T engine included running steady-state and transient cycle emission tests using two different fuels. Steady-state testing included ISO Type-C1 testing. Transient testing included duplicate FTP cycles and a single BHL cycle using both fuels. Table 17 gives results for emissions of sulfate, ammonia, and selected inorganic elements. Most elements were below the level of quantification, and only a few showed "trace" levels. Table 18 contains results of hydrocarbon speciation (i.e., C_1 through C_{12}), showing species of special interest to EPA, reported on both a mass and brake-specific basis. Table 19 gives mass based levels for the higher molecular weight PAH compounds, with the corresponding brake-specific PAH levels shown in Table 20. Similarly, results for the lower molecular weight PAH compounds are summarized in Tables 21 and 22. Resulting nitro-PAH compounds are summarized in Table 23 for the Deere 6068T engine.

B. Toxics Measured for a Cummins M11C

Using both fuels, testing of the Cummins engine included running duplicate FTP cycles, a single BHL cycle, and an ISO Type-C1 test. Table 24 contains results for emissions of sulfate, ammonia, and inorganic elements. Table 25 gives results for C_1 through C_{12} hydrocarbon species on both a mass and brake-specific basis. Results of higher molecular weight PAH compounds are given in Table 26 on a mass basis, with corresponding brake-specific PAH levels shown in Table 27. Similarly, the results of lower molecular weight PAH compounds are summarized in Tables 28 and 29. Table 30 contains results of the different nitro-PAH compounds measured for the Cummins engine.

C. Toxics Measured for a Caterpillar 3196

The scope of work on the Caterpillar 3196 engine was identical to that of the Deere and Cummins engines. Table 31 contains results for emissions of sulfate, ammonia, and inorganic elements. Table 32 gives results for C_1 through C_{12} hydrocarbon species on both a mass and brake-specific basis. Results for higher molecular weight PAH compounds are given in Table 33 on a mass basis, with corresponding brake-specific PAH levels shown in Table 34. Similarly, the results of lower molecular weight PAH compounds are summarized in Tables 35 and 36. Table 37 contains results of nitro-PAH compounds measured for the Caterpillar engine.

D. Toxics Measured for a Cummins ISB190

The scope of work on the Cummins engine was identical to that of the Caterpillar engine. Table 38 contains results for emissions of sulfate, ammonia, and inorganic elements. Table 39 gives results for C_1 through C_{12} hydrocarbon species on both a mass and brake-specific basis. Results for higher molecular weight PAH compounds are given in Table 40 on a mass basis, with corresponding brake-specific PAH levels shown in Table 41. Similarly, the results of lower molecular weight PAH compounds are summarized in Tables 42 and 43. Table 44 contains results of nitro-PAH compounds measured for the Caterpillar engine.

TABLE 17. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR SULFATE, AMMONIA, AND SELECTED INORGANIC ELEMENTS FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Sulfate		Ammonia		Inorganic Elements, mg/hp-hr					
				mg/hr	mg/hp-hr	mg/hr	mg/hp-hr	Mercury	Manganese	Lead	Nickel	Arsenic	Chromium
2D	Mode-1	J12DU8B	100R100	413	2.6		nd						
2D	Mode-2	J12DU8B	100R075	322	2.7		nd						
2D	Mode-3	J12DU8B	100R050	215	2.7		nd						
2D	Mode-4	J12DU8B	100R010	51	3.0		nd						
2D	Mode-5	J12DU8B	060R100	335	2.7	35	0.3						
2D	Mode-6	J12DU8B	060R075	185	2.0	51	0.5						
2D	Mode-7	J12DU8B	060R050	121	1.9	90	1.4						
2D	Mode-8	J12DU8B	100I000	15	na	76	na						
2D	ISO Type-C1 Weighted Composite			na	2.7	na	0.3	nd	nd	nd	nd	nd	nd
NR	Mode-1	J2NRU8E	100R100	3,114	19.5		nd						
NR	Mode-2	J2NRU8E	100R075	3,548	29.3		nd						
NR	Mode-3	J2NRU8E	100R050	2,220	27.0		nd						
NR	Mode-4	J2NRU8E	100R010	512	26.3		nd			trace			
NR	Mode-5	J2NRU8E	060R100	1,618	13.2		nd						
NR	Mode-6	J2NRU8E	060R075	1,601	17.3		nd						
NR	Mode-7	J2NRU8E	060R050	5,278	85.5		nd						
NR	Mode-8	J2NRU8E	100I000	81	na		na						
NR	ISO Type-C1 Weighted Composite			na	23.4	na	nd	nd	nd	nd	nd	nd	nd
				Transient Cycle Emission Levels									
2D	BHL	J12DBHL1	Hot-Start	107	2.8	na	nd						
NR	BHL	J2NRBHL1	Hot-Start	1,078	28.0	na	0.2						
2D	FTP	J12DFTP1	Hot-Start	90	2.6	na	nd						
2D	FTP	J12DFTP2	Hot-Start	85	2.4	na	nd						
NR	FTP	J2NRFTP1	Hot-Start	779	22.1	na	nd						
NR	FTP	J2NRFTP2	Hot-Start	860	24.4	na	0.2						

Notes: For Inorganic Elements: "nd" and empty cells indicate none detected at calculated detection limit of 0.06 mg/hp-hr
"trace" indicates not quantifiable, or quantifiable at level less than twice the detection limit

TABLE 18. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per hour (mg/hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	J12DU8B	100R100	249	40	142	82	70	107		58	1562	409
2D	Mode-2	J12DU8B	100R075		22	125	47	74	123		54	787	266
2D	Mode-3	J12DU8B	100R050		198	204	59	124	157		61	1146	393
2D	Mode-4	J12DU8B	100R010		17	251	84	165	213		87	3837	1494
2D	Mode-5	J12DU8B	060R100	658	8	577	252	58	121		70	3036	746
2D	Mode-6	J12DU8B	060R075		5	193	28	81	114		52	662	190
2D	Mode-7	J12DU8B	060R050	871	10	113	49	78	108		49	505	170
2D	Mode-8	J12DU8B	100I000			77	37	45	56		27	1559	597
NR	Mode-1	J2NRU8E	100R100			159	251	42	145		52	1471	376
NR	Mode-2	J2NRU8E	100R075	492		178	52	47	104		54	760	246
NR	Mode-3	J2NRU8E	100R050		2	212	68	66	143		64	1117	366
NR	Mode-4	J2NRU8E	100R010			402	177	86	180		82	3783	1469
NR	Mode-5	J2NRU8E	060R100	720		497	192	37	86		37	3120	720
NR	Mode-6	J2NRU8E	060R075			66	59	50	90		138	606	156
NR	Mode-7	J2NRU8E	060R050			209	49	42	82		38	519	178
NR	Mode-8	J2NRU8E	100I000			86	23		37		17	1630	615
				Transient Cycle Emission Levels									
2D	BHL	J12DBHL1	Hot-Start	124	28	143	123	81	103		43	1303	461
NR	BHL	J2NRBHL2	Hot-Start	81		150	62	42	100		44	1367	459
2D	FTP	J12DFTP1	Hot-Start		25	166	138	103	125		81	1656	603
2D	FTP	J12DFTP2	Hot-Start		30	128	59	86	117		49	1677	628
NR	FTP	J2NRFTP1	Hot-Start	116	22	136	92	48	114		49	1501	558
NR	FTP	J2NRFTP2	Hot-Start			131	59	48	116		48	1579	579

TABLE 18 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per horsepower hour (mg/hp-hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	J12DU8B	100R100	1.6	0.3	0.9	0.5	0.4	0.7	nd	0.4	9.9	2.6
2D	Mode-2	J12DU8B	100R075	nd	0.2	1.1	0.4	0.6	1.0	nd	0.5	6.6	2.2
2D	Mode-3	J12DU8B	100R050	nd	2.5	2.6	0.7	1.5	2.0	nd	0.8	14.3	4.9
2D	Mode-4	J12DU8B	100R010	nd	1.0	15.0	5.0	9.8	12.7	nd	5.2	228.6	89.0
2D	Mode-5	J12DU8B	060R100	5.3	0.1	4.7	2.0	0.5	1.0	nd	0.6	24.6	6.0
2D	Mode-6	J12DU8B	060R075	nd	0.1	2.1	0.3	0.9	1.2	nd	0.6	7.1	2.0
2D	Mode-7	J12DU8B	060R050	13.7	0.2	1.8	0.8	1.2	1.7	nd	0.8	7.9	2.7
2D	Mode-8	J12DU8B	100I000	na	na	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			2.3	0.5	2.4	0.9	1.0	1.5	nd	0.7	18.8	6.2
NR	Mode-1	J2NRU8E	100R100	nd	nd	1.0	1.6	0.3	0.9	nd	0.3	9.2	2.4
NR	Mode-2	J2NRU8E	100R075	4.0	nd	1.5	0.4	0.4	0.9	nd	0.4	6.3	2.0
NR	Mode-3	J2NRU8E	100R050	nd	trace	2.6	0.8	0.8	1.7	nd	0.8	13.6	4.5
NR	Mode-4	J2NRU8E	100R010	nd	nd	20.7	9.1	4.4	9.3	nd	4.2	194.6	75.6
NR	Mode-5	J2NRU8E	060R100	5.9	nd	4.1	1.6	0.3	0.7	nd	0.3	25.5	5.9
NR	Mode-6	J2NRU8E	060R075	nd	nd	0.7	0.6	0.5	1.0	nd	1.5	6.6	1.7
NR	Mode-7	J2NRU8E	060R050	nd	nd	3.4	0.8	0.7	1.3	nd	0.6	8.4	2.9
NR	Mode-8	J2NRU8E	100I000	na	na	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			1.7	nd	2.5	1.3	0.5	1.3	nd	0.7	18.5	5.9
				Transient Cycle Emission Levels									
2D	BHL	J12DBHL1	Hot-Start	3.3	0.7	3.8	3.3	2.2	2.7	nd	1.2	34.6	12.2
NR	BHL	J2NRBHL1	Hot-Start	2.1	nd	3.9	1.6	1.1	2.6	nd	1.2	35.5	11.9
2D	FTP	J12DFTP1	Hot-Start	nd	0.7	4.7	3.9	3.0	3.6	nd	2.3	47.1	17.2
2D	FTP	J12DFTP2	Hot-Start	nd	0.9	3.6	1.7	2.5	3.3	nd	1.4	47.7	17.8
NR	FTP	J2NRFTP1	Hot-Start	3.3	0.6	3.9	2.6	1.4	3.2	nd	1.4	42.6	15.9
NR	FTP	J2NRFTP2	Hot-Start	nd	nd	3.7	1.7	1.4	3.3	nd	1.4	44.8	16.4

Notes: Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit

TABLE 19. STEADY-STATE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), nanograms per hour (ng/hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	J12DU8B	100R100	80,600	29,700	4,900	6,200	113,000	10,100	14,600	15,900
2D	Mode-2	J12DU8B	100R075	45,300	10,600	6,300	14,600	105,000	13,000	12,000	4,900
2D	Mode-3	J12DU8B	100R050	125,000	18,600	50,000	8,900	173,000	10,000	24,100	52,800
2D	Mode-4	J12DU8B	100R010	72,300	31,900	30,400	29,000	89,400	28,800	35,900	29,100
2D	Mode-5	J12DU8B	060R100	95,500	28,300	28,200	30,900	136,000	29,300	32,400	33,700
2D	Mode-6	J12DU8B	060R075	66,600	20,000	13,100	8,900	97,600	16,900	2,200	6,200
2D	Mode-7	J12DU8B	060R050	73,900	25,700	26,900	31,000	122,000	10,100	7,700	18,700
2D	Mode-8	J12DU8B	100I000	23,700	9,300	4,600	1,300	38,400	3,700	10,000	11,900
NR	Mode-1	J2NRU8E	100R100	2,200	17,400	9,000	13,100	36,400	17,000	17,400	14,600
NR	Mode-2	J2NRU8E	100R075	9,000	9,000	15,600	710	53,300	3,200	13,000	10,200
NR	Mode-3	J2NRU8E	100R050	69,300	66,600	72,000	67,800	248,000	60,700	65,200	62,400
NR	Mode-4	J2NRU8E	100R010	112,000	101,000	98,100	202,000	295,000	105,000	96,800	101,000
NR	Mode-5	J2NRU8E	060R100	51,700	31,400	9,500	3,700	89,100	13,600	6,700	18,200
NR	Mode-6	J2NRU8E	060R075	50,000	18,100	20,700	15,300	100,000	11,100	10,100	7,400
NR	Mode-7	J2NRU8E	060R050	82,700	31,700	37,000	31,600	157,000	36,700	37,100	33,000
NR	Mode-8	J2NRU8E	100I000	49,200	49,200	49,800	49,800	66,100	51,600	50,600	51,200

TABLE 20. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), nanograms per horsepower hour (ng/hp-hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	J12DU8B	100R100	510	190	30	40	720	60	90	100
2D	Mode-2	J12DU8B	100R075	380	90	50	120	890	110	100	40
2D	Mode-3	J12DU8B	100R050	1,600	230	630	110	2,200	130	300	660
2D	Mode-4	J12DU8B	100R010	4,400	1,900	1,800	1,800	5,400	1,700	2,200	1,800
2D	Mode-5	J12DU8B	060R100	780	230	230	250	1,100	240	260	270
2D	Mode-6	J12DU8B	060R075	720	220	140	100	1,000	180	20	70
2D	Mode-7	J12DU8B	060R050	1,200	400	420	490	1,900	160	120	290
2D	Mode-8	J12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			860	250	240	180	1,300	170	200	260
NR	Mode-1	J2NRU8E	100R100	10	110	60	80	230	110	110	90
NR	Mode-2	J2NRU8E	100R075	70	70	130	6	440	30	110	80
NR	Mode-3	J2NRU8E	100R050	850	820	880	830	3,000	750	800	770
NR	Mode-4	J2NRU8E	100R010	6,000	5,500	5,300	10,900	16,000	5,700	5,200	5,400
NR	Mode-5	J2NRU8E	060R100	420	260	80	30	730	110	60	150
NR	Mode-6	J2NRU8E	060R075	540	200	220	170	1,100	120	110	80
NR	Mode-7	J2NRU8E	060R050	1,400	520	610	520	2,600	600	610	540
NR	Mode-8	J2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			580	470	460	530	1,500	430	440	440
				Transient Cycle Emission Levels							
2D	BHL	J12DBHL1	Hot-Start	1,600	560	520	520	1,900	170	290	610
NR	BHL	J2NRBHL1	Hot-Start	1,900	700	680	670	4,200	700	730	660
2D	FTP	J12DFTP1	Hot-Start	1,800	570	650	570	2,300	580	560	540
2D	FTP	J12DFTP2	Hot-Start	2,100	590	880	560	2,600	560	570	550
NR	FTP	J2NRFTP1	Hot-Start	1,800	520	620	560	3,500	520	560	530
NR	FTP	J2NRFTP2	Hot-Start	1,900	590	580	580	4,300	580	530	560

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.7 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 21. STEADY-STATE EMISSION LEVELS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per hour (µg/hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluo-ranthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	J12DU8B	100R100	5,700	3,500	1,700	790	8,800	27,200	19,300	1,800
2D	Mode-2	J12DU8B	100R075	7,000	3,600	1,700	650	10,000	23,300	19,500	1,800
2D	Mode-3	J12DS8B	100R050	10,600	6,900	2,500	1,100	15,800	43,500	28,800	2,600
2D	Mode-4	J12DU8B	100R010	9,300	4,400	2,000	400	16,900	36,100	20,300	1,300
2D	Mode-5	J12DU8B	060R100	3,400	6,600	3,000	870	4,600	50,500	23,400	1,600
2D	Mode-6	J12DU8B	060R075	6,200	3,900	1,300	640	8,400	21,600	16,500	1,500
2D	Mode-7	J12DU8B	060R050	6,900	5,300	1,300	600	10,000	24,500	18,000	1,500
2D	Mode-8	J12DU8B	100I000	4,700	2,100	920	210	7,200	18,100	11,800	660
NR	Mode-1	J2NRU8E	100R100	1,800	1,400	10	290	2,500	12,200	7,100	30
NR	Mode-2	J2NRU8E	100R075	3,100	1,700	130	450	4,800	17,400	10,600	80
NR	Mode-3	J2NRU8E	100R050	5,800	4,600	500	1,000	8,800	31,200	19,200	500
NR	Mode-4	J2NRU8E	100R010	10,200	6,000	1,800	680	15,600	51,100	28,400	1,900
NR	Mode-5	J2NRU8E	060R100	710	2,100	590	390	1,100	14,200	9,100	530
NR	Mode-6	J2NRU8E	060R075	2,800	2,100	330	430	4,200	13,000	9,400	640
NR	Mode-7	J2NRU8E	060R050	4,400	4,100	840	560	5,900	22,600	12,100	1,000
NR	Mode-8	J2NRU8E	100I000	2,900	2,100	500	230	4,500	19,800	8,300	460

TABLE 22. STEADY-STATE AND TRANSIENT CYCLE EMISSIONS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per horsepower hour (µg/hp-hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluor-anthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	J12DU8B	100R100	40	20	10	5	60	170	120	10
2D	Mode-2	J12DU8B	100R075	60	30	10	6	90	200	170	20
2D	Mode-3	J12DU8B	100R050	130	90	30	10	200	550	360	30
2D	Mode-4	J12DU8B	100R010	560	270	120	20	1,000	2,200	1,200	80
2D	Mode-5	J12DU8B	060R100	30	50	20	7	40	410	190	10
2D	Mode-6	J12DU8B	060R075	70	40	10	7	90	230	180	20
2D	Mode-7	J12DU8B	060R050	110	80	20	9	160	390	280	20
2D	Mode-8	J12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			80	50	20	8	120	360	240	20
NR	Mode-1	J2NRU8E	100R100	10	8	nd	2	20	80	40	nd
NR	Mode-2	J2NRU8E	100R075	30	10	trace	4	40	140	90	trace
NR	Mode-3	J2NRU8E	100R050	70	60	6	10	110	380	240	6
NR	Mode-4	J2NRU8E	100R010	550	330	100	40	840	2,800	1,500	100
NR	Mode-5	J2NRU8E	060R100	6	20	5	3	9	120	70	4
NR	Mode-6	J2NRU8E	060R075	30	20	4	5	40	140	100	7
NR	Mode-7	J2NRU8E	060R050	70	70	10	9	100	370	200	20
NR	Mode-8	J2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			50	30	6	6	70	260	150	7
				Transient Cycle Emission Levels							
2D	BHL	J12DBHL1	Hot-Start	180	110	30	9	250	620	440	20
NR	BHL	J2NRBHL1	Hot-Start	110	110	20	10	240	660	360	20
2D	FTP	J12DFTP1	Hot-Start	190	90	30	10	340	670	480	30
2D	FTP	J12DFTP2	Hot-Start	220	90	40	10	320	680	530	50
NR	FTP	J2NRFTP1	Hot-Start	120	70	20	10	230	560	360	20
NR	FTP	J2NRFTP2	Hot-Start	140	70	20	10	270	590	440	30

Notes:
Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.07 µg/hp-hr
Emission levels expressed in units of micrograms per horsepower-hour
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 23. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate NITRO Polynuclear Aromatic Hydrocarbon (n-PAH), Nanograms per hour (ng/hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	J12DU8B	100R100	1,000	2,700	70	4,000	1,100	450	540
2D	Mode-2	J12DU8B	100R075	730	1,300	250	2,700	360	1,200	840
2D	Mode-3	J12DU8B	100R050	590	6,800	40	9,500	1,000	270	690
2D	Mode-4	J12DU8B	100R010	730	8,000	540	6,700	280	240	730
2D	Mode-5	J12DU8B	060R100	650	2,700	540	1,300	60	700	530
2D	Mode-6	J12DU8B	060R075	1,200	1,200	320	2,700	450	130	470
2D	Mode-7	J12DU8B	060R050	580	2,700	60	8,200	560	350	1,100
2D	Mode-8	J12DU8B	100I000	300	2,500	110	1,200		520	490
NR	Mode-1	J2NRU8E	100R100	570	1,300	740	4,100	9	680	230
NR	Mode-2	J2NRU8E	100R075	100	1,300	460	4,000	530	1,200	640
NR	Mode-3	J2NRU8E	100R050	1,200	5,400	300	9,500	370	780	290
NR	Mode-4	J2NRU8E	100R010	500	14,800		14,800	440	410	420
NR	Mode-5	J2NRU8E	060R100	940	930	720	790	1,000	270	1,300
NR	Mode-6	J2NRU8E	060R075	10	850	340	1,300	810	90	870
NR	Mode-7	J2NRU8E	060R050	550	1,000	250	8,000	640	60	440
NR	Mode-8	J2NRU8E	100I000	470	1,300	380	1,300	460	170	nd

TABLE 23 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 1996 DEERE 6068T ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake Specific NITRO-PAH Compounds, Nanograms per horsepower-hour (ng/hp-hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	J12DU8B	100R100	7	20	trace	30	7	3	3
2D	Mode-2	J12DU8B	100R075	6	10	2	20	3	10	7
2D	Mode-3	J12DU8B	100R050	7	90	trace	120	10	3	9
2D	Mode-4	J12DU8B	100R010	40	490	30	400	20	10	40
2D	Mode-5	J12DU8B	060R100	5	20	4	10	0	6	4
2D	Mode-6	J12DU8B	060R075	10	10	3	30	5	trace	5
2D	Mode-7	J12DU8B	060R050	9	40	trace	130	9	6	20
2D	Mode-8	J12DU8B	100I000	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			9	40	3	50	6	6	8
NR	Mode-1	J2NRU8E	100R100	4	8	5	30	nd	4	trace
NR	Mode-2	J2NRU8E	100R075	trace	10	4	30	4	10	5
NR	Mode-3	J2NRU8E	100R050	10	70	4	120	5	10	4
NR	Mode-4	J2NRU8E	100R010	30	800	nd	800	20	20	20
NR	Mode-5	J2NRU8E	060R100	8	8	6	6	9	2	10
NR	Mode-6	J2NRU8E	060R075	trace	9	4	10	9	trace	9
NR	Mode-7	J2NRU8E	060R050	9	20	4	130	10	trace	7
NR	Mode-8	J2NRU8E	100I000	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			6	40	5	60	6	6	6
				Transient Cycle Emission Levels						
2D	BHL	J12DBHL1	Hot-Start	6	700	3	540	trace	4	nd
NR	BHL	J2NRBHL1	Hot-Start	trace	570	nd	460	5	nd	2
2D	FTP	J12DFTP1	Hot-Start	30	760	2	390	4	4	nd
2D	FTP	J12DFTP2	Hot-Start	20	630	5	410	2	trace	3
NR	FTP	J2NRFTP1	Hot-Start	10	700	3	470	trace	2	nd
NR	FTP	J2NRFTP2	Hot-Start	10	800	5	580	2	nd	nd

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated nPAH detection limit was 0.4 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 24. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR SULFATE, AMMONIA, AND SELECTED INORGANIC ELEMENTS FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Sulfate		Ammonia		Inorganic Elements, mg/hp-hr					
				mg/hr	mg/hp-hr	mg/hr	mg/hp-hr	Mercury	Manganese	Lead	Nickel	Arsenic	Chromium
2D	Mode-1	M12DU8B	100R100	692	2.5		nd						
2D	Mode-2	M12DU8B	100R075	422	2.0		nd						
2D	Mode-3	M12DU8B	100R050	301	2.2		nd						
2D	Mode-4	M12DU8B	100R010	65	2.3		nd						
2D	Mode-5	M12DU8B	060R100	488	2.0		nd						
2D	Mode-6	M12DU8B	060R075	295	1.7		nd						
2D	Mode-7	M12DU8B	060R050	174	2.0		nd						
2D	Mode-8	M12DU8B	100I000	15	na		na						
2D	ISO Type-C1 Weighted Composite			na	2.2	na	nd	nd	nd	nd	nd	nd	nd
NR	Mode-1	M2NRU8E	100R100	3,965	14.5		nd						
NR	Mode-2	M2NRU8E	100R075	3,333	16.0	63	0.3						
NR	Mode-3	M2NRU8E	100R050	3,064	22.0	86	0.6						
NR	Mode-4	M2NRU8E	100R010	625	22.4	48	1.7						
NR	Mode-5	M2NRU8E	060R100	2,866	12.1	42	0.2						
NR	Mode-6	M2NRU8E	060R075	3,238	18.1		nd						
NR	Mode-7	M2NRU8E	060R050	1,696	18.7		nd				trace		
NR	Mode-8	M2NRU8E	100I000	99	na		na						
NR	ISO Type-C1 Weighted Composite			na	16.4	na	0.2	nd	nd	nd	nd	nd	nd
				Transient Cycle Emission Levels									
2D	BHL	M12DBHL1	Hot-Start	162	2.7	na	nd						
NR	BHL	M2NRBHL1	Hot-Start	1,299	21.0	na	nd						
2D	FTP	M12DFTP1	Hot-Start	146	2.5	na	nd						
2D	FTP	M12DFTP2	Hot-Start	142	2.4	na	nd						
NR	FTP	M2NRFTP1	Hot-Start	1,296	21.7	na	nd						
NR	FTP	M2NRFTP2	Hot-Start	1,495	25.0	na	nd						

Notes: For Inorganic Elements: "nd" and empty cells indicate none detected at calculated detection limit of 0.06 mg/hp-hr
"trace" indicates not quantifiable, or quantifiable at level less than twice the detection limit

TABLE 25. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per hour (mg/hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	M12DU8B	100R100	240	28	204	69	87	92		95	1954	521
2D	Mode-2	M12DU8B	100R075	50	25	117	32	84	140		78	1587	468
2D	Mode-3	M12DU8B	100R050		35	111	27	30	116		56	1552	527
2D	Mode-4	M12DU8B	100R010		51	229	70	98	161		56	3561	1324
2D	Mode-5	M12DU8B	060R100		32	465	246	67	155		153	2721	713
2D	Mode-6	M12DU8B	060R075		34	195	103	30	123		47	1668	401
2D	Mode-7	M12DU8B	060R050		32	171	151	54	91		42	1259	418
2D	Mode-8	M12DU8B	100l000		29	177	171	67	64		36	4217	1285
NR	Mode-1	M2NRU8E	100R100		27	168	339	110	210		116	1606	361
NR	Mode-2	M2NRU8E	100R075	979		135	385	88	179		101	1249	410
NR	Mode-3	M2NRU8E	100R050			139	218	77	166		86	877	311
NR	Mode-4	M2NRU8E	100R010			269	136	90	188		82	1982	856
NR	Mode-5	M2NRU8E	060R100			465	262	64	139		79	2886	746
NR	Mode-6	M2NRU8E	060R075		61	172	104	29	112		52	1855	476
NR	Mode-7	M2NRU8E	060R050		27	106	44	66	126		62	1304	485
NR	Mode-8	M2NRU8E	100l000			169	220	76	126		51	4283	1513
				Transient Cycle Emission Levels									
2D	BHL	M12DBHL1	Hot-Start			223		86	119		52	2190	735
NR	BHL	M2NRBHL2	Hot-Start			259	82	55	110		43	2436	859
2D	FTP	M12DFTP3	Hot-Start	400	13	299	173	88	141		79	4014	1481
2D	FTP	M12DFTP4	Hot-Start	394		314		67	134		59	4498	1420
NR	FTP	M2NRFTP1	Hot-Start		54	357	205	74	158		70	4460	1494
NR	FTP	M2NRFTP2	Hot-Start		26	341	167	63	144		65	4245	1443

TABLE 25 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per horsepower hour (mg/hp-hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	M12DU8B	100R100	0.9	0.1	0.7	0.3	0.3	0.3	nd	0.4	7.1	1.9
2D	Mode-2	M12DU8B	100R075	0.2	0.1	0.6	0.2	0.4	0.7	nd	0.4	7.6	2.2
2D	Mode-3	M12DU8B	100R050	nd	0.3	0.8	0.2	0.2	0.8	nd	0.4	11.1	3.8
2D	Mode-4	M12DU8B	100R010	nd	1.8	7.9	2.5	3.4	5.6	nd	1.9	122.9	45.7
2D	Mode-5	M12DU8B	060R100	nd	0.1	2.0	1.0	0.3	0.7	nd	0.6	11.4	3.0
2D	Mode-6	M12DU8B	060R075	nd	0.2	1.1	0.6	0.2	0.7	nd	0.3	9.4	2.3
2D	Mode-7	M12DU8B	060R050	nd	0.4	1.9	1.7	0.2	1.0	nd	0.5	14.1	4.7
2D	Mode-8	M12DU8B	100l000	na	na	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			0.30	0.2	1.3	0.7	0.4	0.8	nd	0.5	15.8	4.8
NR	Mode-1	M2NRU8E	100R100	nd	0.1	0.6	1.2	0.4	0.8	nd	0.4	5.8	1.3
NR	Mode-2	M2NRU8E	100R075	4.7	nd	0.7	1.9	0.4	0.9	nd	0.5	6.0	2.0
NR	Mode-3	M2NRU8E	100R050	nd	nd	1.0	1.6	0.6	1.2	nd	0.6	6.3	2.2
NR	Mode-4	M2NRU8E	100R010	nd	nd	9.7	4.9	3.3	6.8	nd	2.9	71.0	30.7
NR	Mode-5	M2NRU8E	060R100	nd	nd	2.0	1.1	0.3	0.6	nd	0.3	12.1	3.1
NR	Mode-6	M2NRU8E	060R075	nd	0.4	1.0	0.6	0.2	0.6	nd	0.3	10.4	2.7
NR	Mode-7	M2NRU8E	060R050	nd	0.3	1.2	0.5	0.7	1.4	nd	0.7	14.4	5.4
NR	Mode-8	M2NRU8E	100l000	na	na	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			1.0	0.1	1.3	1.6	0.5	1.1	nd	0.5	13.6	4.4
				Transient Cycle Emission Levels									
2D	BHL	M12DBHL1	Hot-Start	nd	nd	3.6	nd	1.4	2.0	nd	0.9	35.8	12.0
NR	BHL	M2NRBHL1	Hot-Start	nd	nd	4.2	1.3	0.9	1.8	nd	0.7	39.3	13.9
2D	FTP	M12DFTP3	Hot-Start	6.7	0.2	5.1	2.9	1.5	2.4	nd	1.3	67.6	25.0
2D	FTP	M12DFTP4	Hot-Start	6.7	nd	5.3	nd	1.1	2.3	nd	1.0	75.9	24.0
NR	FTP	M2NRFTP1	Hot-Start	nd	0.9	6.0	3.4	1.3	2.7	nd	1.2	74.7	25.0
NR	FTP	M2NRFTP2	Hot-Start	nd	0.4	5.7	2.8	1.1	2.4	nd	1.1	71.0	24.2

Notes: Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit

TABLE 26. STEADY-STATE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), nanograms per hour (ng/hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	M12DU8B	100R100	93,900	33,600	37,200	25,000	162,000	4,800	10,800	20,800
2D	Mode-2	M12DU8B	100R075	60,100	33,800	34,800	15,000	104,000	5,900	9,300	17,000
2D	Mode-3	M12DU8B	100R050	84,300	44,500	38,400	28,400	122,000	50	9,300	17,000
2D	Mode-4	M12DU8B	100R010	125,000	70,100	53,100	47,600	177,000	410	37,300	38,800
2D	Mode-5	M12DU8B	060R100	90,000	32,200	37,300	13,900	163,000	710	5,300	8,300
2D	Mode-6	M2DUS8B	060R075	119,000	24,600	23,900	17,800	108,000	3,300	4,600	3,400
2D	Mode-7	M12DU8B	060R050	100,000	62,700	51,800	41,400	133,000	3,000	21,600	27,200
2D	Mode-8	M12DU8B	100I000	97,000	63,400	51,400	34,300	107,000	3,500	48,000	47,700
NR	Mode-1	M2NRU8E	100R100	44,200	12,700	44,900	13,600	222,000	3,900	5,500	4,300
NR	Mode-2	M2NRU8E	100R075	220,000	5,900	37,100	13,100	200,000	6,700	5,700	3,500
NR	Mode-3	M2NRU8E	100R050	277,000	11,400	44,900	20,500	258,000	3,200	6,700	5,400
NR	Mode-4	M2NRU8E	100R010	196,000	64,300	68,000	42,800	373,000	4,100	39,800	37,700
NR	Mode-5	M2NRU8E	060R100	26,400	13,700	21,800	9,400	181,000	2,400	4,700	4,400
NR	Mode-6	M2NRU8E	060R075	19,800	8,100	23,300	12,000	128,000	1,500	6,000	5,600
NR	Mode-7	M2NRU8E	060R050	130,000	17,600	50,800	39,400	260,000	7,100	11,700	10,400
NR	Mode-8	M2NRU8E	100I000	136,000	67,500	58,700	39,300	219,000	5,300	51,100	54,800

TABLE 27. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), nanograms per horsepower hour (ng/hp-hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	M12DU8B	100R100	340	120	130	90	580	20	40	80
2D	Mode-2	M12DU8B	100R075	290	160	170	70	500	30	40	80
2D	Mode-3	M12DU8B	100R050	600	320	270	200	860	0	70	120
2D	Mode-4	M12DU8B	100R010	4,600	2,600	2,000	1,800	6,600	20	1,400	1,400
2D	Mode-5	M12DU8B	060R100	380	130	160	60	680	3	20	30
2D	Mode-6	M12DU8B	060R075	670	140	130	100	610	20	30	20
2D	Mode-7	M12DU8B	060R050	1,200	720	590	480	1,500	30	250	310
2D	Mode-8	M12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			640	310	280	190	900	20	130	160
NR	Mode-1	M2NRU8E	100R100	160	50	160	50	800	10	20	20
NR	Mode-2	M2NRU8E	100R075	1,100	30	180	60	960	30	30	20
NR	Mode-3	M2NRU8E	100R050	2,000	80	320	150	1,800	20	50	40
NR	Mode-4	M2NRU8E	100R010	6,900	2,300	2,400	1,500	13,100	140	1,400	1,300
NR	Mode-5	M2NRU8E	060R100	110	60	90	40	760	10	20	20
NR	Mode-6	M2NRU8E	060R075	110	50	130	70	720	8	30	30
NR	Mode-7	M2NRU8E	060R050	1,400	200	560	440	2,900	80	130	120
NR	Mode-8	M2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			940	170	300	160	1,600	30	110	110
				Transient Cycle Emission Levels							
2D	BHL	M12DBHL1	Hot-Start	2,600	1,500	1,400	920	3,000	110	510	680
NR	BHL	M2NRBHL1	Hot-Start	3,500	680	2,200	1,500	6,000	80	460	710
2D	FTP	M12DFTP3	Hot-Start	2,800	1,700	1,600	980	3,500	100	910	1,500
2D	FTP	M12DFTP4	Hot-Start	2,900	1,700	1,600	1,000	3,600	70	840	1,400
NR	FTP	M2NRFTP1	Hot-Start	3,600	1,600	2,200	1,300	6,000	80	1,000	1,900
NR	FTP	M2NRFTP2	Hot-Start	5,000	2,000	3,000	1,800	7,300	110	910	1,600

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.7 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 28. STEADY-STATE EMISSION LEVELS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per hour (µg/hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluo-ranthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	M12DU8B	100R100	6,300	4,400	2,000	770	8,300	27,200	19,700	2,000
2D	Mode-2	M12DU8B	100R075	5,900	3,300	1,700	540	8,000	22,700	18,500	1,800
2D	Mode-3	M12DS8B	100R050	8,200	3,900	1,900	630	10,400	28,900	22,100	2,400
2D	Mode-4	M12DU8B	100R010	14,200	8,500	3,500	670	22,200	79,700	38,500	3,100
2D	Mode-5	M12DU8B	060R100	3,400	6,100	1,800	610	4,200	40,200	13,900	1,200
2D	Mode-6	M12DU8B	060R075	3,500	3,900	1,500	540	4,500	26,900	12,600	1,200
2D	Mode-7	M12DU8B	060R050	7,100	4,100	1,800	580	9,900	27,500	19,300	2,100
2D	Mode-8	M12DU8B	100I000	10,000	6,800	2,100	460	15,200	62,300	25,100	1,600
NR	Mode-1	M2NRU8E	100R100	6,100	4,700	960	740	7,500	42,700	20,500	600
NR	Mode-2	M2NRU8E	100R075	6,800	3,900	560	620	9,400	33,000	21,900	400
NR	Mode-3	M2NRU8E	100R050	8,700	4,600	1,000	660	11,300	43,500	305,000	1,000
NR	Mode-4	M2NRU8E	100R010	12,300	8,200	2,300	750	16,700	76,500	34,700	3,100
NR	Mode-5	M2NRU8E	060R100	2,400	5,200	410	540	3,800	25,700	11,100	100
NR	Mode-6	M2NRU8E	060R075	3,000	3,600	120	460	4,300	18,100	11,900	40
NR	Mode-7	M2NRU8E	060R050	5,300	3,700	1,200	630	8,000	18,200	18,600	1,800
NR	Mode-8	M2NRU8E	100I000	8,300	7,200	1,800	570	13,000	50,200	25,500	1,800

TABLE 29. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per horsepower hour (µg/hp-hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluor-anthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	M12DU8B	100R100	20	20	7	3	30	100	70	7
2D	Mode-2	M12DU8B	100R075	30	20	8	3	40	110	90	8
2D	Mode-3	M12DU8B	100R050	60	30	10	4	70	210	160	20
2D	Mode-4	M12DU8B	100R010	530	310	130	20	820	3,000	1,400	120
2D	Mode-5	M12DU8B	060R100	10	30	8	3	20	170	60	5
2D	Mode-6	M12DU8B	060R075	20	20	8	3	30	150	70	7
2D	Mode-7	M12DU8B	060R050	80	50	20	7	110	320	220	20
2D	Mode-8	M12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			50	30	10	4	70	260	140	10
NR	Mode-1	M2NRU8E	100R100	20	20	3	3	30	150	70	2
NR	Mode-2	M2NRU8E	100R075	30	20	3	3	50	160	110	2
NR	Mode-3	M2NRU8E	100R050	60	30	7	5	80	310	2,200	7
NR	Mode-4	M2NRU8E	100R010	430	290	80	30	580	2,700	1,200	110
NR	Mode-5	M2NRU8E	060R100	10	20	2	2	20	110	50	0
NR	Mode-6	M2NRU8E	060R075	20	20	1	3	20	100	70	0
NR	Mode-7	M2NRU8E	060R050	60	40	10	7	90	200	210	20
NR	Mode-8	M2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			50	30	7	4	60	270	430	7
				Transient Cycle Emission Levels							
2D	BHL	M12DBHL1	Hot-Start	120	110	40	10	160	680	350	40
NR	BHL	M2NRBHL1	Hot-Start	110	150	30	30	170	630	420	60
2D	FTP	M12DFTP3	Hot-Start	150	170	50	20	240	1,200	530	50
2D	FTP	M12DFTP4	Hot-Start	150	160	60	20	240	1,100	520	50
NR	FTP	M2NRFTP1	Hot-Start	120	160	30	20	190	820	470	60
NR	FTP	M2NRFTP2	Hot-Start	100	170	40	30	190	700	400	60

Notes:
Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.07 µg/hp-hr
Emission levels expressed in units of micrograms per horsepower-hour
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 30. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate NITRO Polynuclear Aromatic Hydrocarbon (n-PAH), Nanograms per hour (ng/hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	M12DU8B	100R100	760	1,600	5,800	6,000	5,000	5,400	1,400
2D	Mode-2	M12DU8B	100R075	2,600	570	1,200	1,700	5,000	4,900	1,500
2D	Mode-3	M12DU8B	100R050	3,100	480	4,300	770	5,200	6,600	1,500
2D	Mode-4	M12DU8B	100R010	3,100	1,700	3,600	2,600	5,600	6,900	1,500
2D	Mode-5	M12DU8B	060R100	1,900	1,500	1,000	2,400	2,000	3,400	1,400
2D	Mode-6	M12DU8B	060R075	4,500	1,600	2,800	1,600	850	6,600	1,400
2D	Mode-7	M12DU8B	060R050	4,900	450	5,600	560	1,800	6,200	1,400
2D	Mode-8	M12DU8B	100I000	1,100	2,500	2,700	650	900	730	120
NR	Mode-1	M2NRU8E	100R100	5,700	2,100	3,600	3,300	910	3,900	570
NR	Mode-2	M2NRU8E	100R075	4,400	740	2,900	8,700	3,800	6,300	5,000
NR	Mode-3	M2NRU8E	100R050	4,200	750	2,600	4,400	3,400	2,400	3,300
NR	Mode-4	M2NRU8E	100R010	6,400	300	2,200	3,500	3,100	1,500	1,500
NR	Mode-5	M2NRU8E	060R100	5,900	2,500	1,500	1,600	4,100	1,400	1,500
NR	Mode-6	M2NRU8E	060R075	6,800	6,200	5,200	800	6,900	6,900	1,600
NR	Mode-7	M2NRU8E	060R050	1,400	5,800	2,000	1,700	6,600	3,900	2,500
NR	Mode-8	M2NRU8E	100I000	1,700	2,300	480	690	360	2,700	530

TABLE 30 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 1998 CUMMINS M11C ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake Specific NITRO-PAH Compounds, Nanograms per horsepower-hour (ng/hp-hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	M12DU8B	100R100	3	6	20	20	20	20	5
2D	Mode-2	M12DU8B	100R075	10	3	6	8	20	20	7
2D	Mode-3	M12DU8B	100R050	20	3	30	5	40	50	10
2D	Mode-4	M12DU8B	100R010	110	60	130	100	210	260	60
2D	Mode-5	M12DU8B	060R100	8	6	4	10	8	10	6
2D	Mode-6	M12DU8B	060R075	30	9	20	9	5	40	8
2D	Mode-7	M12DU8B	060R050	60	5	60	6	20	70	20
2D	Mode-8	M12DU8B	100I000	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			20	9	20	10	20	30	8
NR	Mode-1	M2NRU8E	100R100	20	7	10	10	3	10	2
NR	Mode-2	M2NRU8E	100R075	20	4	10	40	20	30	20
NR	Mode-3	M2NRU8E	100R050	30	5	20	30	20	20	20
NR	Mode-4	M2NRU8E	100R010	220	10	80	120	110	50	50
NR	Mode-5	M2NRU8E	060R100	20	10	6	7	20	6	6
NR	Mode-6	M2NRU8E	060R075	40	30	30	5	40	40	9
NR	Mode-7	M2NRU8E	060R050	20	60	20	20	70	40	30
NR	Mode-8	M2NRU8E	100I000	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			30	20	20	20	20	20	10
				Transient Cycle Emission Levels						
2D	BHL	M12DBHL1	Hot-Start	20	90	60	70	30	60	4
NR	BHL	M2NRBHL1	Hot-Start	40	10	3	190	20	40	10
2D	FTP	M12DFTP3	Hot-Start	50	120	3	90	10	50	2
2D	FTP	M12DFTP4	Hot-Start	6	120	2	80	40	30	2
NR	FTP	M2NRFTP1	Hot-Start	40	50	6	220	40	5	9
NR	FTP	M2NRFTP2	Hot-Start	7	100	6	330	20	20	9

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated nPAH detection limit was 0.4 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 31. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR SULFATE, AMMONIA, AND SELECTED INORGANIC ELEMENTS FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Sulfate		Ammonia		Inorganic Elements, mg/hp-hr					
				mg/hr	mg/hp-hr	mg/hr	mg/hp-hr	Mercury	Manganese	Lead	Nickel	Arsenic	Chromium
2D	Mode-1	E12DU8B	100R100	1,347	3.3		nd						
2D	Mode-2	E12DU8B	100R075	1,031	3.3		nd			trace			
2D	Mode-3	E12DU8B	100R050	744	3.6		nd			trace			
2D	Mode-4	E12DU8B	100R010	144	3.5	154	3.8						
2D	Mode-5	E12DU8B	060R100	1,342	3.7		nd						
2D	Mode-6	E12DU8B	060R075	772	2.8		nd						
2D	Mode-7	E12DU8B	060R050	498	2.7		nd						
2D	Mode-8	E12DU8B	100I000	21	na		na						
2D	ISO Type-C1 Weighted Composite			na	3.2	na	0.1	nd	nd	nd	nd	nd	nd
NR	Mode-1	E2NRU8E	100R100	11,510	27.6		nd						
NR	Mode-2	E2NRU8E	100R075	10,051	32.2		nd						
NR	Mode-3	E2NRU8E	100R050	9,833	46.5		nd						
NR	Mode-4	E2NRU8E	100R010	8,957	204.5		nd						
NR	Mode-5	E2NRU8E	060R100	1,394	3.8		nd						
NR	Mode-6	E2NRU8E	060R075	6,264	23.1		nd						
NR	Mode-7	E2NRU8E	060R050	4,740	25.7		nd						
NR	Mode-8	E2NRU8E	100I000	164	na	16	na						
NR	ISO Type-C1 Weighted Composite			na	34.5	na	0.0	nd	nd	nd	nd	nd	nd
				Transient Cycle Emission Levels									
2D	BHL	E12DBHL1	Hot-Start	375	3.8	na	0.0			trace			
NR	BHL	E2NRBHL1	Hot-Start	3,104	31.1	na	0.0						
2D	FTP	E12DFTP1	Hot-Start	310	3.3	na	0.0						
2D	FTP	E12DFTP2	Hot-Start	318	3.4	na	1.8						
NR	FTP	E2NRFTP1	Hot-Start	3,402	35.5	na	0.0						
NR	FTP	E2NRFTP2	Hot-Start	2,630	27.6	na	0.0						

Notes: For Inorganic Elements: "nd" and empty cells indicate none detected at calculated detection limit of 0.06 mg/hp-hr
"trace" indicates not quantifiable, or quantifiable at level less than twice the detection limit

TABLE 32. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per hour (mg/hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	E12DU8B	100R100		78	88	425		186		148	2081	699
2D	Mode-2	E12DU8B	100R075		101	109	269	107	144		66	1464	536
2D	Mode-3	E12DU8B	100R050			80	249	67	134		59	1585	558
2D	Mode-4	E12DU8B	100R010			155	343	91	144		61	5115	1865
2D	Mode-5	E12DU8B	060R100	2878		80	225		113		581	1346	389
2D	Mode-6	E12DU8B	060R075			120	221		81			1068	301
2D	Mode-7	E12DU8B	060R050			90	222		88			926	289
2D	Mode-8	E12DU8B	100I000									1112	423
NR	Mode-1	E2NRU8E	100R100			135	282	60	109		74	2130	740
NR	Mode-2	E2NRU8E	100R075			82	647	72	151		65	1374	499
NR	Mode-3	E2NRU8E	100R050		67	136	248	61	123		766	1656	602
NR	Mode-4	E2NRU8E	100R010			271	125	57	102			5021	1807
NR	Mode-5	E2NRU8E	060R100			121	129		65			1406	388
NR	Mode-6	E2NRU8E	060R075			97	107		69			1084	300
NR	Mode-7	E2NRU8E	060R050			136	112					950	263
NR	Mode-8	E2NRU8E	100I000			194						1115	361
				Transient Cycle Emission Levels									
2D	BHL	E12DBHL1	Hot-Start			229	220	62	87			1280	427
NR	BHL	E2NRBHL2	Hot-Start			134	120					1281	445
2D	FTP	E12DFTP1	Hot-Start			23			85			1322	516
2D	FTP	E12DFTP2	Hot-Start			100	320	64	84			1349	481
NR	FTP	E2NRFTP1	Hot-Start			542	316					1300	459
NR	FTP	E2NRFTP2	Hot-Start			309	128		57			1365	485

TABLE 32 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per horsepower hour (mg/hp-hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	E12DU8B	100R100	nd	0.2	0.2	1.0	nd	0.5	nd	0.4	5.0	1.7
2D	Mode-2	E12DU8B	100R075	nd	0.3	0.4	0.9	0.3	0.5	nd	0.2	4.7	1.7
2D	Mode-3	E12DU8B	100R050	nd	nd	0.4	1.2	0.3	0.6	nd	0.3	7.6	2.7
2D	Mode-4	E12DU8B	100R010	nd	nd	3.8	8.4	2.2	3.6	nd	1.5	125.5	45.8
2D	Mode-5	E12DU8B	060R100	7.9	nd	0.2	0.6	nd	0.3	nd	1.6	3.7	1.1
2D	Mode-6	E12DU8B	060R075	nd	nd	0.4	0.8	nd	0.3	nd	nd	3.9	1.1
2D	Mode-7	E12DU8B	060R050	nd	nd	0.5	1.2	nd	0.5	nd	nd	5.0	1.6
2D	Mode-8	E12DU8B	100I000	na	na	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			1.27	0.1	0.4	1.1	0.2	0.5	nd	0.5	7.8	2.7
NR	Mode-1	E2NRU8E	100R100	nd	nd	0.3	0.7	0.1	0.3	nd	0.2	5.1	1.8
NR	Mode-2	E2NRU8E	100R075	nd	nd	0.3	2.1	0.2	0.5	nd	0.2	4.4	1.6
NR	Mode-3	E2NRU8E	100R050	nd	0.3	0.6	1.2	0.3	0.6	nd	3.6	7.8	2.9
NR	Mode-4	E2NRU8E	100R010	nd	nd	6.2	2.9	1.3	2.3	nd	nd	114.6	41.3
NR	Mode-5	E2NRU8E	060R100	nd	nd	0.3	0.4	nd	0.2	nd	nd	3.9	1.1
NR	Mode-6	E2NRU8E	060R075	nd	nd	0.4	0.4	nd	0.3	nd	nd	4.0	1.1
NR	Mode-7	E2NRU8E	060R050	nd	nd	0.7	0.6	nd	nd	nd	nd	5.2	1.4
NR	Mode-8	E2NRU8E	100I000	na	na	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			nd	nd	0.6	1.0	0.2	0.4	nd	0.6	7.9	2.7
				Transient Cycle Emission Levels									
2D	BHL	E12DBHL1	Hot-Start	nd	nd	2.3	2.2	0.6	0.9	nd	nd	13.0	4.3
NR	BHL	E2NRBHL1	Hot-Start	nd	nd	1.3	1.2	nd	nd	nd	nd	12.9	4.5
2D	FTP	E12DFTP1	Hot-Start	nd	nd	2.5	nd	nd	0.9	nd	nd	14.0	5.5
2D	FTP	E12DFTP2	Hot-Start	nd	nd	1.1	3.4	0.7	0.9	nd	nd	14.3	5.1
NR	FTP	E2NRFTP1	Hot-Start	nd	nd	5.7	3.3	nd	nd	nd	nd	13.6	4.8
NR	FTP	E2NRFTP2	Hot-Start	nd	nd	3.2	1.3	nd	0.6	nd	nd	14.3	5.1

Notes: Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit

TABLE 33. STEADY-STATE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), nanograms per hour (ng/hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	E12DU8B	100R100	18,100	4,900	24,100	3,800	70,800	2,200	4,400	4,400
2D	Mode-2	E12DU8B	100R075	33,000	6,700	21,200	13,400	74,400	5,600	11,200	8,900
2D	Mode-3	E12DU8B	100R050	93,900	27,300	34,100	40,900	103,000	20,500	19,300	22,700
2D	Mode-4	E12DU8B	100R010	123,000	48,400	41,500	47,200	180,000	25,300	39,200	28,800
2D	Mode-5	E12DU8B	060R100	130,000	133,000	85,900	106,000	152,000	15,600	110,000	133,000
2D	Mode-6	E12DU8B	060R075	19,800	21,400	12,400	22,500	45,800	24,800	24,800	24,800
2D	Mode-7	E12DU8B	060R050	10,900	6,800	6,800	4,500	40,500	6,800	5,700	7,700
2D	Mode-8	E12DU8B	100I000	10,400	12,500	4,900	7,600	19,300	9,300	18,500	11,400
NR	Mode-1	E2NRU8E	100R100	40,300	6,600	23,100	6,600	48,200	4,400	7,700	3,300
NR	Mode-2	E2NRU8E	100R075	33,100	7,800	19,000	7,800	76,800	7,800	12,300	20,100
NR	Mode-3	E2NRU8E	100R050	21,200	38,700	49,000	59,200	178,000	28,500	59,200	59,200
NR	Mode-4	E2NRU8E	100R010	178,000	46,700	41,000	45,600	327,000	33,000	52,400	62,700
NR	Mode-5	E2NRU8E	060R100	110,000	23,900	18,200	25,000	41,700	20,500	25,000	25,000
NR	Mode-6	E2NRU8E	060R075	41,800	20,600	30,900	18,300	46,500	34,300	20,600	20,600
NR	Mode-7	E2NRU8E	060R050	14,600	8,100	35,900	9,800	48,300	12,700	12,700	12,700
NR	Mode-8	E2NRU8E	100I000	61,900	26,800	40,500	32,800	67,500	11,500	44,300	46,000

TABLE 34. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), nanograms per horsepower hour (ng/hp-hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	E12DU8B	100R100	40	10	60	9	170	5	10	10
2D	Mode-2	E12DU8B	100R075	110	20	70	40	240	20	40	30
2D	Mode-3	E12DU8B	100R050	450	130	160	200	490	100	90	110
2D	Mode-4	E12DU8B	100R010	3,200	1,300	1,100	1,200	4,700	660	1,000	750
2D	Mode-5	E12DU8B	060R100	360	360	230	290	420	40	300	360
2D	Mode-6	E12DU8B	060R075	70	80	40	80	170	90	90	90
2D	Mode-7	E12DU8B	060R050	60	40	40	20	220	40	30	40
2D	Mode-8	E12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			230	130	120	120	360	60	110	120
NR	Mode-1	E2NRU8E	100R100	100	20	60	20	120	10	20	8
NR	Mode-2	E2NRU8E	100R075	110	30	60	30	250	30	40	60
NR	Mode-3	E2NRU8E	100R050	100	180	230	280	850	140	280	280
NR	Mode-4	E2NRU8E	100R010	4,200	1,100	960	1,100	7,700	780	1,200	1,500
NR	Mode-5	E2NRU8E	060R100	300	70	50	70	110	60	70	70
NR	Mode-6	E2NRU8E	060R075	150	80	110	70	170	130	80	80
NR	Mode-7	E2NRU8E	060R050	80	40	200	50	260	70	70	70
NR	Mode-8	E2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			250	100	140	110	450	80	130	140
				Transient Cycle Emission Levels							
2D	BHL	E12DBHL1	Hot-Start	1,900	1,300	1,600	1,500	2,300	160	1,300	1,800
NR	BHL	E2NRBHL1	Hot-Start	590	160	740	480	1,300	90	350	390
2D	FTP	E12DFTP1	Hot-Start	1,600	1,200	1,500	1,200	2,000	110	1,100	1,700
2D	FTP	E12DFTP2	Hot-Start	2,200	1,600	2,000	1,700	2,800	150	1,300	2,100
NR	FTP	E2NRFTP1	Hot-Start	960	280	1,300	690	1,900	130	510	630
NR	FTP	E2NRFTP2	Hot-Start	1,000	340	1,300	620	2,500	130	550	690

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.9 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 35. STEADY-STATE EMISSION LEVELS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per hour (µg/hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluo-ranthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	E12DU8B	100R100	1,500	580	320	310	2,100	5,900	4,300	620
2D	Mode-2	E12DU8B	100R075	4,600	1,800	730	370	5,000	17,900	9,800	1,000
2D	Mode-3	E12DS8B	100R050	5,100	2,600	1,100	480	8,000	15,900	12,400	1,400
2D	Mode-4	E12DU8B	100R010	9,200	6,700	2,100	660	18,900	41,500	27,500	1,900
2D	Mode-5	E12DU8B	060R100	660	510	80	70	450	6,600	450	240
2D	Mode-6	E12DU8B	060R075	2,100	1,200	500	250	2,700	7,900	5,600	580
2D	Mode-7	E12DU8B	060R050	2,400	1,600	510	210	3,200	11,400	6,000	480
2D	Mode-8	E12DU8B	100I000	2,800	3,400	710	290	4,800	14,200	9,100	590
NR	Mode-1	E2NRU8E	100R100	1,900	660	20	410	1,800	14,400	3,900	620
NR	Mode-2	E2NRU8E	100R075	3,500	1,500	60	410	4,700	16,800	8,500	1,100
NR	Mode-3	E2NRU8E	100R050	4,800	2,800	400	630	7,500	20,500	13,600	1,300
NR	Mode-4	E2NRU8E	100R010	8,300	7,500	2,200	900	14,100	49,000	28,400	2,000
NR	Mode-5	E2NRU8E	060R100	1,000	380	50	300	1,300	10,300	4,900	260
NR	Mode-6	E2NRU8E	060R075	1,900	1,400	70	200	2,600	13,700	5,600	680
NR	Mode-7	E2NRU8E	060R050	2,000	1,500	100	160	2,700	15,100	5,400	590
NR	Mode-8	E2NRU8E	100I000	2,000	2,600	440	220	3,700	14,300	5,400	360

TABLE 36. STEADY-STATE AND TRANSIENT CYCLE EMISSIONS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per horsepower hour (µg/hp-hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluor-anthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	E12DU8B	100R100	4	1	1	1	5	10	10	1
2D	Mode-2	E12DU8B	100R075	10	6	2	1	20	60	30	3
2D	Mode-3	E12DU8B	100R050	20	10	5	2	40	80	60	6
2D	Mode-4	E12DU8B	100R010	240	170	60	20	490	1,100	710	50
2D	Mode-5	E12DU8B	060R100	2	1	0	0	1	20	1	1
2D	Mode-6	E12DU8B	060R075	8	4	2	1	10	30	20	2
2D	Mode-7	E12DU8B	060R050	10	9	3	1	20	60	30	3
2D	Mode-8	E12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			20	10	3	1	20	70	40	4
NR	Mode-1	E2NRU8E	100R100	4	2	0	1	4	30	9	1
NR	Mode-2	E2NRU8E	100R075	10	5	0	1	20	50	30	4
NR	Mode-3	E2NRU8E	100R050	20	10	2	3	40	100	60	6
NR	Mode-4	E2NRU8E	100R010	200	180	50	20	330	1,200	670	50
NR	Mode-5	E2NRU8E	060R100	3	1	0	1	3	30	10	1
NR	Mode-6	E2NRU8E	060R075	7	5	0	1	10	50	20	2
NR	Mode-7	E2NRU8E	060R050	10	8	1	1	10	80	30	3
NR	Mode-8	E2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			10	10	2	2	20	80	40	4
				Transient Cycle Emission Levels							
2D	BHL	E12DBHL1	Hot-Start	30	70	10	20	50	210	100	20
NR	BHL	E2NRBHL1	Hot-Start	20	30	4	7	30	120	60	6
2D	FTP	E12DFTP1	Hot-Start	30	60	10	10	50	220	90	20
2D	FTP	E12DFTP2	Hot-Start	40	80	10	20	60	350	120	20
NR	FTP	E2NRFTP1	Hot-Start	30	60	7	10	50	280	90	9
NR	FTP	E2NRFTP2	Hot-Start	30	70	8	20	60	220	110	10

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.07 µg/hp-hr; Emission levels expressed in units of micrograms per horsepower-hour
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 37. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate NITRO Polynuclear Aromatic Hydrocarbon (n-PAH), Nanograms per hour (ng/hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	E12DU8B	100R100	340	2,000	750	6,400	720	550	860
2D	Mode-2	E12DU8B	100R075	280	880	590	3,200	430	770	870
2D	Mode-3	E12DU8B	100R050	120	900	520	2,100	2	610	890
2D	Mode-4	E12DU8B	100R010	360	7,800	730	5,600	980	730	790
2D	Mode-5	E12DU8B	060R100	550	4,200	990	2,100	340	1,000	650
2D	Mode-6	E12DU8B	060R075	780	670	590	970	80	40	30
2D	Mode-7	E12DU8B	060R050	170	390	120	750	640	400	780
2D	Mode-8	E12DU8B	100I000	970	860	4	400	210	340	850
NR	Mode-1	E2NRU8E	100R100	540	3,100	950	34,000	560	790	860
NR	Mode-2	E2NRU8E	100R075	20	3,100	780	14,400	330	700	880
NR	Mode-3	E2NRU8E	100R050	20	4,300	250	10,100	830	720	890
NR	Mode-4	E2NRU8E	100R010	280	11,200	540	12,400	930	1,100	890
NR	Mode-5	E2NRU8E	060R100	980	4,300	290	10,100	900	120	890
NR	Mode-6	E2NRU8E	060R075	20	3,200	810	3,300	2	810	550
NR	Mode-7	E2NRU8E	060R050	100	4,400	830	2,200	430	770	700
NR	Mode-8	E2NRU8E	100I000	430	4,200	2	2,000	1	260	90

TABLE 37 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 2001 CATERPILLAR 3196 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake Specific n-PAH Compounds, Nanograms per horsepower-hour (ng/hp-hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	E12DU8B	100R100	trace	5	2	20	2	trace	2
2D	Mode-2	E12DU8B	100R075	trace	3	2	10	trace	2	3
2D	Mode-3	E12DU8B	100R050	trace	4	2	10	nd	3	4
2D	Mode-4	E12DU8B	100R010	9	200	20	150	30	20	20
2D	Mode-5	E12DU8B	060R100	2	10	3	6	trace	3	2
2D	Mode-6	E12DU8B	060R075	3	2	2	4	nd	nd	nd
2D	Mode-7	E12DU8B	060R050	trace	2	trace	4	3	2	4
2D	Mode-8	E12DU8B	100I000	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			2	9	2	10	2	2	3
NR	Mode-1	E2NRU8E	100R100	trace	7	2	80	trace	2	2
NR	Mode-2	E2NRU8E	100R075	nd	10	3	50	trace	2	3
NR	Mode-3	E2NRU8E	100R050	nd	20	trace	50	4	3	4
NR	Mode-4	E2NRU8E	100R010	7	260	10	290	20	30	20
NR	Mode-5	E2NRU8E	060R100	3	10	trace	30	2	nd	2
NR	Mode-6	E2NRU8E	060R075	nd	10	3	10	nd	3	2
NR	Mode-7	E2NRU8E	060R050	trace	20	5	10	2	4	4
NR	Mode-8	J2NRU8E	100I000	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			trace	20	2	50	2	3	3
				Transient Cycle Emission Levels						
2D	BHL	E12DBHL1	Hot-Start	6	120	10	1,500	6	10	10
NR	BHL	E2NRBHL1	Hot-Start	10	120	10	1,300	3	4	3
2D	FTP	E12DFTP1	Hot-Start	20	120	30	1,900	20	10	3
2D	FTP	E12DFTP2	Hot-Start	20	170	20	1,800	10	20	3
NR	FTP	E2NRFTP1	Hot-Start	40	290	60	3,300	20	5	3
NR	FTP	E2NRFTP2	Hot-Start	20	350	20	1,800	10	10	4

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated nPAH detection limit was 0.8 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 38. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR SULFATE, AMMONIA, AND SELECTED INORGANIC ELEMENTS FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Sulfate		Ammonia		Inorganic Elements, mg/hp-hr					
				mg/hr	mg/hp-hr	mg/hr	mg/hp-hr	Mercury	Manganese	Lead	Nickel	Arsenic	Chromium
2D	Mode-1	B12DU8B	100R100	643	3.3	30	0.2						
2D	Mode-2	B12DU8B	100R075	453	3.2		nd						
2D	Mode-3	B12DU8B	100R050	328	3.3	37	0.4						
2D	Mode-4	B12DU8B	100R010	115	5.8		nd						
2D	Mode-5	B12DU8B	060R100	427	3.2	9	0.1						
2D	Mode-6	B12DU8B	060R075	241	2.4		nd						
2D	Mode-7	B12DU8B	060R050	160	2.3		nd						
2D	Mode-8	B12DU8B	100I000	37	na		nd						
2D	ISO Type-C1 Weighted Composite			na	3.2	na	0.1	nd	nd	nd	nd	nd	nd
NR	Mode-1	B2NRU8E	100R100	4,884	25.1		nd				trace		
NR	Mode-2	B2NRU8E	100R075	5,408	37.9		nd	trace					
NR	Mode-3	B2NRU8E	100R050	4,988	50.5		nd						
NR	Mode-4	B2NRU8E	100R010	906	41.3		nd	trace					
NR	Mode-5	B2NRU8E	060R100	3,147	23.5		nd						
NR	Mode-6	B2NRU8E	060R075	2,016	20.5		nd						
NR	Mode-7	B2NRU8E	060R050	1,214	18.3	4	0.1						
NR	Mode-8	B2NRU8E	100I000	76	na		na						
NR	ISO Type-C1 Weighted Composite			na	33.7	na	trace	nd	nd	nd	nd	nd	nd
				Transient Cycle Emission Levels									
2D	BHL	B12DBHL1	Hot-Start	109	2.7	na	0.9						
NR	BHL	B2NRBHL1	Hot-Start	942	23.1	na	nd				trace		
2D	FTP	B12DFTP1	Hot-Start	133	3.4	na	nd						
2D	FTP	B12DFTP2	Hot-Start	119	3.1	na	nd						
NR	FTP	B2NRFTP1	Hot-Start	1,295	33.3	na	nd	trace					
NR	FTP	B2NRFTP2	Hot-Start	1,288	32.9	na	nd	trace					

Notes: For inorganic elements: “nd” and empty cells indicate none detected at calculated detection limit of 0.06 mg/hp-hr
“trace” indicates not quantifiable, or quantifiable at level less than twice the detection limit

TABLE 39. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per hour (mg/hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	B12DU8B	100R100	47	69	68		37	79		42	341	94
2D	Mode-2	B12DU8B	100R075		34	49		39	57		33	330	114
2D	Mode-3	B12DU8B	100R050			82	788	33	67		30	839	306
2D	Mode-4	B12DU8B	100R010			156	691	59	71		32	2341	826
2D	Mode-5	B12DU8B	060R100			45	13	30	66			514	41
2D	Mode-6	B12DU8B	060R075			45	1234	33	44			239	54
2D	Mode-7	B12DU8B	060R050				452	42	64			328	106
2D	Mode-8	B12DU8B	100I000				282					605	196
NR	Mode-1	B2NRU8E	100R100			59			31			324	116
NR	Mode-2	B2NRU8E	100R075			60	121	23	32			305	129
NR	Mode-3	B2NRU8E	100R050		24	91	358	33	45			804	305
NR	Mode-4	B2NRU8E	100R010			122	265	36				1916	701
NR	Mode-5	B2NRU8E	060R100			60		24				151	37
NR	Mode-6	B2NRU8E	060R075			60	22	26	103			237	69
NR	Mode-7	B2NRU8E	060R050			55	199	24	62			306	106
NR	Mode-8	B2NRU8E	100I000			64	2					591	206
				Transient Cycle Emission Levels									
2D	BHL	B12DBHL1	Hot-Start				201	34	38			715	251
NR	BHL	B2NRBHL2	Hot-Start			44						669	242
2D	FTP	B12DFTP1	Hot-Start			48	110					606	209
2D	FTP	B12DFTP2	Hot-Start			56		27				570	198
NR	FTP	B2NRFTP1	Hot-Start			68	170					581	208
NR	FTP	B2NRFTP2	Hot-Start			53	53					563	200

TABLE 39 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS OF SELECTED C_1 THROUGH C_{12} HYDROCARBON SPECIES FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Speciated Hydrocarbons, milligrams per horsepower hour (mg/hp-hr)									
				1,3-Butadiene	n-Hexane	Benzene	Toluene	Ethyl-benzene	m-&p-Xylene	Styrene	o-Xylene	Form-aldehyde	Acet-aldehyde
2D	Mode-1	B12DU8B	100R100	0.2	0.4	0.4	nd	0.2	0.4	nd	0.2	1.8	0.5
2D	Mode-2	B12DU8B	100R075	nd	0.2	0.3	nd	0.3	0.4	nd	0.2	2.3	0.8
2D	Mode-3	B12DU8B	100R050	nd	nd	0.8	7.9	0.3	0.7	nd	0.3	8.4	3.1
2D	Mode-4	B12DU8B	100R010	nd	nd	7.9	34.9	3.0	3.6	nd	1.6	118.2	41.7
2D	Mode-5	B12DU8B	060R100	nd	nd	0.3	0.1	0.2	0.5	nd	nd	3.9	0.3
2D	Mode-6	B12DU8B	060R075	nd	nd	0.4	12.2	0.3	0.4	nd	nd	2.4	0.5
2D	Mode-7	B12DU8B	060R050	nd	nd	nd	6.6	0.6	0.9	nd	nd	4.8	1.5
2D	Mode-8	B12DU8B	100I000	na	na	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			0.07	0.2	0.6	4.1	0.3	0.6	nd	0.2	6.7	2.1
NR	Mode-1	B2NRU8E	100R100	nd	nd	0.3	nd	nd	0.2	nd	nd	1.7	0.6
NR	Mode-2	B2NRU8E	100R075	nd	nd	0.4	0.9	0.2	0.2	nd	nd	2.1	0.9
NR	Mode-3	B2NRU8E	100R050	nd	nd	0.9	3.6	0.3	0.5	nd	nd	8.1	3.1
NR	Mode-4	B2NRU8E	100R010	nd	nd	5.6	12.1	1.7	nd	nd	nd	87.2	31.9
NR	Mode-5	B2NRU8E	060R100	nd	nd	0.5	nd	0.2	nd	nd	nd	1.1	0.3
NR	Mode-6	B2NRU8E	060R075	nd	nd	0.6	0.2	0.3	1.0	nd	nd	2.4	0.7
NR	Mode-7	B2NRU8E	060R050	nd	nd	0.8	3.0	0.4	0.9	nd	nd	4.6	1.6
NR	Mode-8	B2NRU8E	100I000	na	na	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			nd	nd	0.7	1.2	0.2	0.3	nd	nd	5.7	2.1
				Transient Cycle Emission Levels									
2D	BHL	B12DBHL1	Hot-Start	nd	nd	nd	5.0	0.9	nd	nd	nd	17.8	6.3
NR	BHL	B2NRBHL1	Hot-Start	nd	nd	1.1	nd	nd	nd	nd	nd	16.4	6.0
2D	FTP	B12DFTP1	Hot-Start	nd	nd	1.2	2.8	nd	nd	nd	nd	15.7	5.4
2D	FTP	B12DFTP2	Hot-Start	nd	nd	1.5	nd	0.7	nd	nd	nd	14.8	5.2
NR	FTP	B2NRFTP1	Hot-Start	nd	nd	1.8	4.4	nd	nd	nd	nd	15.0	5.4
NR	FTP	B2NRFTP2	Hot-Start	nd	nd	1.4	1.4	nd	nd	nd	nd	14.4	5.1

Notes: Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit

TABLE 40. STEADY-STATE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), nanograms per hour (ng/hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	B12DU8B	100R100	13,100	4,500	4,500	4,900	21,100	4,700	4,900	4,900
2D	Mode-2	B12DU8B	100R075	10,600	4,700	4,700	5,200	15,800	4,900	5,200	5,100
2D	Mode-3	B12DU8B	100R050	7,500	1,900	2,900	2,300	23,900	4,600	4,900	2,800
2D	Mode-4	B12DU8B	100R010	25,100	5,400	4,400	4,300	41,500	4,600	6,900	9,800
2D	Mode-5	B12DU8B	060R100	3,900	4,400	4,400	4,800	7,200	4,600	4,900	4,800
2D	Mode-6	B12DU8B	060R075	4,000	4,400	4,400	4,900	4,800	4,700	4,900	4,800
2D	Mode-7	B12DU8B	060R050	3,900	4,400	4,400	4,800	6,800	4,600	4,900	4,800
2D	Mode-8	B12DU8B	100I000	7,400	2,500	1,300	2,400	9,900	2,000	3,900	4,000
NR	Mode-1	B2NRU8E	100R100	4,000	4,500	4,500	4,900	16,600	4,700	5,000	4,900
NR	Mode-2	B2NRU8E	100R075	4,000	4,500	4,500	4,900	10,400	4,700	4,900	4,900
NR	Mode-3	B2NRU8E	100R050	4,000	4,400	2,400	4,900	18,900	4,700	4,900	4,800
NR	Mode-4	B2NRU8E	100R010	25,900	2,900	4,400	4,300	89,300	4,600	5,400	11,300
NR	Mode-5	B2NRU8E	060R100	12,000	4,400	4,400	4,900	6,800	4,700	4,900	4,800
NR	Mode-6	B2NRU8E	060R075	159,000	134,000	159,000	134,000	174,000	149,000	154,000	164,000
NR	Mode-7	B2NRU8E	060R050	103,000	78,500	78,500	93,700	123,000	88,600	98,700	104,000
NR	Mode-8	B2NRU8E	100I000	62,400	41,700	41,700	51,500	72,000	53,600	56,200	60,800

TABLE 41. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR HIGHER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), nanograms per horsepower hour (ng/hp-hr)							
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd)pyrene	Benzo(ghi) perylene
2D	Mode-1	B12DU8B	100R100	70	20	20	30	110	20	30	30
2D	Mode-2	B12DU8B	100R075	70	30	30	40	110	30	40	40
2D	Mode-3	B12DU8B	100R050	80	20	30	20	240	50	50	30
2D	Mode-4	B12DU8B	100R010	1,300	280	230	220	2,100	240	350	500
2D	Mode-5	B12DU8B	060R100	30	30	30	40	50	30	40	40
2D	Mode-6	B12DU8B	060R075	40	40	40	50	50	50	50	50
2D	Mode-7	B12DU8B	060R050	60	60	60	70	100	70	70	70
2D	Mode-8	B12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			100	40	40	40	170	40	50	50
NR	Mode-1	B2NRU8E	100R100	20	20	20	30	80	20	30	20
NR	Mode-2	B2NRU8E	100R075	30	30	30	30	70	30	30	30
NR	Mode-3	B2NRU8E	100R050	40	40	20	50	190	50	50	50
NR	Mode-4	B2NRU8E	100R010	1,200	140	210	210	4,300	220	260	540
NR	Mode-5	B2NRU8E	060R100	90	30	30	40	50	30	40	40
NR	Mode-6	B2NRU8E	060R075	1,600	1,400	1,600	1,400	1,800	1,500	1,600	1,700
NR	Mode-7	B2NRU8E	060R050	1,500	1,200	1,200	1,400	1,800	1,300	1,500	1,600
NR	Mode-8	B2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			420	310	330	340	580	360	380	410
				Transient Cycle Emission Levels							
2D	BHL	B12DBHL1	Hot-Start	410	80	80	70	560	70	90	160
NR	BHL	B2NRBHL1	Hot-Start	1,300	890	890	1,100	1,900	1,100	1,100	1,400
2D	FTP	B12DFTP1	Hot-Start	270	50	60	40	440	50	40	70
2D	FTP	B12DFTP2	Hot-Start	270	50	50	50	500	50	40	70
NR	FTP	B2NRFTP1	Hot-Start	400	310	780	550	1,600	240	730	1,000
NR	FTP	B2NRFTP2	Hot-Start	2,300	1,800	2,100	1,700	3,100	1,800	2,200	2,300

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.7 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 42. STEADY-STATE EMISSION LEVELS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A MASS BASIS FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per hour (µg/hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluo-ranthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	B12DU8B	100R100	400	280	90	120	700	2,300	1,800	120
2D	Mode-2	B12DU8B	100R075	580	360	100	100	900	3,600	2,200	110
2D	Mode-3	B12DS8B	100R050	2,000	1,000	420	180	3,100	10,900	7,200	310
2D	Mode-4	B12DU8B	100R010	3,500	2,700	1,300	270	7,400	24,500	15,200	580
2D	Mode-5	B12DU8B	060R100	330	170	50	80	540	3,800	1,100	80
2D	Mode-6	B12DU8B	060R075	310	160	70	40	490	6,400	870	60
2D	Mode-7	B12DU8B	060R050	840	250	170	60	1,500	4,800	2,700	120
2D	Mode-8	B12DU8B	100I000	1,300	810	260	80	2,400	6,900	3,900	160
NR	Mode-1	B2NRU8E	100R100	370	220	10	70	600	4,400	1,200	191
NR	Mode-2	B2NRU8E	100R075	450	290	20	60	700	4,900	1,400	179
NR	Mode-3	B2NRU8E	100R050	1,300	840	60	30	1,800	9,400	4,700	209
NR	Mode-4	B2NRU8E	100R010	2,100	1,800	780	210	3,300	16,300	9,200	477
NR	Mode-5	B2NRU8E	060R100	290	160	2	60	260	6,400	720	174
NR	Mode-6	B2NRU8E	060R075	490	270	140	180	580	7,800	1,300	166
NR	Mode-7	B2NRU8E	060R050	1,500	480	270	160	1,900	9,200	4,000	269
NR	Mode-8	B2NRU8E	100I000	1,300	900	220	130	2,200	9,200	3,700	213

TABLE 43. STEADY-STATE AND TRANSIENT CYCLE EMISSIONS FOR LOWER MOLECULAR WEIGHT PAH COMPOUNDS ON A BRAKE-SPECIFIC BASIS FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake-Specific Polynuclear Aromatic Hydrocarbon (PAH), Micrograms per horsepower hour (µg/hp-hr)							
				Ace-napthene	Ace-nepthylene	Anthra-cene	Fluor-anthene	Fluorene	Naptha-lene	Phen-anthrene	Pyrene
2D	Mode-1	B12DU8B	100R100	2	trace	nd	trave	4	10	9	trace
2D	Mode-2	B12DU8B	100R075	4	2	trace	trace	6	20	10	trace
2D	Mode-3	B12DU8B	100R050	20	10	4	2	30	110	70	3
2D	Mode-4	B12DU8B	100R010	180	140	70	10	380	1,300	780	30
2D	Mode-5	B12DU8B	060R100	2	trace	nd	trace	4	30	8	trace
2D	Mode-6	B12DU8B	060R075	3	2	trace	nd	5	60	9	trace
2D	Mode-7	B12DU8B	060R050	10	4	2	trace	20	70	40	2
2D	Mode-8	B12DU8B	100I000	na	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			10	7	3	trace	20	80	40	2
NR	Mode-1	B2NRU8E	100R100	2	trace	nd	nd	3	20	6	trace
NR	Mode-2	B2NRU8E	100R075	3	2	nd	nd	5	30	9	trace
NR	Mode-3	B2NRU8E	100R050	10	8	trace	nd	20	100	50	2
NR	Mode-4	B2NRU8E	100R010	100	90	40	10	160	780	440	20
NR	Mode-5	B2NRU8E	060R100	2	trace	nd	nd	2	50	5	trace
NR	Mode-6	B2NRU8E	060R075	5	3	trace	2	6	80	10	2
NR	Mode-7	B2NRU8E	060R050	20	7	4	2	30	140	60	4
NR	Mode-8	B2NRU8E	100I000	na	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			10	6	2	trace	10	80	30	2
				Transient Cycle Emission Levels							
2D	BHL	B12DBHL1	Hot-Start	50	30	10	4	110	220	180	8
NR	BHL	B2NRBHL1	Hot-Start	30	30	7	4	50	190	110	5
2D	FTP	B12DFTP1	Hot-Start	40	30	10	4	70	200	150	7
2D	FTP	B12DFTP2	Hot-Start	40	30	9	4	60	210	130	7
NR	FTP	B2NRFTP1	Hot-Start	20	30	7	9	50	90	100	10
NR	FTP	B2NRFTP2	Hot-Start	20	20	4	5	40	170	90	5

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated PAH detection limit was 0.07 µg/hp-hr
Emission levels expressed in units of micrograms per horsepower-hour
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

TABLE 44. STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Mass Rate NITRO Polynuclear Aromatic Hydrocarbon (n-PAH), Nanograms per hour (ng/hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	B12DU8B	100R100	460	4,100	340	5,000	220	420	900
2D	Mode-2	B12DU8B	100R075	110	2,200	nd	1,600	280	110	950
2D	Mode-3	B12DU8B	100R050	400	4,600	320	5,000	250	330	890
2D	Mode-4	B12DU8B	100R010	6,500	85,000	30	29,600	220	60	890
2D	Mode-5	B12DU8B	060R100	300	2,600	100	960	220	330	880
2D	Mode-6	B12DU8B	060R075	300	1,100	470	260	440	300	390
2D	Mode-7	B12DU8B	060R050	240	1,600	160	960	30	230	380
2D	Mode-8	B12DU8B	100I000	420	1,900	80	430	180	30	130
NR	Mode-1	B2NRU8E	100R100	1,500	9,800	390	9,700	20	470	390
NR	Mode-2	B2NRU8E	100R075	460	5,100	70	3,500	290	60	390
NR	Mode-3	B2NRU8E	100R050	460	5,600	130	7,500	190	130	390
NR	Mode-4	B2NRU8E	100R010	4,500	48,600	310	49,000	460	90	880
NR	Mode-5	B2NRU8E	060R100	250	2,100	310	2,000	200	280	890
NR	Mode-6	B2NRU8E	060R075	250	2,000	150	950	280	190	880
NR	Mode-7	B2NRU8E	060R050	940	6,000	420	6,400	280	60	380
NR	Mode-8	B2NRU8E	100I000	660	8,500	150	3,000	190	170	360

TABLE 44 (CONT'D). STEADY-STATE AND TRANSIENT CYCLE EMISSION LEVELS FOR NITRO-PAH COMPOUNDS ON BOTH A MASS AND BRAKE-SPECIFIC BASIS FOR A 2001 CUMMINS ISB190 ENGINE USING TWO FUELS

Fuel ID	Test Type	SwRI Test Name	Test ID	Brake Specific NITRO-PAH Compounds, Nanograms per horsepower-hour (ng/hp-hr)						
				2-Nitro Fluorene	9-Nitro Anthracene	3-Nitro Fluoranthene	1-Nitro Pyrene	6-Nitro Chrysene	Di-Nitro Pyrene	6-Nitro Benzo(a)pyrene
2D	Mode-1	B12DU8B	100R100	2	20	2	30	trace	2	5
2D	Mode-2	B12DU8B	100R075	trace	20	nd	10	2	trace	6
2D	Mode-3	B12DU8B	100R050	4	50	3	50	2	3	9
2D	Mode-4	B12DU8B	100R010	330	4,400	2	1,500	10	3	50
2D	Mode-5	B12DU8B	060R100	2	20	trace	7	2	2	7
2D	Mode-6	B12DU8B	060R075	3	10	5	3	4	3	4
2D	Mode-7	B12DU8B	060R050	3	20	2	10	0	3	6
2D	Mode-8	B12DU8B	100I000	na	na	na	na	na	na	na
2D	ISO Type-C1 Weighted Composite			10	110	2	50	2	2	7
NR	Mode-1	B2NRU8E	100R100	8	50	2	50	nd	2	2
NR	Mode-2	B2NRU8E	100R075	3	40	trace	20	2	nd	3
NR	Mode-3	B2NRU8E	100R050	5	60	trace	80	2	trace	4
NR	Mode-4	B2NRU8E	100R010	210	2,300	10	2,300	20	4	40
NR	Mode-5	B2NRU8E	060R100	2	20	2	10	trace	2	7
NR	Mode-6	B2NRU8E	060R075	3	20	trace	10	3	2	9
NR	Mode-7	B2NRU8E	060R050	10	90	6	100	4	trace	6
NR	Mode-8	B2NRU8E	100I000	na	na	na	na	na	na	na
NR	ISO Type-C1 Weighted Composite			10	100	2	100	2	2	5
				Transient Cycle Emission Levels						
2D	BHL	B12DBHL1	Hot-Start	10	600	trace	380	2	2	10
NR	BHL	B2NRBHL1	Hot-Start	10	460	3	500	trace	3	10
2D	FTP	B12DFTP1	Hot-Start	20	600	5	360	nd	2	9
2D	FTP	B12DFTP2	Hot-Start	20	540	3	400	nd	4	3
NR	FTP	B2NRFTP1	Hot-Start	20	500	5	1,200	4	3	9
NR	FTP	B2NRFTP2	Hot-Start	3	nd	2	5	nd	2	trace

Notes: Detection limit expressed in units of ng/hp-hr was calculated using the minimum value that could be quantified by the analytical procedure.
Calculated nPAH detection limit was 0.5 ng/hp-hr
Values shown were each background and blank corrected
"nd" indicates none detected at calculated detection limit
"trace" indicates a quantifiable level at less than twice the calculated detection limit

VII. SUMMARY

This report covers work performed during fiscal year 2002 under WA 3-04. Testing evaluated a 1996 Deere 6068T engine rated for 160 horsepower, a 1998 Cummins M11C engine rated for 270 horsepower, a Caterpillar 3196 engine rated for 420 horsepower, and a Cummins ISB engine rated for 190 horsepower. All four engines were obtained from in-use fleets of equipment owned by leasing agencies specializing in nonroad equipment. Engine setup assistance was obtained from applicable engine manufacturers to correctly adjust engine intake air and exhaust restrictions, and so on.

Each engine was tested to characterize its regulated and selected unregulated emission levels over steady-state and transient duty cycles, using both on-highway and nonroad fuels. The on-highway and nonroad diesel fuels used in this work differed mostly in sulfur content, at 390 and 2,570 ppm sulfur, respectively. Work included configuring test cells for obtaining the desired emission samples over various steady-state and transient tests, and performing numerous post-test analyses of samples gathered for each test. Testing of each engine was completed without incident. Good transient cycle control of the different engines was achieved over the FTP transient duty cycle, with satisfactory performance over BHL and SAT nonroad cycles. In all cases, engine performance was very stable over the eight modes of the Type-C1 steady-state operations.

Duplicate transient FTP, BHL, and SAT cycles on each engine showed good repeatability for regulated emissions, and duplicate FTP cycles showed good unregulated emissions repeatability on both fuels. Statistical assessment of result reproducibility is outside the scope of this report. Single BHL cycles were run for toxics information, and the SAT cycles were only run for regulated emissions data. Table 45 summarizes the computed averages (where possible) for all emissions measured for the four different nonroad engines over the various cycles, each using two different diesel fuels. Information presented in this report was also submitted to EPA in electronic spreadsheet and wordprocessor formats.

TABLE 45. SUMMARY OF TOXICS AND REGULATED EMISSION LEVELS FOR FOUR DIFFERENT NONROAD ENGINES OVER STEADY-STATE AND TRANSIENT CYCLES USING LOW AND HIGH SULFUR DIESEL FUELS

Engine	Deere 6068T						Cummins M11C						Caterpillar 3196						Cummins ISB190					
Cycle	C1		FTP		BHL		C1		FTP		BHL		C1		FTP		BHL		C1		FTP		BHL	
Fuel	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR
HC, g/hp-hr	0.37	0.34	0.85	0.94	0.62	0.55	0.27	0.29	0.79	0.74	0.56	0.62	0.07	0.06	0.06	0.08	0.12	0.09	0.05	0.04	0.10	0.08	0.14	0.12
CO, g/hp-hr	0.96	1.00	1.60	1.46	2.19	2.20	0.57	0.75	2.58	2.67	2.53	2.89	0.83	0.84	1.36	1.33	1.31	1.43	0.49	0.48	0.99	0.92	1.29	1.19
NO_X, g/hp-hr	10.35	10.51	10.31	10.20	8.64	8.71	6.07	5.99	6.50	6.48	6.70	6.47	6.04	5.98	6.33	6.24	6.42	6.34	3.85	3.42	4.12	3.99	4.77	4.43
PM, g/hp-hr	0.229	0.303	0.292	0.321	0.323	0.392	0.134	0.165	0.331	0.384	0.371	0.433	0.076	0.122	0.123	0.178	0.134	0.186	0.072	0.112	0.095	0.152	0.096	0.130
N_2O, mg/hp-hr	6.1	22.3	4.4	5.4	4.6	6.2	3.5	10.5	3.6	4.5	5.0	5.7	4.3	12.2	4.4	4.4	3.6	4.1	3.6	6.0	2.1	5.2	9.7	7.0
Sulfate, mg/hp-hr	2.7	23.4	2.5	23.2	2.8	28.0	2.2	16.4	2.4	23.4	2.7	21.0	3.2	34.5	3.3	31.6	3.8	31.1	3.2	33.7	3.30	33.10	2.7	23.1
Ammonia, mg/hp-hr	0.3			0.1		0.2		0.2					0.1		0.9				0.1				0.90	
1,3-Butadiene, mg/hp-hr	2.3	1.7		1.7	3.3	2.1	0.3	1.0	6.7				1.3						0.1					
n-Hexane, mg/hp-hr	0.5		0.8	0.3	0.7		0.2	0.1	0.1	0.7			0.1						0.2					
Benzene, mg/hp-hr	2.4	2.5	4.2	3.8	3.8	3.9	1.3	1.3	5.2	5.9	3.6	4.2	0.4	0.6	1.8	4.5	2.3	1.3	0.6	0.7	1.4	1.6		1.1
Toluene, mg/hp-hr	0.9	1.3	2.8	2.2	3.3	1.6	0.7	1.6	1.5	3.1		1.3	1.1	1.0	1.7	2.3	2.2	1.2	4.1	1.2	1.4	2.9	5.0	
Ethylbenzene, mg/hp-hr	1.0	0.5	2.8	1.4	2.2	1.1	0.4	0.5	1.3	1.2	1.4	0.9	0.2	0.2	0.4		0.6		0.3	0.2	0.4		0.9	
m-&p-Xylene, mg/hp-hr	1.5	1.3	3.5	3.3	2.7	2.6	0.8	1.1	2.4	2.6	2.0	1.8	0.5	0.4	0.9	0.3	0.9		0.6	0.3				
Styrene, mg/hp-hr																								
o-Xylene, mg/hp-hr	0.7	0.7	1.9	1.4	1.2	1.2	0.5	0.5	1.2	1.2	0.9	0.7	0.5	0.6					0.2					
Formaldehyde, mg/hp-hr	18.8	18.5	47.4	43.7	34.6	35.5	15.8	13.6	71.8	72.9	35.8	39.3	7.8	7.9	14.2	14.0	13.0	12.9	6.7	5.7	15.3	14.7	17.8	16.4
Acetaldehyde, mg/hp-hr	6.2	5.9	17.5	16.2	12.2	11.9	4.8	4.4	24.5	24.6	12.0	13.9	2.7	2.7	5.3	5.0	4.3	4.5	2.1	2.1	5.3	5.3	6.3	6.0
Benzo(a)anthracene, ng/hp-hr	860	580	1950	1850	1600	1900	640	940	2850	4300	2600	3500	230	250	1900	980	1900	590	100	420	270	1350	410	1300
Benzo(a)pyrene, ng/hp-hr	250	470	580	555	560	700	310	170	1700	1800	1500	680	130	100	1400	310	1300	160	40	310	50	1055	80	890
Benzo(b)fluoranthene, ng/hp-hr	240	460	765	600	520	680	280	300	1600	2600	1400	2200	120	140	1750	1300	1600	740	40	330	55	1440	80	890
Benzo(k)fluoranthene, ng/hp-hr	180	530	565	570	520	670	190	160	990	1550	920	1500	120	110	1450	655	1500	480	40	340	45	1125	70	1100
Chrysene, ng/hp-hr	1300	1500	2450	3900	1900	4200	900	1600	3550	6650	3000	6000	360	450	2400	2200	2300	1300	170	580	470	2350	560	1900
Dibenz(a,h)anthracene, ng/hp-hr	170	430	570	550	170	700	20	30	85	95	110	80	60	80	130	130	160	90	40	360	50	1020	70	1100
Indeno(1,2,3-cd)pyrene, ng/hp-hr	200	440	565	545	290	730	130	110	875	955	510	460	110	130	1200	530	1300	350	50	380	40	1465	90	1100
Benzo(ghi)perylene, ng/hp-hr	260	440	545	545	610	660	160	110	1450	1750	680	710	120	140	1900	660	1800	390	50	410	70	1650	160	1400

TABLE 45 (CONT'D). SUMMARY OF TOXICS AND REGULATED EMISSION LEVELS FOR FOUR DIFFERENT NONROAD ENGINES OVER SELECT STEADY-STATE AND TRANSIENT CYCLES USING LOW AND HIGH SULFUR DIESEL FUELS

Engine	Deere 6068T						Cummins M11C						Caterpillar 3196						Cummins ISB190					
Cycle	C1		FTP		BHL		C1		FTP		BHL		C1		FTP		BHL		C1		FTP		BHL	
Fuel	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR	2D	NR
Acenapthene, µg/hp-hr	80	50	205	130	180	110	50	50	150	110	120	110	20	10	35	30	30	20	10	10	40	20	50	30
Acenepthylene, µg/hp-hr	50	30	90	70	110	110	30	30	165	165	110	150	10	10	70	65	70	30	7	6	30	25	30	30
Anthracene, µg/hp-hr	20	6	35	20	30	20	10	7	55	35	40	30	3	2	10	8	10	4	3	2	10	6	10	7
Fluoranthene, µg/hp-hr	8	6	10	10	9	10	4	4	20	25	10	30		2	15	15	20	7			4	7	4	4
Fluorene, µg/hp-hr	120	70	330	250	250	240	70	60	240	190	160	170	20	20	55	55	50	30	20	10	65	45	110	50
Napthalene, µg/hp-hr	360	260	675	575	620	660	260	270	1150	760	680	630	70	80	285	250	210	120	80	80	205	130	220	190
Phenanthrene, µg/hp-hr	240	150	505	400	440	360	140	430	525	435	350	420	40	40	105	100	100	60	40	30	140	95	180	110
Pyrene, µg/hp-hr	20	7	40	25	20	20	10	7	50	60	40	60	4	4	20	10	20	6	2	2	7	8	8	5
2-Nitro Fluorene, ng/hp-hr	9	6	25	10	6		20	30	28	24	20	40	2		20	30	6	10	10	10	20	12	10	10
9-Nitro Anthracene, ng/hp-hr	40	40	695	750	700	570	9	20	120	75	90	10	9	20	145	320	120	120	110	100	570	245	600	460
3-Nitro Fluoranthene, ng/hp-hr	3	5	4	4	3		20	20	3	6	60	3	2	2	25	40	10	10	2	2	4	4		3
1-Nitro Pyrene, ng/hp-hr	50	60	400	525	540	460	10	20	85	275	70	190	10	50	1850	2550	1500	1300	50	100	380	603	380	500
6-Nitro Chrysene, ng/hp-hr	6	6	3	2		5	20	20	25	30	30	20	2	2	15	15	6	3	2	2		2	2	
Di-Nitro Pyrene, ng/hp-hr	6	6	3		4		30	20	40	13	60	40	2	3	15	8	10	4	2	2	3	3	2	3
6-Nitro Benzo(a)pyrene, ng/hp-hr	8	6	2			2	8	10	2	9	4	10	3	3	3	4	10	3	7	5	6	5	10	10

C1	ISO Type-C1 composite weighted emission levels
FTP	U.S. on-highway transient duty cycle
BHL	Nonroad transient duty cycle based on backhoe loader activities

APPENDIX A

DETAILED COMPUTER PRINTOUTS FOR TRANSIENT EMISSION TESTS ON A DEERE 6068T ENGINE OVER FTP, BHL, AND SAT CYCLES USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
J02DFTP1	FTP	2D	Without	Transient Cycle Emissions Summary	A-1
J02DFTP2	FTP	2D	Without[a]	Transient Cycle Emissions Summary	A-2
J02DBHL1	BHL	2D	Without	Transient Cycle Emissions Summary	A-3
J02DBHL2	BHL	2D	Without[a]	Transient Cycle Emissions Summary	A-4
J02DSAT1	SAT	2D	Without	Transient Cycle Emissions Summary	A-5
J02DSAT2	SAT	2D	Without[a]	Transient Cycle Emissions Summary	A-6
J12DFTP1	FTP	2D	Yes	Transient Cycle Emissions Summary	A-7
J12DFTP2	FTP	2D	Yes	Transient Cycle Emissions Summary	A-9
J12DBHL1	BHL	2D	Yes	Transient Cycle Emissions Summary	A-11
J2NRFTP1	FTP	NR	Yes	Transient Cycle Emissions Summary	A-13
J2NRFTP2	FTP	NR	Yes	Transient Cycle Emissions Summary	A-15
J2NRBHL1	BHL	NR	Yes	Transient Cycle Emissions Summary	A-17

Note: [a] - Measured nitric oxide (NO) level instead of NO_X

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J02DFTP1	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 07/09/2002 Time: 01:30	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.17	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	68.8	gr/lb	9.8 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	85.0	°F	29.4 °C
Abs. Humidity	66.5	gr/lb	9.5 g/kg
Rel. Humidity:	36	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.71	ppm	
HC Bckgrd	n/a		4.30	ppm	
CO	11.9	2	11.32	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		51.38	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	44.6	1	0.3270	%	(Wet)
CO2 Bckgrd	6.6	1	0.0419	%	

Corrected Concentrations

HC	13.51	ppm
CO	10.85	ppm
NOx	50.33	ppm
CO2	0.2861	%

Mass Emissions

HC	9.656	grams
CO	15.708	grams
NOx	117.810	grams
Particulate	3.120	grams
CO2	6.511	kg
Fuel	4.55 lb	2.06 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,181.9	61.79
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.60	0.05
Gas Meter 2:	4.11	0.12
Sample Rate:	2.50	0.07
Total Flow Rate:	2,184.37	61.86

Particulate Data

Filter Number:	2102.0-428 (pair)	
Weight Gain:	3.577	mg
Sample Multiplier:	0.872	

Correction Factors

NOx Humidity CF:	0.984
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	41.26

Test Cycle Data

Sample Time:	1,206.40	sec		
Work:	11.60	hp-hr	8.65	kW-hr
Reference Work:	11.32	hp-hr	8.44	kW-hr
Total Volume (Vmix):	43,920.4	scf	1,243.85	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.832 g/hp-hr	1.116	g/kW-hr
CO		1.354 g/hp-hr	1.816	g/kW-hr
NOx	(Cell)	10.156 g/hp-hr	13.619	g/kW-hr
Particulate		0.269 g/hp-hr	0.361	g/kW-hr
CO2		561.3 g/hp-hr	752.66	g/kW-hr
BSFC		0.392 lb/hp-hr	0.238	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J02DFTP2	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 07/09/2002 Time: 02:10	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.16	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.4	°F	13.6 °C
Abs. Humidity:	69.8	gr/lb	10.0 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	86.0	°F	30.0 °C
Abs. Humidity	40.8	gr/lb	5.8 g/kg
Rel. Humidity:	21	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.55	ppm	
HC Bckgrd	n/a		4.20	ppm	
CO	12.6	2	12.00	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		45.70	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	44.6	1	0.3270	%	(Wet)
CO2 Bckgrd	6.6	1	0.0419	%	

Corrected Concentrations

HC	13.45	ppm
CO	11.66	ppm
NOx	45.04	ppm
CO2	0.2861	%

Mass Emissions

HC	9.590	grams
CO	16.844	grams
NOx	105.484	grams
Particulate	3.148	grams
CO2	6.496	kg
Fuel	4.54 lb	2.06 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,177.3	61.66
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.60	0.05
Gas Meter 2:	4.09	0.12
Sample Rate:	2.49	0.07
Total Flow Rate:	2,179.81	61.73

Particulate Data

Filter Number:	2103.0-429 (pair)	
Weight Gain:	3.596	mg
Sample Multiplier:	0.875	

Correction Factors

NOx Humidity CF:	0.987
Dry-to-Wet CF, Sample:	0.988
Dry-to-Wet CF, Bckgrd:	0.991
Dilution Factor:	41.26

Test Cycle Data

Sample Time:	1,206.20	sec		
Work:	11.61	hp-hr	8.66	kW-hr
Reference Work:	11.32	hp-hr	8.44	kW-hr
Total Volume (Vmix):	43,821.4	scf	1,241.05	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.826 g/hp-hr	1.108	g/kW-hr
CO		1.451 g/hp-hr	1.946	g/kW-hr
NOx	(Cell)	9.086 g/hp-hr	12.184	g/kW-hr
Particulate		0.271 g/hp-hr	0.364	g/kW-hr
CO2		559.5 g/hp-hr	750.32	g/kW-hr
BSFC		0.391 lb/hp-hr	0.238	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: JO2DBHL1	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 07/09/2002 Time: 03:11	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.16	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.7	°F	13.7 °C
Abs. Humidity:	70.6	gr/lb	10.1 g/kg
Rel. Humidity:	53	%	
Dilution Air:			
Temperature:	86.0	°F	30.0 °C
Abs. Humidity	64.9	gr/lb	9.3 g/kg
Rel. Humidity:	34	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		15.68	ppm	
HC Bckgrd	n/a		4.20	ppm	
CO	19.7	2	18.90	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		46.47	ppm	(Dry)
NOx Bckgrd	0.3	1	0.08	ppm	
CO2 Sample	48.0	1	0.3584	%	(Wet)
CO2 Bckgrd	6.5	1	0.0413	%	

Corrected Concentrations

HC	11.59	ppm
CO	18.38	ppm
NOx	45.56	ppm
CO2	0.3182	%

Mass Emissions

HC	6.518	grams
CO	20.946	grams
NOx	84.319	grams
Particulate	3.301	grams
CO2	5.698	kg
Fuel	3.98 lb	1.81 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,186.8	61.93
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.61	0.05
Gas Meter 2:	4.02	0.11
Sample Rate:	2.41	0.07
Total Flow Rate:	2,189.16	62.00

Particulate Data

Filter Number:	2104.0-430 (pair)	
Weight Gain:	3.634	mg
Sample Multiplier:	0.908	

Correction Factors

NOx Humidity CF:	0.989
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	37.62

Test Cycle Data

Sample Time:	947.30	sec		
Work:	9.87	hp-hr	7.36	kW-hr
Reference Work:	9.73	hp-hr	7.26	kW-hr
Total Volume (Vmix):	34,563.2	scf	978.85	scm

Brake-Specific Emission Results

BSHC (Cell)	0.660	g/hp-hr	0.886	g/kW-hr
CO	2.122	g/hp-hr	2.846	g/kW-hr
NOx (Cell)	8.543	g/hp-hr	11.456	g/kW-hr
Particulate	0.334	g/hp-hr	0.449	g/kW-hr
CO2	577.3	g/hp-hr	774.18	g/kW-hr
BSFC	0.404	lb/hp-hr	0.245	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: JO2DBHL2	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 07/10/2002 Time: 09:53	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.22	in Hg	98.9 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	55.4	°F	13.0 °C
Abs. Humidity:	67.1	gr/lb	9.6 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	85.0	°F	29.4 °C
Abs. Humidity	66.4	gr/lb	9.5 g/kg
Rel. Humidity:	36	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		15.75	ppm	
HC Bckgrd	n/a		4.40	ppm	
CO	20.0	2	19.19	ppm	(Dry)
CO Bckgrd	0.6	2	0.56	ppm	
NOx Sample	n/a		42.69	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	48.1	1	0.3594	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	

Corrected Concentrations

HC	11.47	ppm
CO	18.30	ppm
NOx	41.77	ppm
CO2	0.3174	%

Mass Emissions

HC	6.466	grams
CO	20.909	grams
NOx	76.832	grams
Particulate	3.109	grams
CO2	5.699	kg
Fuel	3.98 lb	1.81 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,192.6	62.09
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.59	0.05
Gas Meter 2:	4.07	0.12
Sample Rate:	2.48	0.07
Total Flow Rate:	2,195.05	62.16

Particulate Data

Filter Number:	2105.0-431 (pair)
Weight Gain:	3.511 mg
Sample Multiplier:	0.885

Correction Factors

NOx Humidity CF:	0.980
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	37.51

Test Cycle Data

Sample Time:	947.40	sec		
Work:	9.96	hp-hr	7.43	kW-hr
Reference Work:	9.73	hp-hr	7.26	kW-hr
Total Volume (Vmix):	34,659.8	scf	981.59	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.649 g/hp-hr	0.871	g/kW-hr
CO		2.099 g/hp-hr	2.815	g/kW-hr
NOx	(Cell)	7.714 g/hp-hr	10.345	g/kW-hr
Particulate		0.312 g/hp-hr	0.419	g/kW-hr
CO2		572.2 g/hp-hr	767.28	g/kW-hr
BSFC		0.400 lb/hp-hr	0.243	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: JO2DSAT1	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 07/10/2002 Time: 01:30	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.21	in Hg	98.9 kPa
Engine Inlet Air			
Temperature:	78.0	°F	25.6 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	70.7	gr/lb	10.1 g/kg
Rel. Humidity:	48	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.1	gr/lb	10.4 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		21.09	ppm	
HC Bckgrd	n/a		4.50	ppm	
CO	13.3	2	12.67	ppm	(Dry)
CO Bckgrd	0.8	2	0.75	ppm	
NOx Sample	n/a		75.05	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	61.5	1	0.4974	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	

Corrected Concentrations

HC	16.76	ppm
CO	11.65	ppm
NOx	73.33	ppm
CO2	0.4558	%

Mass Emissions

HC	12.276	grams		
CO	17.304	grams		
NOx	176.896	grams		
Particulate	3.397	grams		
CO2	10.635	kg		
Fuel	7.41	lb	3.36	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,167.5	61.39
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.60	0.05
Gas Meter 2:	4.12	0.12
Sample Rate:	2.52	0.07
Total Flow Rate:	2,170.05	61.46

Particulate Data

Filter Number:	2186.0-432 (pair)	
Weight Gain:	3.941	mg
Sample Multiplier:	0.862	

Correction Factors

NOx Humidity CF:	0.989
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	27.18

Test Cycle Data

Sample Time:	1,245.20	sec		
Work:	19.46	hp-hr	14.51	kW-hr
Reference Work:	20.00	hp-hr	14.91	kW-hr
Total Volume (Vmix):	45,035.8	scf	1,275.44	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.631 g/hp-hr	0.846	g/kW-hr
CO		0.889 g/hp-hr	1.192	g/kW-hr
NOx	(Cell)	9.090 g/hp-hr	12.190	g/kW-hr
Particulate		0.175 g/hp-hr	0.234	g/kW-hr
CO2		546.5 g/hp-hr	732.87	g/kW-hr
BSFC		0.381 lb/hp-hr	0.232	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: JO2DSAT2	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 07/10/2002 Time: 02:10	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.20	in Hg	98.9 kPa
Engine Inlet Air			
Temperature:	77.0	°F	25.0 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	70.7	gr/lb	10.1 g/kg
Rel. Humidity:	50	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	69.8	gr/lb	10.0 g/kg
Rel. Humidity:	44	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		21.36	ppm	
HC Bckgrd	n/a		4.20	ppm	
CO	14.2	2	13.55	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		66.58	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	60.6	1	0.4874	%	(Wet)
CO2 Bckgrd	6.6	1	0.0419	%	

Corrected Concentrations

HC	17.31	ppm
CO	12.96	ppm
NOx	65.11	ppm
CO2	0.4470	%

Mass Emissions

HC	12.683	grams
CO	19.249	grams
NOx	157.078	grams
Particulate	3.406	grams
CO2	10.430	kg
Fuel	7.27 lb	3.30 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,167.0	61.37
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.59	0.05
Gas Meter 2:	4.06	0.11
Sample Rate:	2.47	0.07
Total Flow Rate:	2,169.47	61.44

Particulate Data

Filter Number:	2187.0-433 (pair)	
Weight Gain:	3.875	mg
Sample Multiplier:	0.879	

Correction Factors

NOx Humidity CF:	0.989
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	27.73

Test Cycle Data

Sample Time:	1,245.50	sec		
Work:	19.43	hp-hr	14.49	kW-hr
Reference Work:	20.00	hp-hr	14.91	kW-hr
Total Volume (Vmix):	45,034.5	scf	1,275.40	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.653 g/hp-hr	0.875	g/kW-hr
CO		0.991 g/hp-hr	1.329	g/kW-hr
NOx	(Cell)	8.084 g/hp-hr	10.841	g/kW-hr
Particulate		0.175 g/hp-hr	0.235	g/kW-hr
CO2		536.8 g/hp-hr	719.85	g/kW-hr
BSFC		0.374 lb/hp-hr	0.228	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DFTP1	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/24/2002 Time: 10:13	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.14	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	59.6	°F	15.3 °C
Abs. Humidity:	78.5	gr/lb	11.2 g/kg
Rel. Humidity:	63	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.4	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		20.46	ppm	
HC Bckgrd	n/a		7.00	ppm	
CO	14.2	2	13.55	ppm	(Dry)
CO Bckgrd	0.5	2	0.47	ppm	
NOx Sample	n/a		50.63	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	44.7	1	0.3279	%	(Wet)
CO2 Bckgrd	6.7	1	0.0425	%	
CH4 Sample	n/a	n/a	2.01	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.95	ppm	

Corrected Concentrations

HC	13.63	ppm
CO	12.82	ppm
NOx	49.51	ppm
CO2	0.2864	%
CH4	0.12	ppm (1.00)

Mass Emissions

HC	10.062	grams
CO	19.174	grams
NOx	122.814	grams
Particulate	3.610	grams
CO2	6.734	kg
CH4	0.099	grams
Fuel	4.71 lb	2.13 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,191.4	62.06
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.57	0.04
Gas Meter 2:	4.07	0.12
Sample Rate:	2.50	0.07
20X20 Sample Rate:	13.23	0.37
47 mm Sample Rate:	50.16	1.42
Chemistry Sample Rate:	0.134	0.076
Total Flow Rate:	2,257.46	64.00

Particulate Data

Filter Number:	1420.0-323 (pair)	
Weight Gain:	3.992	mg
Sample Multiplier:	0.904	

Correction Factors

NOx Humidity CF:	1.009
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	41.09

Test Cycle Data

Sample Time:	1,206.10	sec		
Work:	11.78	hp-hr	8.78	kW-hr
Reference Work:	11.32	hp-hr	8.44	kW-hr
Total Volume (Vmix):	45,376.1	scf	1,285.08	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.854 g/hp-hr	1.145	g/kW-hr
CO		1.628 g/hp-hr	2.183	g/kW-hr
NOx	(Cell)	10.426 g/hp-hr	13.981	g/kW-hr
Particulate		0.306 g/hp-hr	0.411	g/kW-hr
CO2		571.6 g/hp-hr	766.58	g/kW-hr
BSFC		0.400 lb/hp-hr	0.243	kg/kW-hr
NMHC		0.742 g/hp-hr	0.995	g/kW-hr
CH4		0.008 g/hp-hr	0.011	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 6.8 L (413 CID) 6
Engine Cycle: Diesel
Engine S/N: 553496

Test No.: J12DFTP1
Date: 06/24/2002 Time: 10:13
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1

DIESEL 2D, 2D=EM4619F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

	Sample		Background	
Formaldehyde				
Concentration	0.356	ppm	0.003	ppm
Mass	555.81	mg		
Acetaldehyde				
Concentration	0.089	ppm	0.001	ppm
Mass	202.35	mg		
Acrolein				
Concentration	0.035	ppm	0.000	ppm
Mass	102.42	mg		
Acetone				
Concentration	0.007	ppm	0.000	ppm
Mass	22.11	mg		
Propionaldehyde				
Concentration	0.015	ppm	0.000	ppm
Mass	44.23	mg		
Crotonaldehyde				
Concentration	0.012	ppm	0.000	ppm
Mass	44.64	mg		
Isobutyr + MEK				
Concentration	0.011	ppm	0.001	ppm
Mass	36.08	mg		
Benzaldehyde				
Concentration	0.003	ppm	0.000	ppm
Mass	14.36	mg		
Hexanaldehyde				
Concentration	0.001	ppm	0.000	ppm
Mass	7.83	mg		

Brake-Specific Results

Formaldehyde	47.182 mg/hp-hr	Crotonaldehyde	3.790 mg/hp-hr
Acetaldehyde	17.177 mg/hp-hr	Isobutyr + MEK	3.063 mg/hp-hr
Acrolein	8.695 mg/hp-hr	Benzaldehyde	1.219 mg/hp-hr
Acetone	1.877 mg/hp-hr	Hexanaldehyde	0.664 mg/hp-hr
Propionaldehyde	3.755 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DFTP2	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/24/2002 Time: 10:53	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.14	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	58.8	°F	14.9 °C
Abs. Humidity:	76.3	gr/lb	10.9 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.3	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		20.31	ppm	
HC Bckgrd	n/a		7.10	ppm	
CO	13.4	2	12.77	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		49.78	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	44.1	1	0.3225	%	(Wet)
CO2 Bckgrd	6.7	1	0.0425	%	
CH4 Sample	n/a	n/a	1.54	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.09	ppm	

Corrected Concentrations

HC	13.38	ppm	
CO	12.34	ppm	
NOx	48.74	ppm	
CO2	0.2810	%	
CH4	-0.49	ppm	(1.00)

Mass Emissions

HC	9.872	grams	
CO	18.446	grams	
NOx	120.127	grams	
Particulate	3.262	grams	
CO2	6.604	kg	
CH4	0.000	grams	
Fuel	4.62 lb	2.09 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,191.2	62.06
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.56	0.04
Gas Meter 2:	4.10	0.12
Sample Rate:	2.54	0.07
20X20 Sample Rate:	12.64	0.36
47 mm Sample Rate:	50.31	1.42
Chemistry Sample Rate:	0.131	0.075
Total Flow Rate:	2,256.81	63.98

Particulate Data

Filter Number:	1421.0-324 (pair)	
Weight Gain:	3.666	mg
Sample Multiplier:	0.890	

Correction Factors

NOx Humidity CF:	1.003
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	41.78

Test Cycle Data

Sample Time:	1,205.90	sec		
Work:	11.79	hp-hr	8.79	kW-hr
Reference Work:	11.32	hp-hr	8.44	kW-hr
Total Volume (Vmix):	45,355.4	scf	1,284.49	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.837 g/hp-hr	1.123	g/kW-hr
CO		1.565 g/hp-hr	2.098	g/kW-hr
NOx	(Cell)	10.189 g/hp-hr	13.663	g/kW-hr
Particulate		0.277 g/hp-hr	0.371	g/kW-hr
CO2		560.1 g/hp-hr	751.10	g/kW-hr
BSFC		0.391 lb/hp-hr	0.238	kg/kW-hr
NMHC		0.728 g/hp-hr	0.976	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DFTP2	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/24/2002 Time: 10:53	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

	Sample	Background
Formaldehyde		
Concentration	0.360 ppm	0.003 ppm
Mass	561.84 mg	
Acetaldehyde		
Concentration	0.092 ppm	0.001 ppm
Mass	210.39 mg	
Acrolein		
Concentration	0.037 ppm	0.000 ppm
Mass	106.78 mg	
Acetone		
Concentration	0.014 ppm	0.000 ppm
Mass	43.76 mg	
Propionaldehyde		
Concentration	0.016 ppm	0.000 ppm
Mass	49.77 mg	
Crotonaldehyde		
Concentration	0.013 ppm	0.000 ppm
Mass	49.05 mg	
Isobutyr + MEK		
Concentration	0.011 ppm	0.001 ppm
Mass	38.82 mg	
Benzaldehyde		
Concentration	0.003 ppm	0.000 ppm
Mass	14.54 mg	
Hexanaldehyde		
Concentration	0.002 ppm	0.000 ppm
Mass	8.91 mg	

Brake-Specific Results

Formaldehyde	47.654 mg/hp-hr	Crotonaldehyde	4.160 mg/hp-hr
Acetaldehyde	17.845 mg/hp-hr	Isobutyr + MEK	3.293 mg/hp-hr
Acrolein	9.057 mg/hp-hr	Benzaldehyde	1.234 mg/hp-hr
Acetone	3.712 mg/hp-hr	Hexanaldehyde	0.756 mg/hp-hr
Propionaldehyde	4.221 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DBHL1	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/24/2002 Time: 11:59	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.12	in Hg	98.6 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	74.7	gr/lb	10.7 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.4	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		19.01	ppm	
HC Bckgrd	n/a		8.60	ppm	
CO	19.9	2	19.09	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		45.30	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	47.6	1	0.3547	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	
CH4 Sample	n/a	n/a	2.05	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.14	ppm	

Corrected Concentrations

HC	10.64	ppm	
CO	18.43	ppm	
NOx	44.36	ppm	
CO2	0.3121	%	
CH4	-0.03	ppm	(1.00)

Mass Emissions

HC	6.183	grams
CO	21.716	grams
NOx	85.773	grams
Particulate	3.207	grams
CO2	5.777	kg
CH4	0.000	grams
Fuel	4.04 lb	1.83 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,195.4	62.17
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.56	0.04
Gas Meter 2:	4.06	0.11
Sample Rate:	2.50	0.07
20X20 Sample Rate:	12.85	0.36
47 mm Sample Rate:	52.02	1.47
Chemistry Sample Rate:	0.130	0.058
Total Flow Rate:	2,262.88	64.14

Particulate Data

Filter Number:	1422.0-325 (pair)	
Weight Gain:	3.538	mg
Sample Multiplier:	0.906	

Correction Factors

NOx Humidity CF:	0.999
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	37.97

Test Cycle Data

Sample Time:	947.50	sec		
Work:	9.93	hp-hr	7.40	kW-hr
Reference Work:	9.73	hp-hr	7.26	kW-hr
Total Volume (Vmix):	35,732.6	scf	1,011.97	scm

Brake-Specific Emission Results

BSHC (Cell)	0.623	g/hp-hr	0.835	g/kW-hr
CO	2.187	g/hp-hr	2.933	g/kW-hr
NOx (Cell)	8.638	g/hp-hr	11.583	g/kW-hr
Particulate	0.323	g/hp-hr	0.433	g/kW-hr
CO2	581.8	g/hp-hr	780.18	g/kW-hr
BSFC	0.407	lb/hp-hr	0.247	kg/kW-hr
NMHC	0.541	g/hp-hr	0.726	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DBHL1	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/24/2002 Time: 11:59	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

	Sample	Background
Formaldehyde		
Concentration	0.278 ppm	0.002 ppm
Mass	343.12 mg	
Acetaldehyde		
Concentration	0.067 ppm	0.001 ppm
Mass	121.49 mg	
Acrolein		
Concentration	0.029 ppm	0.000 ppm
Mass	67.44 mg	
Acetone		
Concentration	0.026 ppm	0.000 ppm
Mass	63.52 mg	
Propionaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Crotonaldehyde		
Concentration	0.013 ppm	0.000 ppm
Mass	37.42 mg	
Isobutyr + MEK		
Concentration	0.008 ppm	0.001 ppm
Mass	22.28 mg	
Benzaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	1.41 mg	

Brake-Specific Results

Formaldehyde	34.554 mg/hp-hr	Crotonaldehyde	3.768 mg/hp-hr
Acetaldehyde	12.235 mg/hp-hr	Isobutyr + MEK	2.243 mg/hp-hr
Acrolein	6.791 mg/hp-hr	Benzaldehyde	0.000 mg/hp-hr
Acetone	6.397 mg/hp-hr	Hexanaldehyde	0.142 mg/hp-hr
Propionaldehyde	0.000 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRFTP1	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/28/2002 Time: 09:33	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	54.5	°F	12.5 °C
Abs. Humidity:	65.3	gr/lb	9.3 g/kg
Rel. Humidity:	51	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.5	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		20.41	ppm	
HC Bckgrd	n/a		8.60	ppm	
CO	13.4	2	12.77	ppm	(Dry)
CO Bckgrd	0.5	2	0.47	ppm	
NOx Sample	n/a		52.54	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	44.8	1	0.3288	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	
CH4 Sample	n/a	n/a	2.07	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.12	ppm	

Corrected Concentrations

HC	12.02	ppm
CO	12.06	ppm
NOx	51.44	ppm
CO2	0.2854	%
CH4	0.00	ppm (1.00)

Mass Emissions

HC	8.779	grams
CO	17.859	grams
NOx	122.007	grams
Particulate	3.832	grams
CO2	6.638	kg
CH4	0.000	grams
Fuel	4.64 lb	2.10 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,167.7	61.39
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.60	0.05
Gas Meter 2:	4.12	0.12
Sample Rate:	2.52	0.07
20X20 Sample Rate:	13.18	0.37
47 mm Sample Rate:	50.33	1.43
Chemistry Sample Rate:	0.133	0.076
Total Flow Rate:	2,233.84	63.34

Particulate Data

Filter Number:	2031.0-414 (pair)	
Weight Gain:	4.319	mg
Sample Multiplier:	0.887	

Correction Factors

NOx Humidity CF:	0.975
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	40.99

Test Cycle Data

Sample Time:	1,206.00	sec		
Work:	11.81	hp-hr	8.81	kW-hr
Reference Work:	11.53	hp-hr	8.60	kW-hr
Total Volume (Vmix):	44,897.6	scf	1,271.53	scm

Brake-Specific Emission Results

BSHC (Cell)	0.743	g/hp-hr	0.997	g/kW-hr
CO	1.512	g/hp-hr	2.028	g/kW-hr
NOx (Cell)	10.331	g/hp-hr	13.854	g/kW-hr
Particulate	0.325	g/hp-hr	0.435	g/kW-hr
CO2	562.1	g/hp-hr	753.80	g/kW-hr
BSFC	0.393	lb/hp-hr	0.239	kg/kW-hr
NMHC	0.646	g/hp-hr	0.866	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRFTP1	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/28/2002 Time: 09:33	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40

	Sample	Background
Formaldehyde		
Concentration	0.327 ppm	0.004 ppm
Mass	503.02 mg	
Acetaldehyde		
Concentration	0.084 ppm	0.002 ppm
Mass	187.20 mg	
Acrolein		
Concentration	0.019 ppm	0.000 ppm
Mass	54.57 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.018 ppm	0.000 ppm
Mass	55.67 mg	
Crotonaldehyde		
Concentration	0.021 ppm	0.000 ppm
Mass	77.77 mg	
Isobutyr + MEK		
Concentration	0.012 ppm	0.001 ppm
Mass	43.42 mg	
Benzaldehyde		
Concentration	0.003 ppm	0.000 ppm
Mass	13.93 mg	
Hexanaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	6.72 mg	

Brake-Specific Results

Formaldehyde	42.593 mg/hp-hr	Crotonaldehyde	6.585 mg/hp-hr
Acetaldehyde	15.851 mg/hp-hr	Isobutyr + MEK	3.677 mg/hp-hr
Acrolein	4.621 mg/hp-hr	Benzaldehyde	1.179 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.569 mg/hp-hr
Propionaldehyde	4.713 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 6.8 L (413 CID) 6
Engine Cycle: Diesel
Engine S/N: 553496

Test No.: J2NRFTP2
Date: 06/28/2002 Time: 10:12
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1

DIESEL 2D, NR=EM2831F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.09	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	54.2	°F	12.3 °C
Abs. Humidity:	64.5	gr/lb	9.2 g/kg
Rel. Humidity:	47	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.5	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		21.23	ppm	
HC Bckgrd	n/a		3.05	ppm	
CO	12.5	2	11.90	ppm	(Dry)
CO Bckgrd	0.5	2	0.47	ppm	
NOx Sample	n/a		51.42	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	44.7	1	0.3279	%	(Wet)
CO2 Bckgrd	7.4	1	0.0471	%	
CH4 Sample	n/a	n/a	2.06	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.10	ppm	

Corrected Concentrations

HC	18.25	ppm
CO	11.21	ppm
NOx	50.28	ppm
CO2	0.2819	%
CH4	0.02	ppm (1.00)

Mass Emissions

HC	13.330	grams
CO	16.593	grams
NOx	118.989	grams
Particulate	3.760	grams
CO2	6.557	kg
CH4	0.015	grams
Fuel	4.59 lb	2.08 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,168.1	61.40
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.60	0.05
Gas Meter 2:	4.09	0.12
Sample Rate:	2.48	0.07
20X20 Sample Rate:	12.94	0.37
47 mm Sample Rate:	49.89	1.41
Chemistry Sample Rate:	0.134	0.076
Total Flow Rate:	2,233.55	63.33

Particulate Data

Filter Number:	2032.0-415 (pair)	
Weight Gain:	4.183	mg
Sample Multiplier:	0.899	

Correction Factors

NOx Humidity CF:	0.973
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	41.10

Test Cycle Data

Sample Time:	1,205.90	sec		
Work:	11.81	hp-hr	8.81	kW-hr
Reference Work:	11.53	hp-hr	8.60	kW-hr
Total Volume (Vmix):	44,888.0	scf	1,271.25	scm

Brake-Specific Emission Results

BSHC (Cell)	1.129	g/hp-hr	1.514	g/kW-hr
CO	1.405	g/hp-hr	1.884	g/kW-hr
NOx (Cell)	10.075	g/hp-hr	13.511	g/kW-hr
Particulate	0.318	g/hp-hr	0.427	g/kW-hr
CO2	555.2	g/hp-hr	744.55	g/kW-hr
BSFC	0.389	lb/hp-hr	0.236	kg/kW-hr
NMHC	0.981	g/hp-hr	1.315	g/kW-hr
CH4	0.001	g/hp-hr	0.002	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 6.8 L (413 CID) 6
Engine Cycle: Diesel
Engine S/N: 553496

Test No.: J2NRFTP2
Date: 06/28/2002 Time: 10:12
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1

DIESEL 2D, NR=EM2831F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

	Sample		Background	
Formaldehyde				
Concentration	0.344	ppm	0.004	ppm
Mass	529.00	mg		
Acetaldehyde				
Concentration	0.087	ppm	0.002	ppm
Mass	194.21	mg		
Acrolein				
Concentration	0.020	ppm	0.000	ppm
Mass	56.98	mg		
Acetone				
Concentration	0.010	ppm	0.000	ppm
Mass	29.12	mg		
Propionaldehyde				
Concentration	0.023	ppm	0.000	ppm
Mass	69.71	mg		
Crotonaldehyde				
Concentration	0.022	ppm	0.000	ppm
Mass	78.21	mg		
Isobutyr + MEK				
Concentration	0.013	ppm	0.001	ppm
Mass	46.26	mg		
Benzaldehyde				
Concentration	0.002	ppm	0.000	ppm
Mass	13.35	mg		
Hexanaldehyde				
Concentration	0.001	ppm	0.000	ppm
Mass	7.44	mg		

Brake-Specific Results

Formaldehyde	44.793	mg/hp-hr	Crotonaldehyde	6.623	mg/hp-hr
Acetaldehyde	16.444	mg/hp-hr	Isobutyr + MEK	3.917	mg/hp-hr
Acrolein	4.825	mg/hp-hr	Benzaldehyde	1.131	mg/hp-hr
Acetone	2.466	mg/hp-hr	Hexanaldehyde	0.630	mg/hp-hr
Propionaldehyde	5.903	mg/hp-hr			

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.:	J2NRBHL1	DIESEL 2D, NR=EM2831F	
Engine Desc.:	6.8 L (413 CID) 6	Date:	06/28/2002 Time: 11:23	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	553496	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	29.06	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	58.8	°F	14.9 °C
Abs. Humidity:	76.5	gr/lb	10.9 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.6	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		19.52	ppm	
HC Bckgrd	n/a		10.00	ppm	
CO	20.7	2	19.87	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		47.02	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	48.9	1	0.3670	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	
CH4 Sample	n/a	n/a	2.16	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.04	ppm	

Corrected Concentrations

HC	9.79	ppm	
CO	19.19	ppm	
NOx	45.99	ppm	
CO2	0.3219	%	
CH4	0.18	ppm	(1.00)

Mass Emissions

HC	5.625	grams	
CO	22.345	grams	
NOx	88.297	grams	
Particulate	3.974	grams	
CO2	5.888	kg	
CH4	0.119	grams	
Fuel	4.11 lb	1.87 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,172.8	61.54
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.60	0.05
Gas Meter 2:	4.01	0.11
Sample Rate:	2.41	0.07
20X20 Sample Rate:	12.48	0.35
47 mm Sample Rate:	49.98	1.42
Chemistry Sample Rate:	0.135	0.060
Total Flow Rate:	2,237.86	63.43

Particulate Data

Filter Number:	2033.0-416 (pair)	
Weight Gain:	4.287	mg
Sample Multiplier:	0.927	

Correction Factors

NOx Humidity CF:	1.004
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	36.70

Test Cycle Data

Sample Time:	946.80	sec		
Work:	10.14	hp-hr	7.56	kW-hr
Reference Work:	9.91	hp-hr	7.39	kW-hr
Total Volume (Vmix):	35,311.3	scf	1,000.04	scm

Brake-Specific Emission Results

BSHC (Cell)	0.555	g/hp-hr	0.744	g/kW-hr
CO	2.204	g/hp-hr	2.955	g/kW-hr
NOx (Cell)	8.708	g/hp-hr	11.677	g/kW-hr
Particulate	0.392	g/hp-hr	0.526	g/kW-hr
CO2	580.7	g/hp-hr	778.75	g/kW-hr
BSFC	0.406	lb/hp-hr	0.247	kg/kW-hr
NMHC	0.482	g/hp-hr	0.646	g/kW-hr
CH4	0.012	g/hp-hr	0.016	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 6.8 L (413 CID) 6
Engine Cycle: Diesel
Engine S/N: 553496

Test No.: J2NRBHL1
Date: 06/28/2002 Time: 11:23
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1

DIESEL 2D, NR=EM2831F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

	Sample	Background
Formaldehyde		
Concentration	0.298 ppm	0.004 ppm
Mass	359.65 mg	
Acetaldehyde		
Concentration	0.069 ppm	0.002 ppm
Mass	120.74 mg	
Acrolein		
Concentration	0.015 ppm	0.000 ppm
Mass	33.62 mg	
Acetone		
Concentration	0.034 ppm	0.000 ppm
Mass	79.90 mg	
Propionaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Crotonaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Isobutyr + MEK		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Benzaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	

Brake-Specific Results

Formaldehyde	35.469 mg/hp-hr	Crotonaldehyde	0.000 mg/hp-hr
Acetaldehyde	11.907 mg/hp-hr	Isobutyr + MEK	0.000 mg/hp-hr
Acrolein	3.316 mg/hp-hr	Benzaldehyde	0.000 mg/hp-hr
Acetone	7.880 mg/hp-hr	Hexanaldehyde	0.000 mg/hp-hr
Propionaldehyde	0.000 mg/hp-hr		

APPENDIX B

GRAPHICAL SUMMARIES OF TRANSIENT CYCLE REGRESSION STATISTICS FOR FTP, BHL, AND SAT TESTING ON A DEERE 6068T USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
J02DFTP1	FTP	2D	Without	Transient Cycle Regression Summary	B-1
J02DFTP2	FTP	2D	Without	Transient Cycle Regression Summary	B-2
J02DBHL1	BHL	2D	Without	Transient Cycle Regression Summary	B-3
J02DBHL2	BHL	2D	Without	Transient Cycle Regression Summary	B-4
J02DSAT1	SAT	2D	Without	Transient Cycle Regression Summary	B-5
J02DSAT2	SAT	2D	Without	Transient Cycle Regression Summary	B-6
J12DFTP1	FTP	2D	Yes	Transient Cycle Regression Summary	B-7
J12DFTP2	FTP	2D	Yes	Transient Cycle Regression Summary	B-8
J12DBHL1	BHL	2D	Yes	Transient Cycle Regression Summary	B-9
J2NRFTP1	FTP	NR	Yes	Transient Cycle Regression Summary	B-10
J2NRFTP2	FTP	NR	Yes	Transient Cycle Regression Summary	B-11
J2NRBHL1	BHL	NR	Yes	Transient Cycle Regression Summary	B-12

HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/9/02
Time: 1:08 PM
Engine ID. DEERE 6068
TO6068T553496

Test No.
J02DFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 92

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

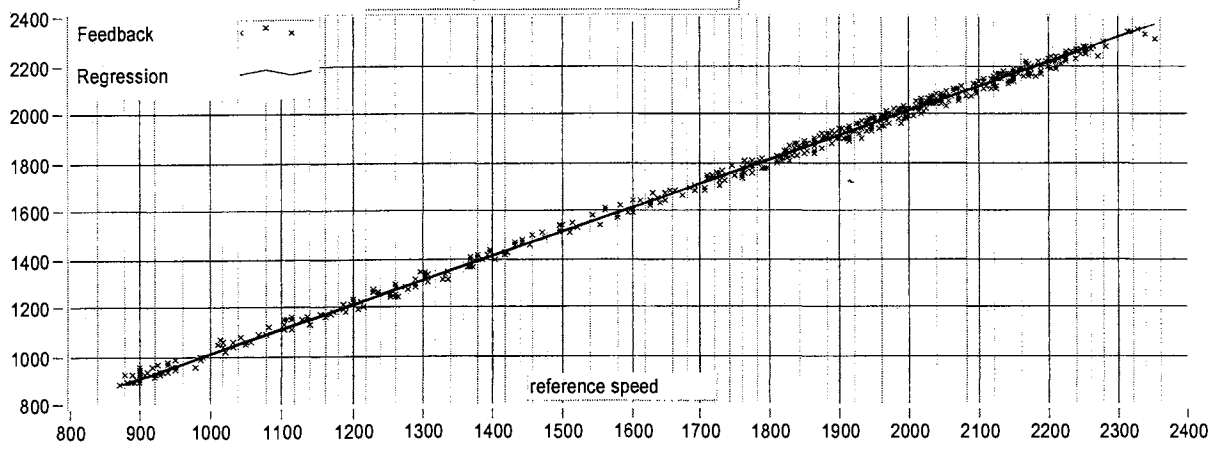
STATS PASS

TIME DELAY [sec]	0.41
CYCLE WORK [HP-HR]	11.60
REFERENCE WORK [HP-HR]	11.32
PERCENT DIFFERENCE	2.46

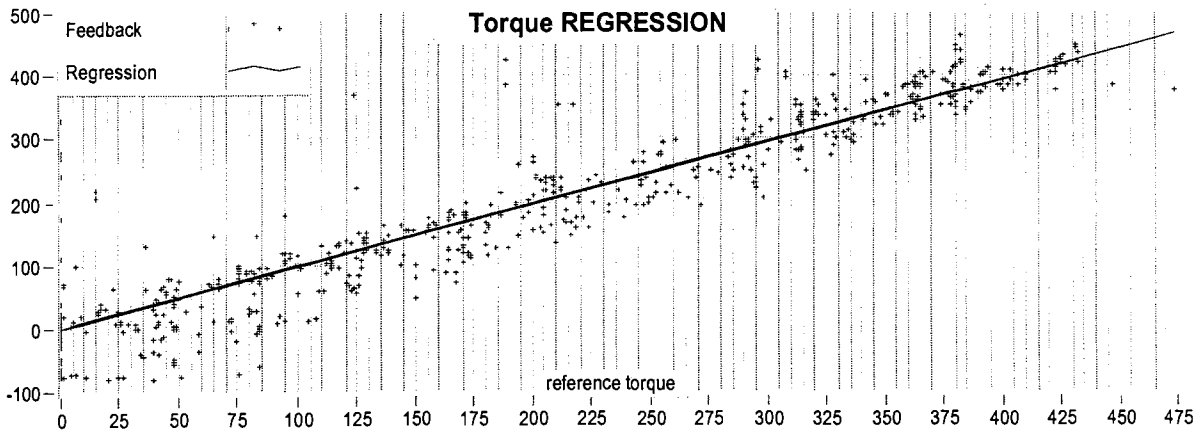
WORK PASS

	SPEED	TORQUE	POWER
SE	15	8	7
M	1.006	0.99	1.00
R2	0.9992	0.9197	0.9497
B	1	-1	-0.9
NO. PTS.	1174	1009	1009

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/9/02
Time: 1:49 PM
Engine ID. DEERE 6068
TO6068T553496

Test No.
J02DFTP2/NO
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 93

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

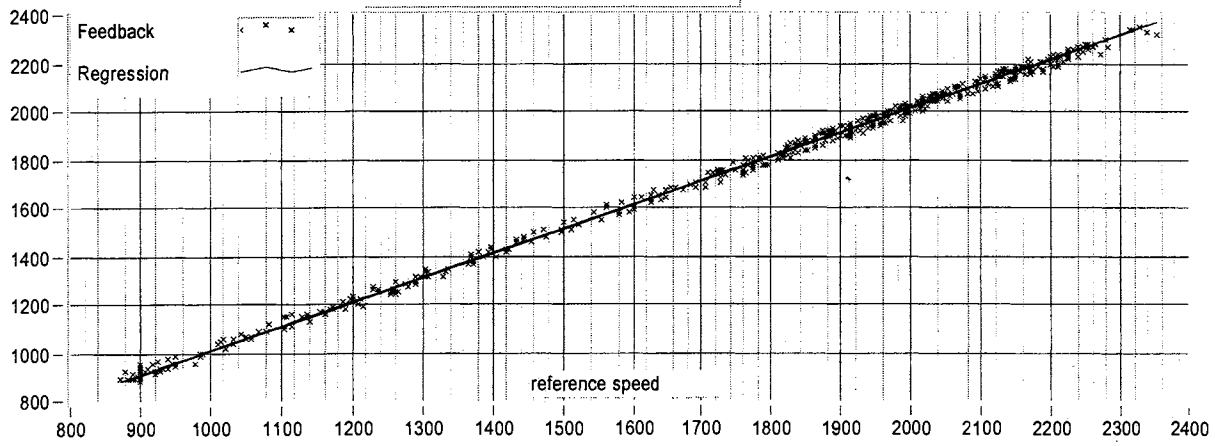
STATS PASS

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	11.61
REFERENCE WORK [HP-HR]	11.32
PERCENT DIFFERENCE	2.53

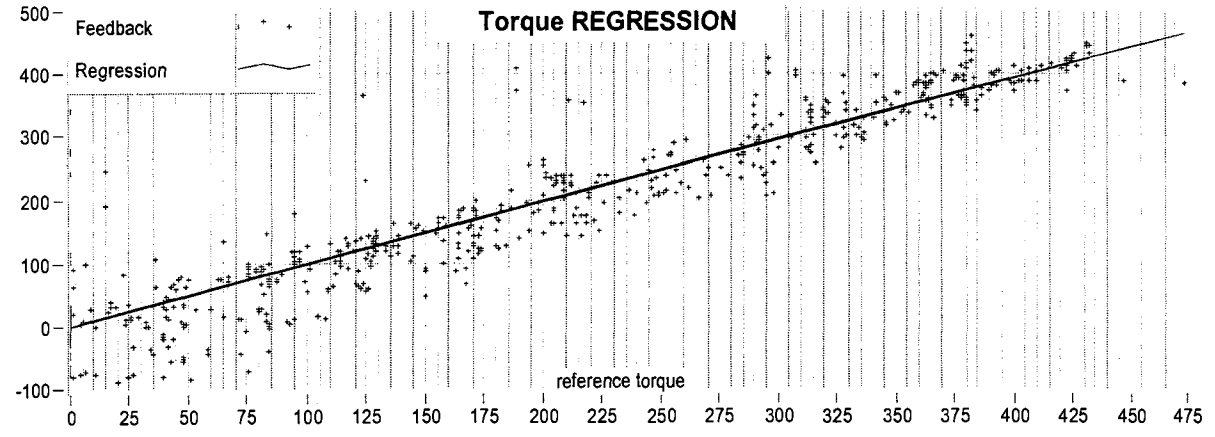
WORK PASS

	SPEED	TORQUE	POWER
SE	15	8	7
M	1.007	0.98	1.00
R2	0.9992	0.9214	0.9506
B	-1	-0	-0.8
NO. PTS.	1174	1012	1012

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/9/02
Time: 2:49 PM
Engine ID. DEERE 6068
TO6068T553496

Test No. J02DBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 95

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

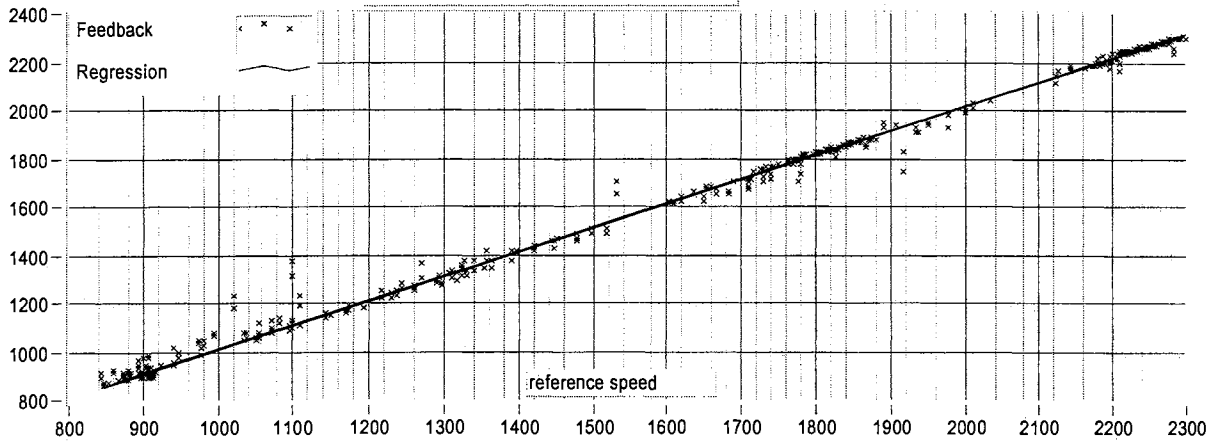
STATS FAIL

WORK PASS

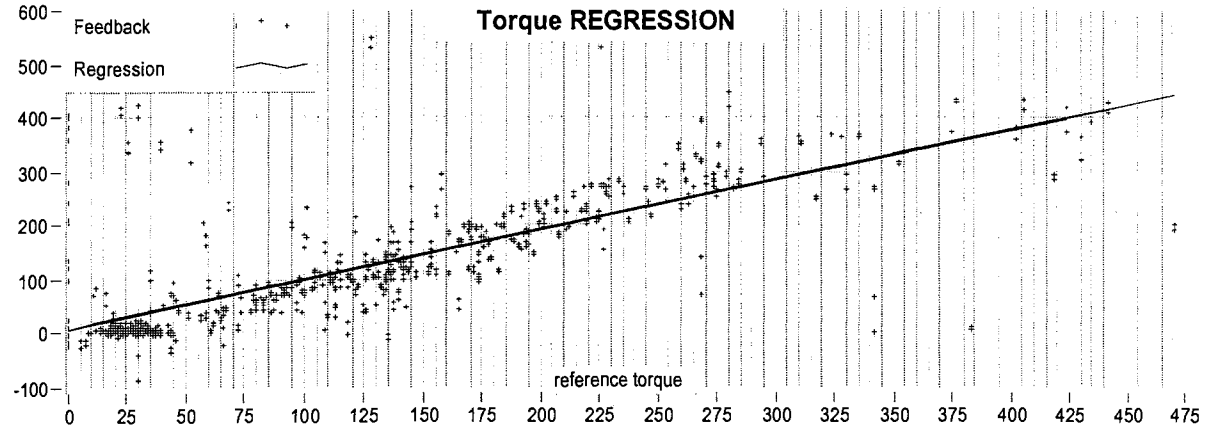
TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	9.87
REFERENCE WORK [HP-HR]	9.73
PERCENT DIFFERENCE	1.48

	SPEED	TORQUE	POWER
SE	24	16	13
M	1.007	0.92	0.99
R2	0.9982	0.5756	0.7426
B	0	8	0.9
NO. PTS.	915	930	930

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/10/02
Time: 9:29 AM
Engine ID. DEERE 6068
TO6068T553496

Test No. J02DBHL2/NO
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 98

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

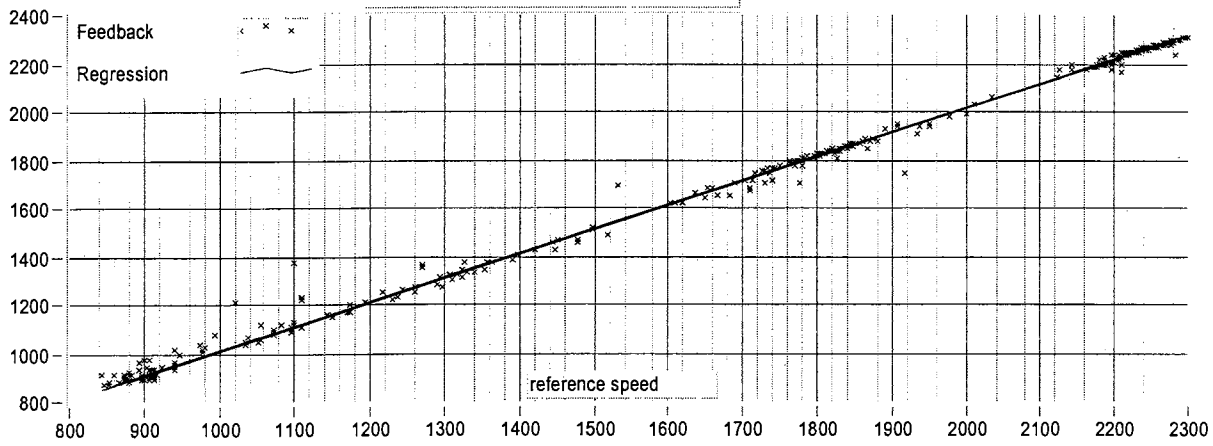
STATS FAIL

WORK PASS

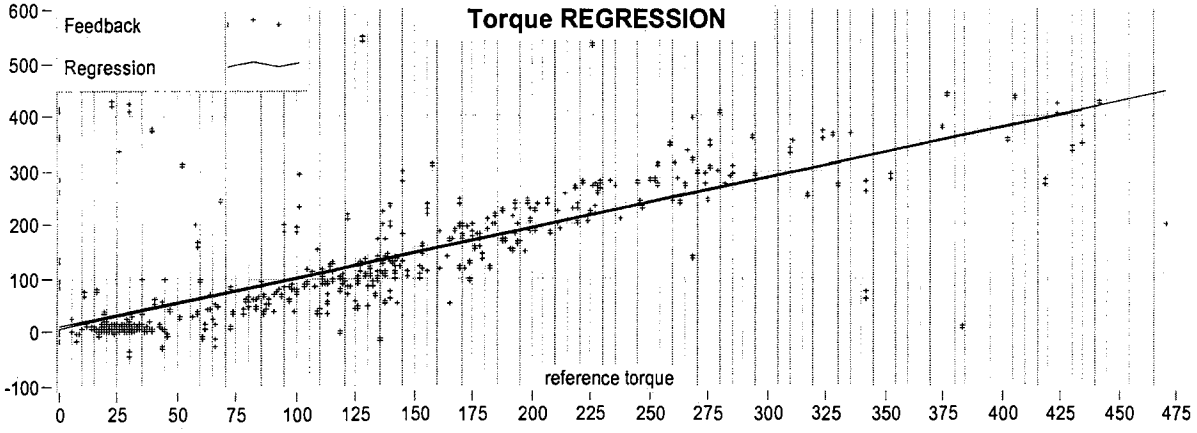
TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	9.96
REFERENCE WORK [HP-HR]	9.73
PERCENT DIFFERENCE	2.40

	SPEED	TORQUE	POWER
SE	26	16	13
M	1.007	0.93	0.99
R2	0.9979	0.5785	0.7417
B	1	9	1.1
NO. PTS.	915	932	932

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/10/02
Time: 1:08 PM
Engine ID. DEERE 6068
TO6068T553496

Test No. J02DSAT1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 102

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

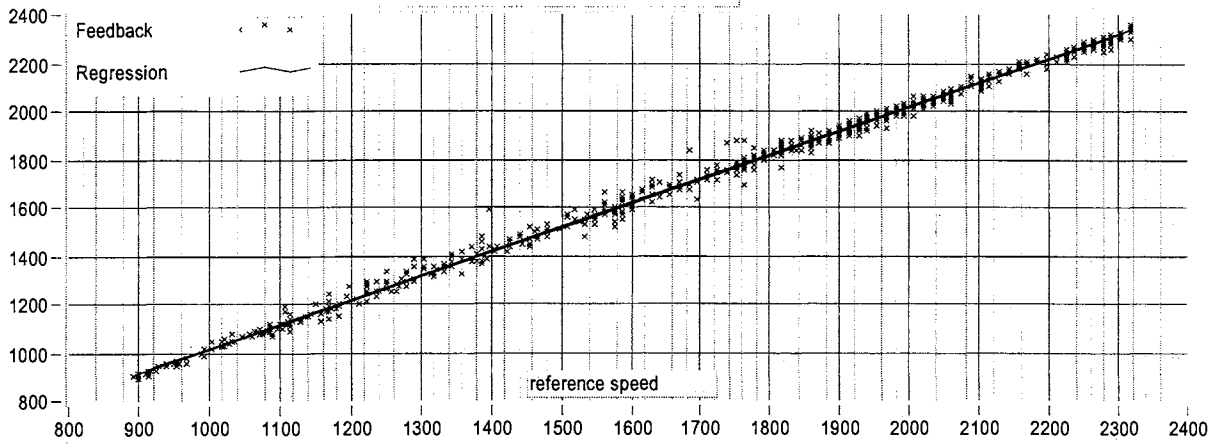
STATS FAIL

WORK PASS

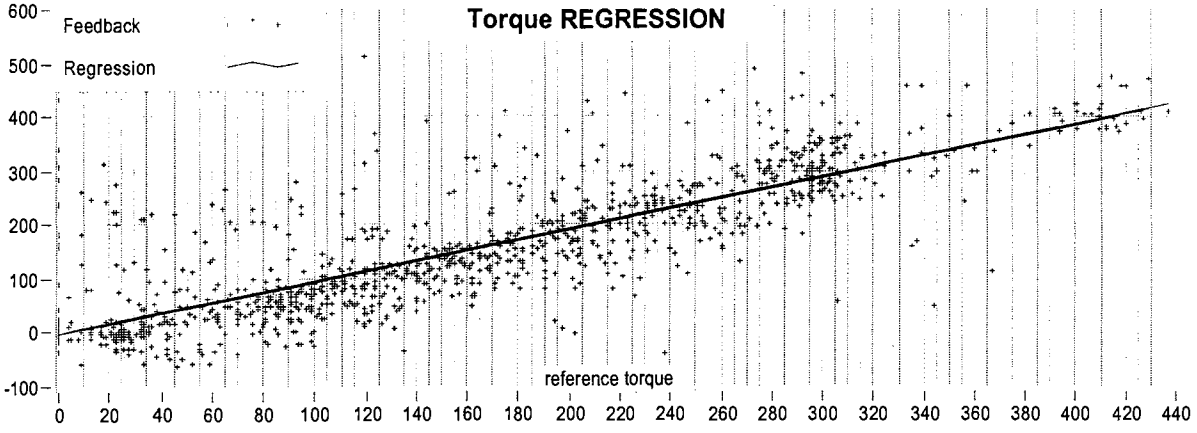
	SPEED	TORQUE	POWER
SE	20	14	14
M	1.003	0.97	1.01
R2	0.9974	0.6898	0.7545
B	11	-3	-2.4
NO. PTS.	1213	1223	1223

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	19.46
REFERENCE WORK [HP-HR]	20.00
PERCENT DIFFERENCE	-2.67

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/10/02
Time: 1:49 PM
Engine ID. DEERE 6068
TO6068T553496

Test No. J02DSAT2/NO
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 103

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

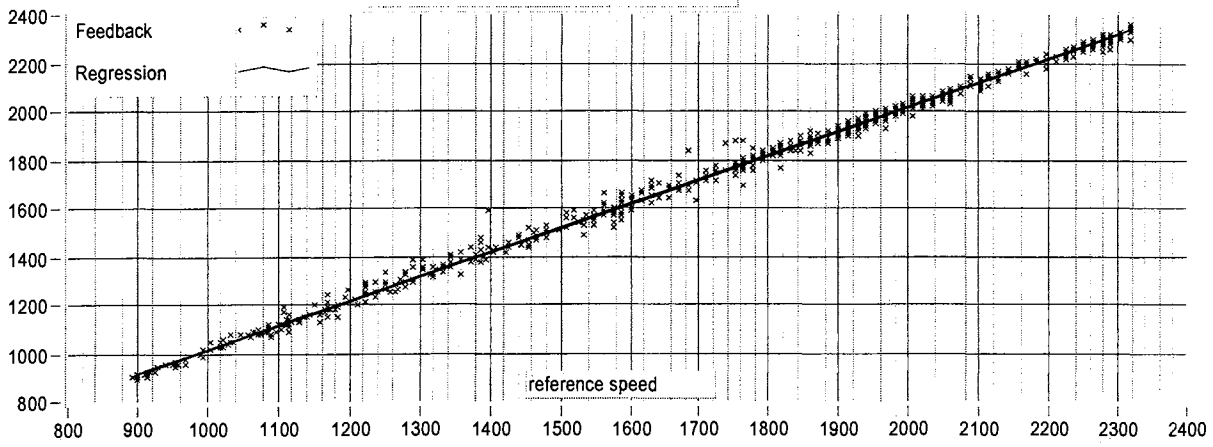
STATS FAIL

WORK PASS

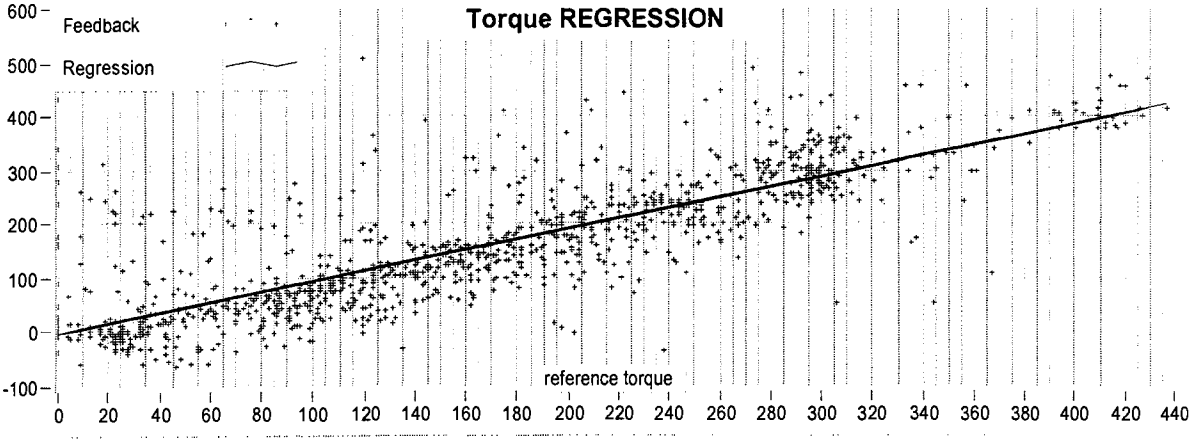
	SPEED	TORQUE	POWER
SE	20	14	14
M	1.003	0.97	1.01
R2	0.9974	0.6914	0.7560
B	11	-4	-2.7
NO. PTS.	1213	1224	1224

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	19.43
REFERENCE WORK [HP-HR]	20.00
PERCENT DIFFERENCE	-2.84

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/24/02
Time: 9:49 AM
Engine ID. DEERE 6068
TO6068T553496

Test No. J12DFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 69

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

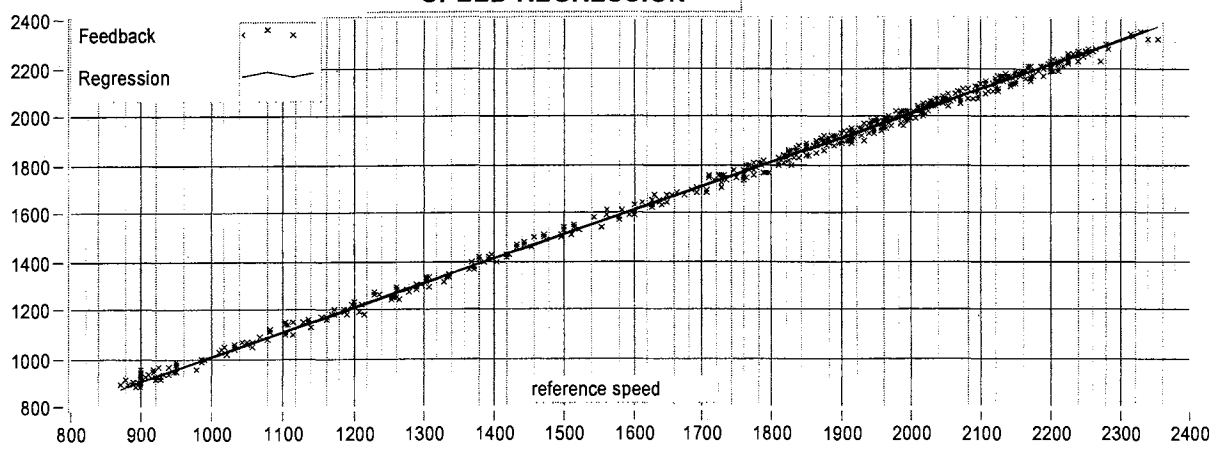
STATS PASS

WORK PASS

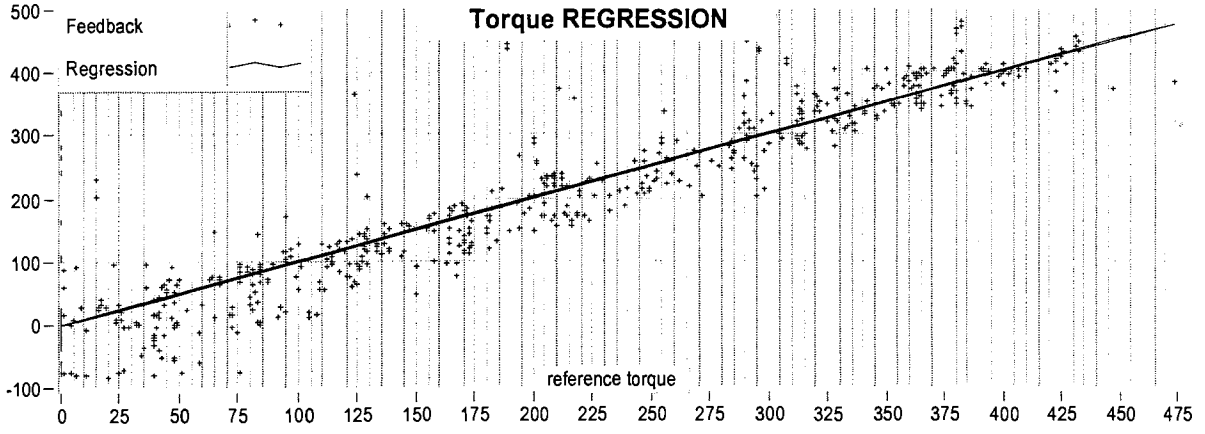
	SPEED	TORQUE	POWER
SE	16	9	7
M	1.007	1.01	1.02
R2	0.9992	0.9170	0.9489
B	-2	-2	-1.2
NO. PTS.	1174	1002	1002

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	11.78
REFERENCE WORK [HP-HR]	11.32
PERCENT DIFFERENCE	4.09

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/24/02
Time: 10:33 AM
Engine ID. DEERE 6068
TO6068T553496

Test No. J12DFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 70

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

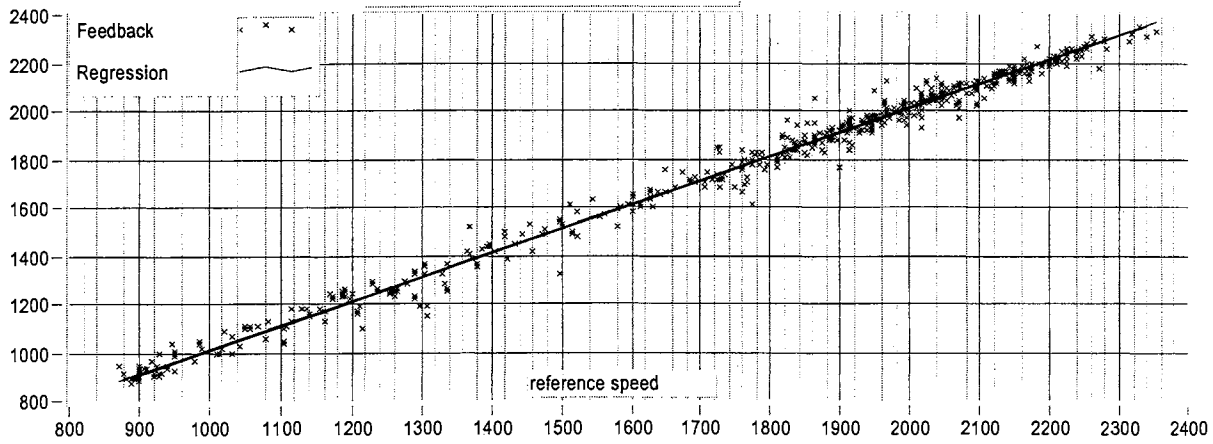
STATS FAIL

WORK PASS

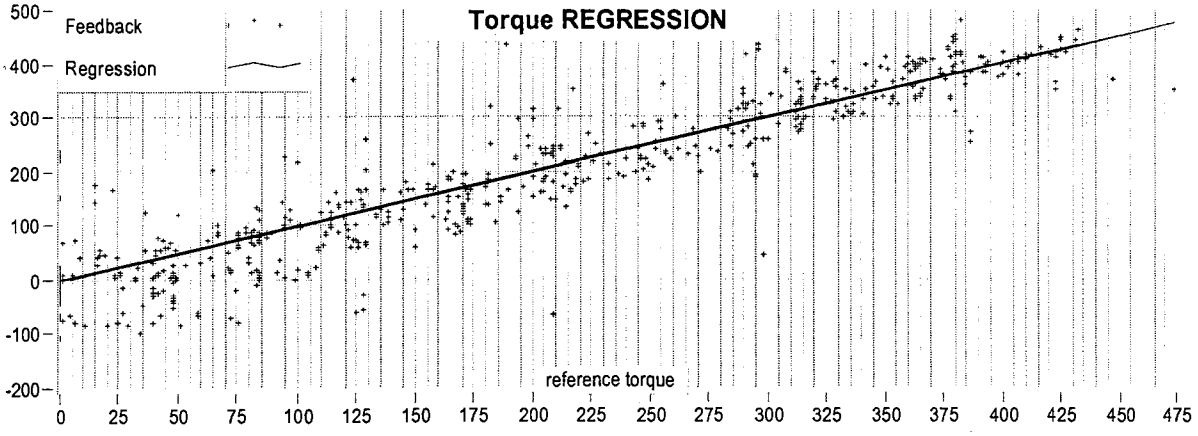
	SPEED	TORQUE	POWER
SE	30	10	9
M	1.003	1.01	1.01
R2	0.9970	0.8993	0.9236
B	4	-3	-1.2
NO. PTS.	1174	1008	1008

TIME DELAY [sec]	0.60
CYCLE WORK [HP-HR]	11.79
REFERENCE WORK [HP-HR]	11.32
PERCENT DIFFERENCE	4.14

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/24/02
Time: 11:41 AM
Engine ID. DEERE 6068
TO6068T553496

Test No. j12dbhl1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 73

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

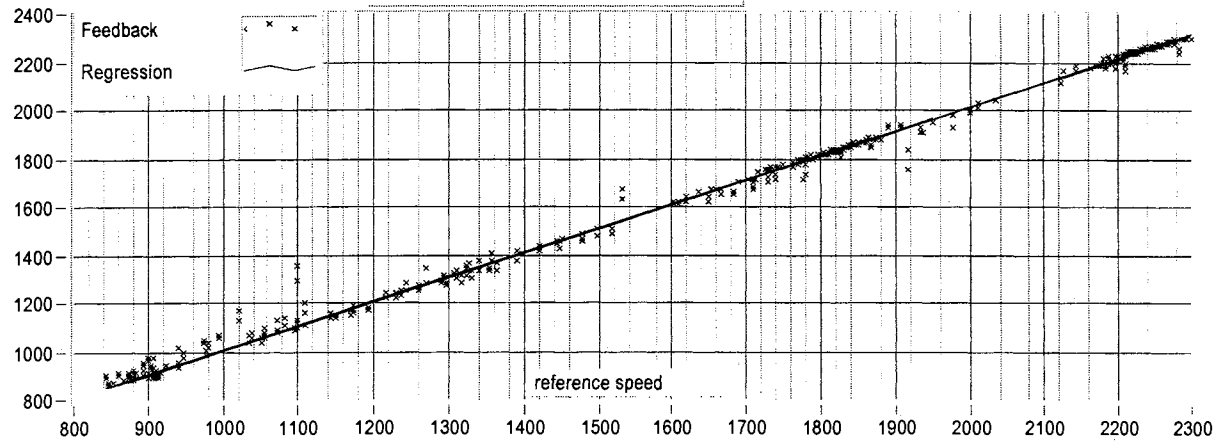
STATS FAIL

WORK PASS

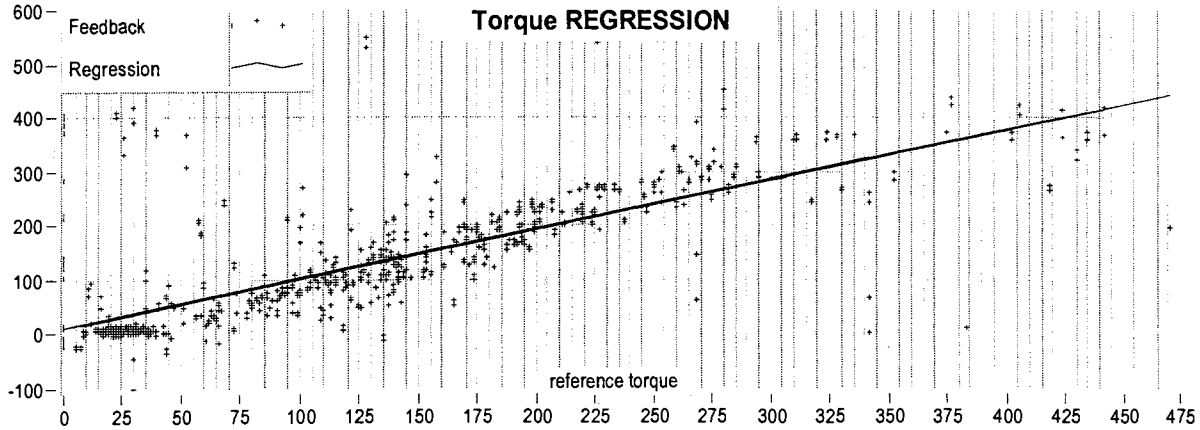
	SPEED	TORQUE	POWER
SE	22	16	13
M	1.008	0.92	0.99
R2	0.9985	0.5716	0.7439
B	-4	10	1.1
NO. PTS.	915	935	935

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	9.93
REFERENCE WORK [HP-HR]	9.73
PERCENT DIFFERENCE	2.12

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/28/02
Time: 9:10 AM
Engine ID. DEERE 6068
TO6068T553496

Test No. J2NRFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 84

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

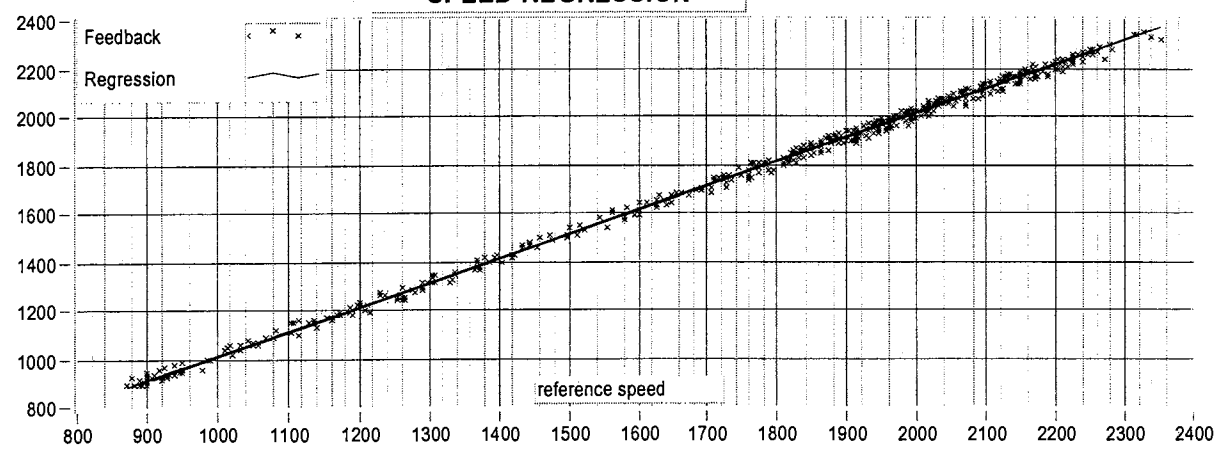
STATS PASS

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	11.81
REFERENCE WORK [HP-HR]	11.53
PERCENT DIFFERENCE	2.39

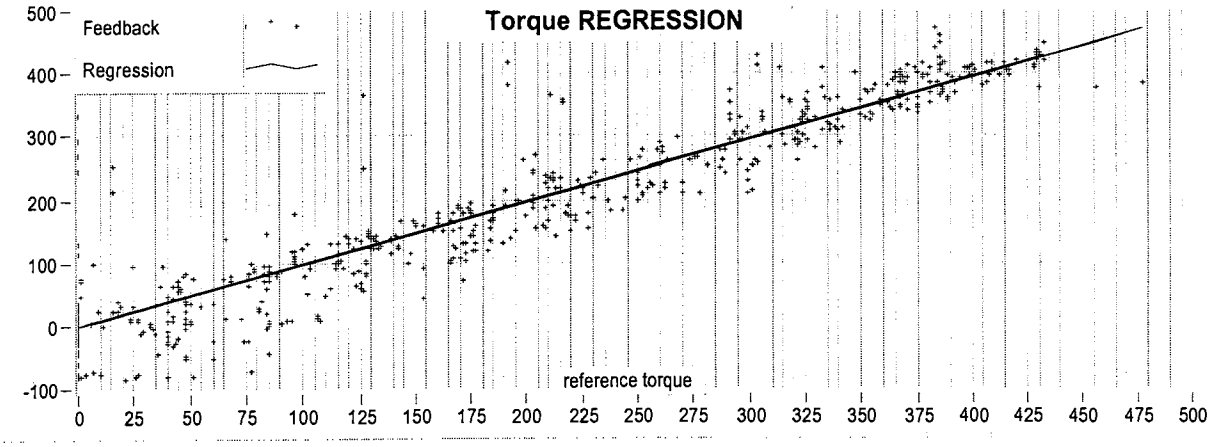
WORK PASS

	SPEED	TORQUE	POWER
SE	15	8	7
M	1.006	0.99	1.00
R2	0.9992	0.9203	0.9494
B	3	-2	-1.1
NO. PTS.	1174	1003	1003

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/28/02
Time: 9:52 AM
Engine ID. DEERE 6068
TO6068T553496

Test No.
J1NRFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 85

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

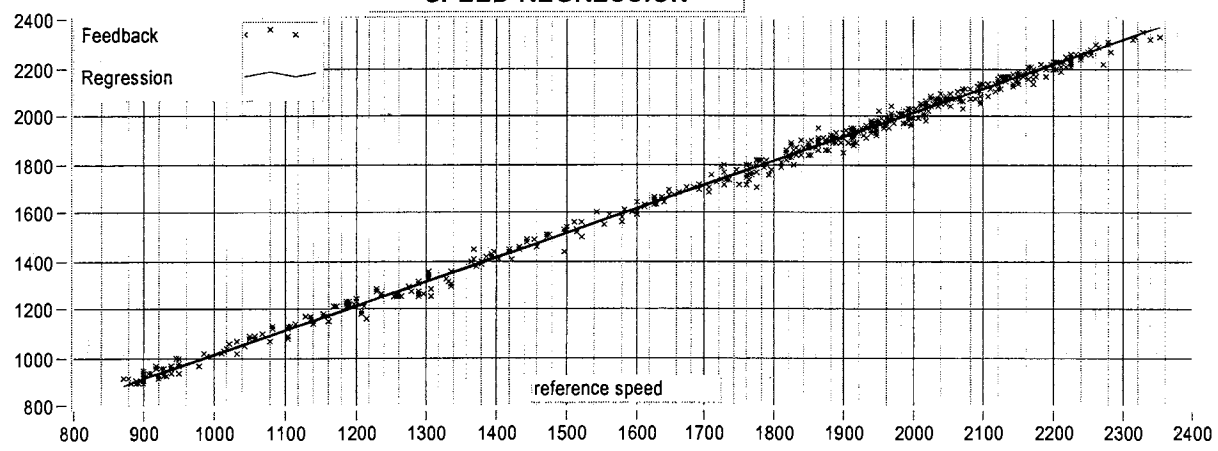
STATS PASS

WORK PASS

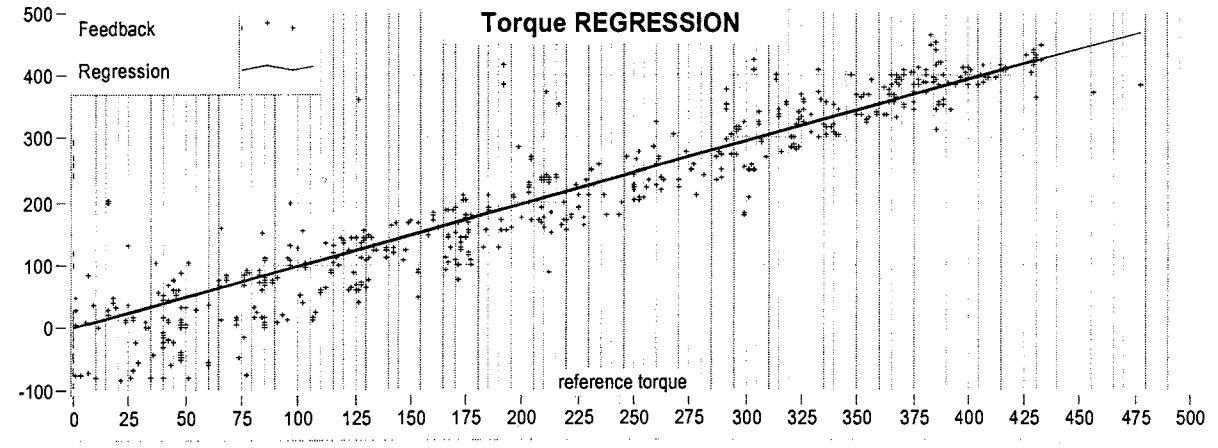
	SPEED	TORQUE	POWER
SE	18	9	7
M	1.004	0.99	1.00
R2	0.9989	0.9197	0.9433
B	6	-2	-1.2
NO. PTS.	1174	1001	1001

TIME DELAY [sec]	0.60
CYCLE WORK [HP-HR]	11.81
REFERENCE WORK [HP-HR]	11.53
PERCENT DIFFERENCE	2.39

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/28/02
Time: 11:01 AM
Engine ID. DEERE 6068
TO6068T553496

Test No.
J2NRBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 87

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

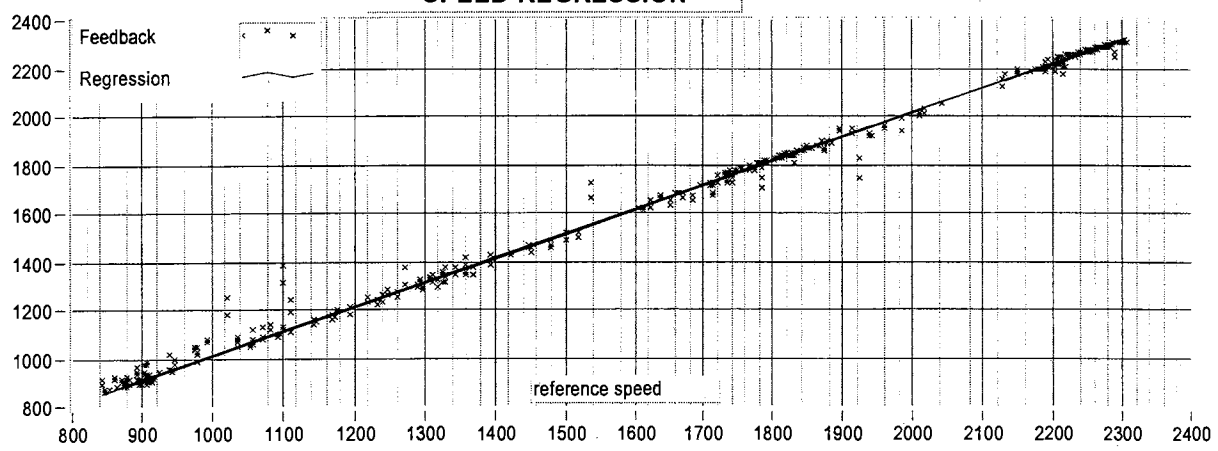
STATS FAIL

WORK PASS

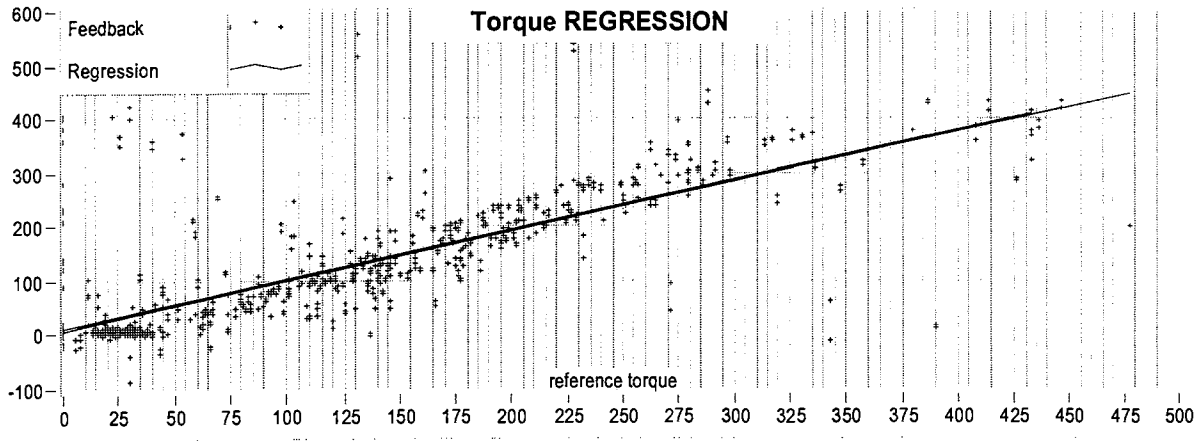
TIME DELAY [sec]	0.42
CYCLE WORK [HP-HR]	10.14
REFERENCE WORK [HP-HR]	9.91
PERCENT DIFFERENCE	2.28

	SPEED	TORQUE	POWER
SE	24	16	13
M	1.008	0.92	1.00
R2	0.9981	0.5818	0.7491
B	1	9	0.9
NO. PTS.	915	932	932

SPEED REGRESSION



Torque REGRESSION



APPENDIX C

DETAILED COMPUTER PRINTOUTS FOR TRANSIENT EMISSION TESTS ON A CUMMINS M11C ENGINE OVER FTP, BHL, AND SAT CYCLES USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
M02DXFTP1	FTP	2D	Without	Transient Cycle Emissions Summary	C-1
M02DXFTP2	FTP	2D	Without	Transient Cycle Emissions Summary	C-2
M42DBHL1	BHL	2D	Without	Transient Cycle Emissions Summary	C-3
M42DBHL2	BHL	2D	Without	Transient Cycle Emissions Summary	C-4
M02DXSAT1	SAT	2D	Without	Transient Cycle Emissions Summary	C-5
M02DXSAT2	SAT	2D	Without	Transient Cycle Emissions Summary	C-6
M12DFTP3	FTP	2D	Yes	Transient Cycle Emissions Summary	C-7
M12DFTP4	FTP	2D	Yes	Transient Cycle Emissions Summary	C-9
M12DBHL1	BHL	2D	Yes	Transient Cycle Emissions Summary	C-11
M2NRFTP1	FTP	NR	Yes	Transient Cycle Emissions Summary	C-13
M2NRFTP2	FTP	NR	Yes	Transient Cycle Emissions Summary	C-15
M2NRBHL1	BHL	NR	Yes	Transient Cycle Emissions Summary	C-17

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M02DXFTP1	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	05/31/2002 Time: 09:41	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	28.99	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	56.7	°F	13.7 °C
Abs. Humidity:	71.0	gr/lb	10.1 g/kg
Rel. Humidity:	51	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	79.1	gr/lb	11.3 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		19.13	ppm	
HC Bckgrd	n/a		4.60	ppm	
CO	28.7	2	27.72	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		42.14	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	51.3	1	0.3903	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	

Corrected Concentrations

HC	14.66	ppm
CO	26.73	ppm
NOx	41.14	ppm
CO2	0.3478	%

Mass Emissions

HC	14.358	grams	
CO	53.041	grams	
NOx	132.741	grams	
Particulate	6.433	grams	
CO2	10.845	kg	
Fuel	7.60 lb	3.45	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,992.3	84.74
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.12	0.06
Gas Meter 2:	4.00	0.11
Sample Rate:	1.88	0.05
Total Flow Rate:	2,994.22	84.80

Particulate Data

Filter Number:	8796.0-177 (pair)	
Weight Gain:	4.049	mg
Sample Multiplier:	1.589	

Correction Factors

NOx Humidity CF:	0.990
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.982
Dilution Factor:	34.47

Test Cycle Data

Sample Time:	1,206.10	sec		
Work:	19.77	hp-hr	14.74	kW-hr
Reference Work:	19.34	hp-hr	14.42	kW-hr
Total Volume (Vmix):	60,188.8	scf	1,704.58	scm

Brake-Specific Emission Results

BSHC (Cell)	0.726	g/hp-hr	0.974	g/kW-hr
CO	2.683	g/hp-hr	3.598	g/kW-hr
NOx (Cell)	6.714	g/hp-hr	9.004	g/kW-hr
Particulate	0.325	g/hp-hr	0.436	g/kW-hr
CO2	548.5	g/hp-hr	735.62	g/kW-hr
BSFC	0.384	lb/hp-hr	0.234	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M02DXFTP2		DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date:	05/31/2002 Time: 10:21	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell:	16 Bag Cart: 1	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	28.99	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.4	°F	13.6 °C
Abs. Humidity:	70.2	gr/lb	10.0 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.8	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		19.30	ppm	
HC Bckgrd	n/a		5.80	ppm	
CO	27.2	2	26.25	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		41.94	ppm	(Dry)
NOx Bckgrd	1.5	1	0.38	ppm	
CO2 Sample	51.3	1	0.3903	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	

Corrected Concentrations

HC	13.67	ppm
CO	25.52	ppm
NOx	40.77	ppm
CO2	0.3484	%

Mass Emissions

HC	13.349	grams
CO	50.505	grams
NOx	130.942	grams
Particulate	6.686	grams
CO2	10.835	kg
Fuel	7.59 lb	3.44 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,984.6	84.52
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.12	0.06
Gas Meter 2:	4.07	0.12
Sample Rate:	1.96	0.06
Total Flow Rate:	2,986.53	84.58

Particulate Data

Filter Number:	8797.0-178 (pair)	
Weight Gain:	4.383	mg
Sample Multiplier:	1.525	

Correction Factors

NOx Humidity CF:	0.988
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	34.48

Test Cycle Data

Sample Time:	1,206.10	sec		
Work:	19.66	hp-hr	14.66	kW-hr
Reference Work:	19.34	hp-hr	14.42	kW-hr
Total Volume (Vmix):	60,034.1	scf	1,700.20	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.679 g/hp-hr	0.911	g/kW-hr
CO		2.569 g/hp-hr	3.445	g/kW-hr
NOx	(Cell)	6.660 g/hp-hr	8.932	g/kW-hr
Particulate		0.340 g/hp-hr	0.456	g/kW-hr
CO2		551.1 g/hp-hr	739.07	g/kW-hr
BSFC		0.386 lb/hp-hr	0.235	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M42DBHL1	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/13/2002 Time: 10:29	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.00	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	77.0	°F	25.0 °C
Dew Point:	57.8	°F	14.3 °C
Abs. Humidity:	73.9	gr/lb	10.6 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	79.1	gr/lb	11.3 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.33	ppm	
HC Bckgrd	n/a		4.40	ppm	
CO	30.6	2	29.60	ppm	(Dry)
CO Bckgrd	3.7	2	3.48	ppm	
NOx Sample	n/a		42.50	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	53.4	1	0.4112	%	(Wet)
CO2 Bckgrd	6.5	1	0.0413	%	

Corrected Concentrations

HC	13.06	ppm
CO	25.59	ppm
NOx	41.46	ppm
CO2	0.3712	%

Mass Emissions

HC	10.040	grams
CO	39.851	grams
NOx	105.774	grams
Particulate	6.193	grams
CO2	9.084	kg
Fuel	6.36 lb	2.88 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,990.1	84.68
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.05	0.06
Gas Meter 2:	4.11	0.12
Sample Rate:	2.07	0.06
Total Flow Rate:	2,992.13	84.74

Particulate Data

Filter Number:	1140.0-305 (pair)
Weight Gain:	4.280 mg
Sample Multiplier:	1.447

Correction Factors

NOx Humidity CF:	0.997
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.982
Dilution Factor:	32.73

Test Cycle Data

Sample Time:	947.30	sec		
Work:	16.02	hp-hr	11.95	kW-hr
Reference Work:	16.11	hp-hr	12.01	kW-hr
Total Volume (Vmix):	47,240.8	scf	1,337.89	scm

Brake-Specific Emission Results

BSHC (Cell)	0.627	g/hp-hr	0.840	g/kW-hr
CO	2.488	g/hp-hr	3.336	g/kW-hr
NOx (Cell)	6.603	g/hp-hr	8.854	g/kW-hr
Particulate	0.387	g/hp-hr	0.518	g/kW-hr
CO2	567.1	g/hp-hr	760.44	g/kW-hr
BSFC	0.397	lb/hp-hr	0.241	kg/kW-hr

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Engine Model:	1998 Cummins M11C	Test No.:	M42DBHL2	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	06/13/2002 Time: 11:04	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	29.00	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	77.0	°F	25.0 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	75.0	gr/lb	10.7 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.9	gr/lb	10.6 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.90	ppm	
HC Bckgrd	n/a		3.80	ppm	
CO	30.4	2	29.40	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		41.86	ppm	(Dry)
NOx Bckgrd	0.3	1	0.08	ppm	
CO2 Sample	53.5	1	0.4122	%	(Wet)
CO2 Bckgrd	6.4	1	0.0406	%	

Corrected Concentrations

HC	14.22	ppm
CO	28.56	ppm
NOx	40.93	ppm
CO2	0.3728	%

Mass Emissions

HC	10.924	grams	
CO	44.474	grams	
NOx	104.698	grams	
Particulate	6.242	grams	
CO2	9.124	kg	
Fuel	6.39 lb	2.90	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,989.5	84.66
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.04	0.06
Gas Meter 2:	4.11	0.12
Sample Rate:	2.07	0.06
Total Flow Rate:	2,991.59	84.72

Particulate Data

Filter Number:	1149.0-306 (pair)	
Weight Gain:	4.316	mg
Sample Multiplier:	1.446	

Correction Factors

NOx Humidity CF:	1.000
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	32.65

Test Cycle Data

Sample Time:	947.30	sec		
Work:	16.06	hp-hr	11.98	kW-hr
Reference Work:	16.17	hp-hr	12.06	kW-hr
Total Volume (Vmix):	47,232.2	scf	1,337.64	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.680 g/hp-hr	0.912	g/kW-hr
CO		2.769 g/hp-hr	3.714	g/kW-hr
NOx	(Cell)	6.519 g/hp-hr	8.742	g/kW-hr
Particulate		0.389 g/hp-hr	0.521	g/kW-hr
CO2		568.1 g/hp-hr	761.85	g/kW-hr
BSFC		0.398 lb/hp-hr	0.242	kg/kW-hr

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EPA Hot Transient Emission Test Results
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Engine Model:	1998 Cummins M11C	Test No.:	M02DXSAT1	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	05/31/2002 Time: 14:15	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 2	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	28.95	in Hg	98.0 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	56.7	°F	13.7 °C
Abs. Humidity:	71.1	gr/lb	10.2 g/kg
Rel. Humidity:	51	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	72.4	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.59	ppm	
HC Bckgrd	n/a		4.43	ppm	
CO	22.1	2	21.25	ppm	(Dry)
CO Bckgrd	0.6	2	0.57	ppm	
NOx Sample	n/a		64.74	ppm	(Dry)
NOx Bckgrd	1.5	1	0.38	ppm	
CO2 Sample	62.8	1	0.6053	%	(Wet)
CO2 Bckgrd	5.0	1	0.0457	%	

Corrected Concentrations

HC	13.36	ppm
CO	20.18	ppm
NOx	62.97	ppm
CO2	0.5616	%

Mass Emissions

HC		13.424	grams	
CO		41.088	grams	
NOx		208.544	grams	
Particulate		7.569	grams	
CO2		17.974	kg	
Fuel	12.52	lb	5.68	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,973.6	84.21
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.11	0.06
Gas Meter 2:	3.99	0.11
Sample Rate:	1.88	0.05
Total Flow Rate:	2,975.45	84.27

Particulate Data

Filter Number:	8807.0-179 (pair)	
Weight Gain:	4.786	mg
Sample Multiplier:	1.581	

Correction Factors

NOx Humidity CF:	0.990
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	22.35

Test Cycle Data

Sample Time:	1,245.60	sec		
Work:	34.41	hp-hr	25.66	kW-hr
Reference Work:	34.60	hp-hr	25.80	kW-hr
Total Volume (Vmix):	61,770.4	scf	1,749.38	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.390 g/hp-hr	0.523	g/kW-hr
CO		1.194 g/hp-hr	1.601	g/kW-hr
NOx	(Cell)	6.061 g/hp-hr	8.127	g/kW-hr
Particulate		0.220 g/hp-hr	0.295	g/kW-hr
CO2		522.4 g/hp-hr	700.50	g/kW-hr
BSFC		0.364 lb/hp-hr	0.221	kg/kW-hr

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Engine Model:	1998 Cummins M11C	Test No.: M02DXSAT2	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 05/31/2002 Time: 14:55	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 2	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	28.94	in Hg	98.0 kPa
Engine Inlet Air			
Temperature:	77.0	°F	25.0 °C
Dew Point:	57.8	°F	14.3 °C
Abs. Humidity:	74.1	gr/lb	10.6 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.6	gr/lb	11.1 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.33	ppm	
HC Bckgrd	n/a		4.46	ppm	
CO	21.7	2	20.87	ppm	(Dry)
CO Bckgrd	0.4	2	0.38	ppm	
NOx Sample	n/a		64.58	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	63.3	1	0.6105	%	(Wet)
CO2 Bckgrd	5.0	1	0.0457	%	

Corrected Concentrations

HC	13.07	ppm
CO	19.96	ppm
NOx	62.95	ppm
CO2	0.5669	%

Mass Emissions

HC		13.088	grams	
CO		40.507	grams	
NOx		209.335	grams	
Particulate		7.755	grams	
CO2		18.076	kg	
Fuel	12.59 lb		5.71	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,964.5	83.96
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.11	0.06
Gas Meter 2:	4.03	0.11
Sample Rate:	1.91	0.05
Total Flow Rate:	2,966.41	84.01

Particulate Data

Filter Number:	8808.0-180 (pair)	
Weight Gain:	4.996	mg
Sample Multiplier:	1.552	

Correction Factors

NOx Humidity CF:	0.998
Dry-to-Wet CF, Sample:	0.977
Dry-to-Wet CF, Bckgrd:	0.982
Dilution Factor:	22.16

Test Cycle Data

Sample Time:	1,244.90	sec		
Work:	34.43	hp-hr	25.67	kW-hr
Reference Work:	34.60	hp-hr	25.80	kW-hr
Total Volume (Vmix):	61,548.1	scf	1,743.08	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.380 g/hp-hr	0.510	g/kW-hr
CO		1.177 g/hp-hr	1.578	g/kW-hr
NOx	(Cell)	6.080 g/hp-hr	8.153	g/kW-hr
Particulate		0.225 g/hp-hr	0.302	g/kW-hr
CO2		525.0 g/hp-hr	704.05	g/kW-hr
BSFC		0.366 lb/hp-hr	0.222	kg/kW-hr

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EPA Hot Transient Emission Test Results
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Engine Model:	1998 Cummins M11C	Test No.:	M12DFTP3	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	06/06/2002 Time: 09:50	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell:	16 Bag Cart: 1	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	29.10	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	54.5	°F	12.5 °C
Abs. Humidity:	65.2	gr/lb	9.3 g/kg
Rel. Humidity:	49	%	
Dilution Air:			
Temperature:	78.0	°F	25.6 °C
Abs. Humidity	68.5	gr/lb	9.8 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		22.99	ppm	
HC Bckgrd	n/a		7.80	ppm	
CO	27.6	2	26.64	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		41.38	ppm	(Dry)
NOx Bckgrd	1.1	1	0.28	ppm	
CO2 Sample	50.1	1	0.3785	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	
CH4 Sample	n/a	n/a	2.18	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.95	ppm	

Corrected Concentrations

HC	15.41	ppm	
CO	25.78	ppm	
NOx	40.33	ppm	
CO2	0.3365	%	
CH4	0.29	ppm	(1.00)

Mass Emissions

HC	15.426	grams	
CO	52.303	grams	
NOx	131.061	grams	
Particulate	6.692	grams	
CO2	10.728	kg	
CH4	0.332	grams	
Fuel	7.52 lb	3.41 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,997.0	84.88
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.14	0.06
Gas Meter 2:	4.08	0.12
Sample Rate:	1.94	0.05
20X20 Sample Rate:	12.39	0.35
47 mm Sample Rate:	50.05	1.42
Chemistry Sample Rate:	0.131	0.075
Total Flow Rate:	3,061.49	86.77

Particulate Data

Filter Number:	8844.0-230 (pair)	
Weight Gain:	4.235	mg
Sample Multiplier:	1.580	

Correction Factors

NOx Humidity CF:	0.975
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	35.50

Test Cycle Data

Sample Time:	1,206.00	sec		
Work:	19.89	hp-hr	14.83	kW-hr
Reference Work:	19.44	hp-hr	14.50	kW-hr
Total Volume (Vmix):	61,533.4	scf	1,742.66	scm

Brake-Specific Emission Results

BSHC (Cell)	0.776	g/hp-hr	1.040	g/kW-hr
CO	2.630	g/hp-hr	3.526	g/kW-hr
NOx (Cell)	6.589	g/hp-hr	8.836	g/kW-hr
Particulate	0.336	g/hp-hr	0.451	g/kW-hr
CO2	539.4	g/hp-hr	723.32	g/kW-hr
BSFC	0.378	lb/hp-hr	0.230	kg/kW-hr
NMHC	0.674	g/hp-hr	0.904	g/kW-hr
CH4	0.017	g/hp-hr	0.022	g/kW-hr

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Engine Model:	1998 Cummins M11C	Test No.:	M12DFTP3	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	06/06/2002 Time: 09:50	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

	Sample		Background	
Formaldehyde				
Concentration	0.631	ppm	0.001	ppm
Mass	1,344.98	mg		
Acetaldehyde				
Concentration	0.159	ppm	0.000	ppm
Mass	496.29	mg		
Acrolein				
Concentration	0.033	ppm	0.000	ppm
Mass	130.72	mg		
Acetone				
Concentration	0.023	ppm	0.000	ppm
Mass	94.63	mg		
Propionaldehyde				
Concentration	0.097	ppm	0.000	ppm
Mass	399.15	mg		
Crotonaldehyde				
Concentration	0.049	ppm	0.000	ppm
Mass	244.76	mg		
Isobutyr + MEK				
Concentration	0.003	ppm	0.000	ppm
Mass	12.81	mg		
Benzaldehyde				
Concentration	0.008	ppm	0.000	ppm
Mass	62.28	mg		
Hexanaldehyde				
Concentration	0.004	ppm	0.000	ppm
Mass	28.50	mg		

Brake-Specific Results

Formaldehyde	67.621	mg/hp-hr	Crotonaldehyde	12.305	mg/hp-hr
Acetaldehyde	24.952	mg/hp-hr	Isobutyr + MEK	0.644	mg/hp-hr
Acrolein	6.572	mg/hp-hr	Benzaldehyde	3.131	mg/hp-hr
Acetone	4.757	mg/hp-hr	Hexanaldehyde	1.433	mg/hp-hr
Propionaldehyde	20.068	mg/hp-hr			

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Engine Model:	1998 Cummins M11C	Test No.:	M12DFTP4	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	06/06/2002 Time: 10:29	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	29.10	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	77.0	°F	25.0 °C
Dew Point:	55.4	°F	13.0 °C
Abs. Humidity:	67.4	gr/lb	9.6 g/kg
Rel. Humidity:	47	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	66.8	gr/lb	9.5 g/kg
Rel. Humidity:	44	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		23.18	ppm	
HC Bckgrd	n/a		7.40	ppm	
CO	27.1	2	26.15	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		40.07	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	49.7	1	0.3747	%	(Wet)
CO2 Bckgrd	6.5	1	0.0413	%	
CH4 Sample	n/a	n/a	2.02	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.14	ppm	

Corrected Concentrations

HC	15.99	ppm	
CO	24.79	ppm	
NOx	39.13	ppm	
CO2	0.3346	%	
CH4	-0.06	ppm	(1.00)

Mass Emissions

HC	15.949	grams	
CO	50.120	grams	
NOx	127.474	grams	
Particulate	6.447	grams	
CO2	10.630	kg	
CH4	0.000	grams	
Fuel	7.45 lb	3.38	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,984.7	84.53
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.14	0.06
Gas Meter 2:	4.20	0.12
Sample Rate:	2.07	0.06
20X20 Sample Rate:	12.48	0.35
47 mm Sample Rate:	50.24	1.42
Chemistry Sample Rate:	0.130	0.074
Total Flow Rate:	3,049.65	86.44

Particulate Data

Filter Number:	8970.0-239, (pair)	
Weight Gain:	4.367	mg
Sample Multiplier:	1.476	

Correction Factors

NOx Humidity CF:	0.981
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	35.86

Test Cycle Data

Sample Time:	1,206.60	sec		
Work:	19.86	hp-hr	14.81	kW-hr
Reference Work:	19.44	hp-hr	14.50	kW-hr
Total Volume (Vmix):	61,325.8	scf	1,736.78	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.803 g/hp-hr	1.077	g/kW-hr
CO		2.524 g/hp-hr	3.384	g/kW-hr
NOx	(Cell)	6.419 g/hp-hr	8.608	g/kW-hr
Particulate		0.325 g/hp-hr	0.435	g/kW-hr
CO2		535.2 g/hp-hr	717.76	g/kW-hr
BSFC		0.375 lb/hp-hr	0.228	kg/kW-hr
NMHC		0.698 g/hp-hr	0.936	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M12DFTP4	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	06/06/2002 Time: 10:29	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell:	16 Bag Cart: 1	Oil Code: 15w40	

	Sample		Background	
Formaldehyde				
Concentration	0.709	ppm	0.001	ppm
Mass	1,507.85	mg		
Acetaldehyde				
Concentration	0.153	ppm	0.000	ppm
Mass	476.10	mg		
Acrolein				
Concentration	0.024	ppm	0.000	ppm
Mass	96.96	mg		
Acetone				
Concentration	0.009	ppm	0.000	ppm
Mass	37.22	mg		
Propionaldehyde				
Concentration	0.078	ppm	0.000	ppm
Mass	321.50	mg		
Crotonaldehyde				
Concentration	0.047	ppm	0.000	ppm
Mass	232.20	mg		
Isobutyr + MEK				
Concentration	0.003	ppm	0.000	ppm
Mass	13.19	mg		
Benzaldehyde				
Concentration	0.008	ppm	0.000	ppm
Mass	57.80	mg		
Hexanaldehyde				
Concentration	0.004	ppm	0.000	ppm
Mass	27.67	mg		

Brake-Specific Results

Formaldehyde	75.924 mg/hp-hr	Crotonaldehyde	11.692 mg/hp-hr
Acetaldehyde	23.973 mg/hp-hr	Isobutyr + MEK	0.664 mg/hp-hr
Acrolein	4.882 mg/hp-hr	Benzaldehyde	2.910 mg/hp-hr
Acetone	1.874 mg/hp-hr	Hexanaldehyde	1.393 mg/hp-hr
Propionaldehyde	16.188 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M12DBHL1	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/06/2002 Time: 11:39	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.10	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	57.4	°F	14.1 °C
Abs. Humidity:	72.6	gr/lb	10.4 g/kg
Rel. Humidity:	54	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	66.8	gr/lb	9.5 g/kg
Rel. Humidity:	44	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		18.86	ppm	
HC Bckgrd	n/a		7.60	ppm	
CO	27.9	2	26.94	ppm	(Dry)
CO Bckgrd	1.0	2	0.94	ppm	
NOx Sample	n/a		42.20	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	52.7	1	0.4042	%	(Wet)
CO2 Bckgrd	6.6	1	0.0419	%	
CH4 Sample	n/a	n/a	1.92	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	19.90	ppm	

Corrected Concentrations

HC	11.49	ppm	
CO	25.45	ppm	
NOx	41.31	ppm	
CO2	0.3636	%	
CH4	-17.38	ppm	(1.00)

Mass Emissions

HC	9.069	grams	
CO	40.724	grams	
NOx	107.899	grams	
Particulate	5.973	grams	
CO2	9.141	kg	
CH4	0.000	grams	
Fuel	6.39 lb	2.90 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,008.8	85.21
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.14	0.06
Gas Meter 2:	4.19	0.12
Sample Rate:	2.05	0.06
20X20 Sample Rate:	12.22	0.35
47 mm Sample Rate:	50.56	1.43
Chemistry Sample Rate:	0.132	0.059
Total Flow Rate:	3,073.80	87.11

Particulate Data

Filter Number:	8971.0-240 (pair)	
Weight Gain:	3.977	mg
Sample Multiplier:	1.502	

Correction Factors

NOx Humidity CF:	0.994
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	33.30

Test Cycle Data

Sample Time:	947.30	sec		
Work:	16.10	hp-hr	12.01	kW-hr
Reference Work:	16.11	hp-hr	12.01	kW-hr
Total Volume (Vmix):	48,528.1	scf	1,374.34	scm

Brake-Specific Emission Results

BSHC (Cell)	0.563	g/hp-hr	0.755	g/kW-hr
CO	2.529	g/hp-hr	3.392	g/kW-hr
NOx (Cell)	6.702	g/hp-hr	8.987	g/kW-hr
Particulate	0.371	g/hp-hr	0.498	g/kW-hr
CO2	567.7	g/hp-hr	761.36	g/kW-hr
BSFC	0.397	lb/hp-hr	0.242	kg/kW-hr
NMHC	0.490	g/hp-hr	0.656	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M12DBHL1	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	06/06/2002 Time: 11:39	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell:	16 Bag Cart: 1	Oil Code: 15w40	

	Sample	Background
Formaldehyde		
Concentration	0.343 ppm	0.001 ppm
Mass	576.40 mg	
Acetaldehyde		
Concentration	0.078 ppm	0.000 ppm
Mass	193.49 mg	
Acrolein		
Concentration	0.007 ppm	0.000 ppm
Mass	22.28 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.030 ppm	0.000 ppm
Mass	99.08 mg	
Crotonaldehyde		
Concentration	0.022 ppm	0.000 ppm
Mass	85.70 mg	
Isobutyr + MEK		
Concentration	0.009 ppm	0.000 ppm
Mass	36.13 mg	
Benzaldehyde		
Concentration	0.004 ppm	0.000 ppm
Mass	24.93 mg	
Hexanaldehyde		
Concentration	0.002 ppm	0.000 ppm
Mass	11.03 mg	

Brake-Specific Results

Formaldehyde	35.801 mg/hp-hr	Crotonaldehyde	5.323 mg/hp-hr
Acetaldehyde	12.018 mg/hp-hr	Isobutyr + MEK	2.244 mg/hp-hr
Acrolein	1.384 mg/hp-hr	Benzaldehyde	1.548 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.685 mg/hp-hr
Propionaldehyde	6.154 mg/hp-hr		

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EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M2NRFTP1	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/11/2002 Time: 09:05	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.02	in Hg	98.3 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	71.2	gr/lb	10.2 g/kg
Rel. Humidity:	53	%	
Dilution Air:			
Temperature:	78.0	°F	25.6 °C
Abs. Humidity	68.8	gr/lb	9.8 g/kg
Rel. Humidity:	46	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,991.4	84.72
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.11	0.12
Sample Rate:	2.04	0.06
20X20 Sample Rate:	12.49	0.35
47 mm Sample Rate:	50.03	1.42
Chemistry Sample Rate:	0.132	0.075
Total Flow Rate:	3,056.12	86.62

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		22.00	ppm	
HC Bckgrd	n/a		7.50	ppm	
CO	29.6	2	28.61	ppm	(Dry)
CO Bckgrd	1.9	2	1.78	ppm	
NOx Sample	n/a		40.53	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	51.0	1	0.3873	%	(Wet)
CO2 Bckgrd	7.2	1	0.0458	%	
CH4 Sample	n/a	n/a	2.26	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.00	ppm	

Particulate Data

Filter Number:	9024.0-285 (pair)	
Weight Gain:	5.086	mg
Sample Multiplier:	1.498	

Correction Factors

NOx Humidity CF:	0.990
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	34.70

Corrected Concentrations

HC	14.72	ppm	
CO	26.27	ppm	
NOx	39.61	ppm	
CO2	0.3428	%	
CH4	0.31	ppm	(1.00)

Test Cycle Data

Sample Time:	1,206.20	sec		
Work:	20.01	hp-hr	14.92	kW-hr
Reference Work:	19.61	hp-hr	14.62	kW-hr
Total Volume (Vmix):	61,435.5	scf	1,739.89	scm

Mass Emissions

HC	14.708	grams	
CO	53.205	grams	
NOx	130.516	grams	
Particulate	7.618	grams	
CO2	10.912	kg	
CH4	0.363	grams	
Fuel	7.65 lb	3.47	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.735 g/hp-hr	0.986	g/kW-hr
CO		2.659 g/hp-hr	3.566	g/kW-hr
NOx	(Cell)	6.523 g/hp-hr	8.747	g/kW-hr
Particulate		0.381 g/hp-hr	0.511	g/kW-hr
CO2		545.3 g/hp-hr	731.29	g/kW-hr
BSFC		0.382 lb/hp-hr	0.232	kg/kW-hr
NMHC		0.639 g/hp-hr	0.857	g/kW-hr
CH4		0.018 g/hp-hr	0.024	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M2NRFTP1	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/11/2002 Time: 09:05	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40

	Sample	Background
Formaldehyde		
Concentration	0.705 ppm	0.004 ppm
Mass	1,494.50 mg	
Acetaldehyde		
Concentration	0.161 ppm	0.001 ppm
Mass	500.64 mg	
Acrolein		
Concentration	0.032 ppm	0.000 ppm
Mass	126.43 mg	
Acetone		
Concentration	0.021 ppm	0.000 ppm
Mass	86.64 mg	
Propionaldehyde		
Concentration	0.031 ppm	0.000 ppm
Mass	126.15 mg	
Crotonaldehyde		
Concentration	0.048 ppm	0.000 ppm
Mass	237.16 mg	
Isobutyr + MEK		
Concentration	0.017 ppm	0.000 ppm
Mass	84.76 mg	
Benzaldehyde		
Concentration	0.022 ppm	0.000 ppm
Mass	167.40 mg	
Hexanaldehyde		
Concentration	0.003 ppm	0.000 ppm
Mass	24.52 mg	

Brake-Specific Results

Formaldehyde	74.688 mg/hp-hr	Crotonaldehyde	11.852 mg/hp-hr
Acetaldehyde	25.020 mg/hp-hr	Isobutyr + MEK	4.236 mg/hp-hr
Acrolein	6.318 mg/hp-hr	Benzaldehyde	8.366 mg/hp-hr
Acetone	4.330 mg/hp-hr	Hexanaldehyde	1.226 mg/hp-hr
Propionaldehyde	6.304 mg/hp-hr		

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EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M2NRFTP2	DIESEL 2D, NR=EM2831F	
Engine Desc.:	10.7 L (655 CID) 6	Date:	06/11/2002 Time: 09:45	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

Ambient/Test Cell Conditions

Barometer:	29.02	in Hg	98.3 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	72.2	gr/lb	10.3 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	78.0	°F	25.6 °C
Abs. Humidity	68.8	gr/lb	9.8 g/kg
Rel. Humidity:	46	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,989.9	84.68
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.10	0.12
Sample Rate:	2.03	0.06
20X20 Sample Rate:	12.04	0.34
47 mm Sample Rate:	49.77	1.41
Chemistry Sample Rate:	0.133	0.076
Total Flow Rate:	3,053.86	86.56

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		22.49	ppm	
HC Bckgrd	n/a		7.80	ppm	
CO	29.6	2	28.61	ppm	(Dry)
CO Bckgrd	1.7	2	1.59	ppm	
NOx Sample	n/a		39.97	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	50.8	1	0.3854	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	
CH4 Sample	n/a	n/a	2.31	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.32	ppm	

Particulate Data

Filter Number:	9025.0-286 (pair)	
Weight Gain:	5.148	mg
Sample Multiplier:	1.506	

Correction Factors

NOx Humidity CF:	0.993
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	34.86

Corrected Concentrations

HC	14.91	ppm	
CO	26.45	ppm	
NOx	39.02	ppm	
CO2	0.3403	%	
CH4	0.05	ppm	(1.00)

Test Cycle Data

Sample Time:	1,205.80	sec		
Work:	20.02	hp-hr	14.93	kW-hr
Reference Work:	19.61	hp-hr	14.62	kW-hr
Total Volume (Vmix):	61,369.8	scf	1,738.03	scm

Mass Emissions

HC	14.889	grams	
CO	53.518	grams	
NOx	128.759	grams	
Particulate	7.752	grams	
CO2	10.821	kg	
CH4	0.061	grams	
Fuel	7.59 lb	3.44	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.744 g/hp-hr	0.997	g/kW-hr
CO		2.673 g/hp-hr	3.585	g/kW-hr
NOx	(Cell)	6.432 g/hp-hr	8.625	g/kW-hr
Particulate		0.387 g/hp-hr	0.519	g/kW-hr
CO2		540.5 g/hp-hr	724.84	g/kW-hr
BSFC		0.379 lb/hp-hr	0.230	kg/kW-hr
NMHC		0.646 g/hp-hr	0.867	g/kW-hr
CH4		0.003 g/hp-hr	0.004	g/kW-hr

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EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M2NRFTP2	DIESEL 2D, NR=EM2831F	
Engine Desc.:	10.7 L (655 CID) 6	Date:	06/11/2002 Time: 09:45	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

	Sample		Background	
Formaldehyde				
Concentration	0.672	ppm	0.004	ppm
Mass	1,421.83	mg		
Acetaldehyde				
Concentration	0.156	ppm	0.001	ppm
Mass	483.50	mg		
Acrolein				
Concentration	0.033	ppm	0.000	ppm
Mass	131.20	mg		
Acetone				
Concentration	0.018	ppm	0.000	ppm
Mass	75.79	mg		
Propionaldehyde				
Concentration	0.029	ppm	0.000	ppm
Mass	119.08	mg		
Crotonaldehyde				
Concentration	0.046	ppm	0.000	ppm
Mass	231.10	mg		
Isobutyr + MEK				
Concentration	0.016	ppm	0.000	ppm
Mass	82.82	mg		
Benzaldehyde				
Concentration	0.021	ppm	0.000	ppm
Mass	156.14	mg		
Hexanaldehyde				
Concentration	0.002	ppm	0.000	ppm
Mass	17.17	mg		

Brake-Specific Results

Formaldehyde	71.021	mg/hp-hr	
Acetaldehyde	24.151	mg/hp-hr	
Acrolein	6.554	mg/hp-hr	
Acetone	3.786	mg/hp-hr	
Propionaldehyde	5.948	mg/hp-hr	
Crotonaldehyde	11.544	mg/hp-hr	
Isobutyr + MEK	4.137	mg/hp-hr	
Benzaldehyde	7.799	mg/hp-hr	
Hexanaldehyde	0.858	mg/hp-hr	

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model: 1998 Cummins M11C
Engine Desc.: 10.7 L (655 CID) 6
Engine Cycle: Diesel
Engine S/N: 34872033

Test No.: M2NRBHL1
Date: 06/11/2002 Time: 10:50
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1
Backhoe Loader Cycle

DIESEL 2D, NR=EM2831F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

Ambient/Test Cell Conditions

Barometer:	29.03	in Hg	98.3 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	74.9	gr/lb	10.7 g/kg
Rel. Humidity:	54	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	72.0	gr/lb	10.3 g/kg
Rel. Humidity:	47	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,999.3	84.94
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.06	0.06
Gas Meter 2:	4.11	0.12
Sample Rate:	2.05	0.06
20X20 Sample Rate:	10.58	0.30
47 mm Sample Rate:	49.97	1.42
Chemistry Sample Rate:	0.135	0.060
Total Flow Rate:	3,062.01	86.77

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		20.51	ppm	
HC Bckgrd	n/a		8.00	ppm	
CO	31.5	2	30.48	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		41.27	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	53.3	1	0.4102	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	
CH4 Sample	n/a	n/a	2.09	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.94	ppm	

Particulate Data

Filter Number: 8986.0-274 (pair)
Weight Gain: 4.720 mg
Sample Multiplier: 1.495

Correction Factors

NOx Humidity CF:	1.000
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	32.78

Corrected Concentrations

HC	12.75	ppm	
CO	29.51	ppm	
NOx	40.30	ppm	
CO2	0.3671	%	
CH4	0.21	ppm	(1.00)

Test Cycle Data

Sample Time:	947.30	sec		
Work:	16.30	hp-hr	12.15	kW-hr
Reference Work:	16.34	hp-hr	12.18	kW-hr
Total Volume (Vmix):	48,341.9	scf	1,369.07	scm

Mass Emissions

HC	10.030	grams	
CO	47.037	grams	
NOx	105.492	grams	
Particulate	7.055	grams	
CO2	9.193	kg	
CH4	0.189	grams	
Fuel	6.44 lb	2.92	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.615 g/hp-hr	0.825	g/kW-hr
CO		2.886 g/hp-hr	3.870	g/kW-hr
NOx	(Cell)	6.472 g/hp-hr	8.679	g/kW-hr
Particulate		0.433 g/hp-hr	0.580	g/kW-hr
CO2		564.0 g/hp-hr	756.34	g/kW-hr
BSFC		0.395 lb/hp-hr	0.240	kg/kW-hr
NMHC		0.535 g/hp-hr	0.717	g/kW-hr
CH4		0.012 g/hp-hr	0.016	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model: 1998 Cummins M11C
Engine Desc.: 10.7 L (655 CID) 6
Engine Cycle: Diesel
Engine S/N: 34872033

Test No.: M2NRBHL1
Date: 06/11/2002 Time: 10:50
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1
Backhoe Loader Cycle

DIESEL 2D, NR=EM2831F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

	Sample	Background
Formaldehyde		
Concentration	0.386 ppm	0.003 ppm
Mass	641.09 mg	
Acetaldehyde		
Concentration	0.093 ppm	0.001 ppm
Mass	226.22 mg	
Acrolein		
Concentration	0.013 ppm	0.000 ppm
Mass	39.78 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.015 ppm	0.000 ppm
Mass	47.99 mg	
Crotonaldehyde		
Concentration	0.027 ppm	0.002 ppm
Mass	99.50 mg	
Isobutyr + MEK		
Concentration	0.009 ppm	0.001 ppm
Mass	33.96 mg	
Benzaldehyde		
Concentration	0.012 ppm	0.000 ppm
Mass	68.77 mg	
Hexanaldehyde		
Concentration	0.002 ppm	0.000 ppm
Mass	12.04 mg	

Brake-Specific Results

Formaldehyde	39.331 mg/hp-hr	Crotonaldehyde	6.104 mg/hp-hr
Acetaldehyde	13.879 mg/hp-hr	Isobutyr + MEK	2.084 mg/hp-hr
Acrolein	2.440 mg/hp-hr	Benzaldehyde	4.219 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.739 mg/hp-hr
Propionaldehyde	2.944 mg/hp-hr		

APPENDIX D

GRAPHICAL SUMMARIES OF TRANSIENT CYCLE REGRESSION STATISTICS FOR FTP, BHL, AND SAT TESTING ON A CUMMINS M11C USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
M02DXFTP1	FTP	2D	Without	Transient Cycle Regression Summary	D-1
M02DXFTP2	FTP	2D	Without	Transient Cycle Regression Summary	D-2
M02DBHL1	BHL	2D	Without	Transient Cycle Regression Summary	D-3
M02DBHL2	BHL	2D	Without	Transient Cycle Regression Summary	D-4
M02DXSAT1	SAT	2D	Without	Transient Cycle Regression Summary	D-5
M02DXSAT2	SAT	2D	Without	Transient Cycle Regression Summary	D-6
M12DFTP3	FTP	2D	Yes	Transient Cycle Regression Summary	D-7
M12DFTP4	FTP	2D	Yes	Transient Cycle Regression Summary	D-8
M12DBHL1	BHL	2D	Yes	Transient Cycle Regression Summary	D-9
M2NRFTP1	FTP	NR	Yes	Transient Cycle Regression Summary	D-10
M2NRFTP2	FTP	NR	Yes	Transient Cycle Regression Summary	D-11
M2NRBHL1	BHL	NR	Yes	Transient Cycle Regression Summary	D-12

HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 5/31/02
Time: 9:24 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M02DXFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 992

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

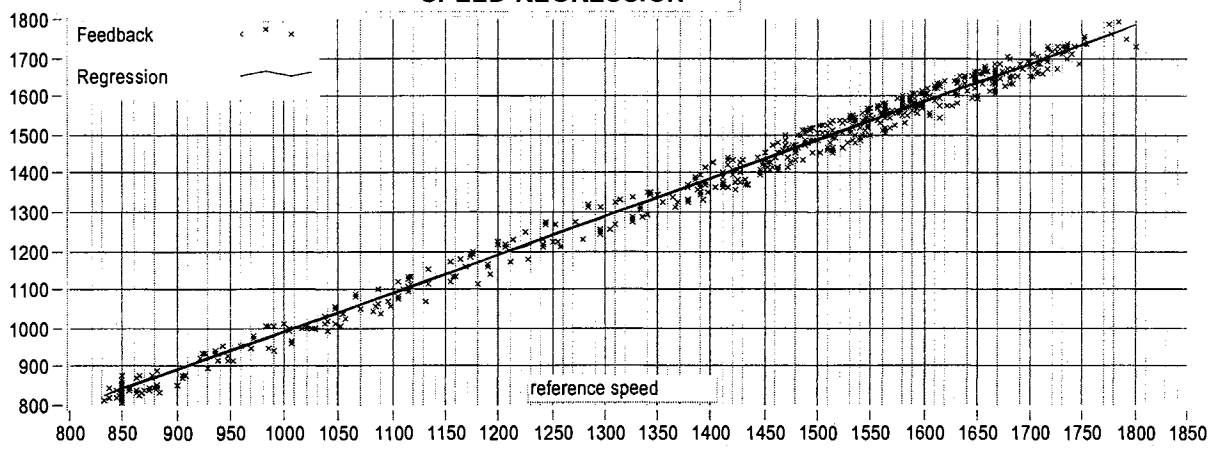
STATS PASS

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	19.77
REFERENCE WORK [HP-HR]	19.34
PERCENT DIFFERENCE	2.23

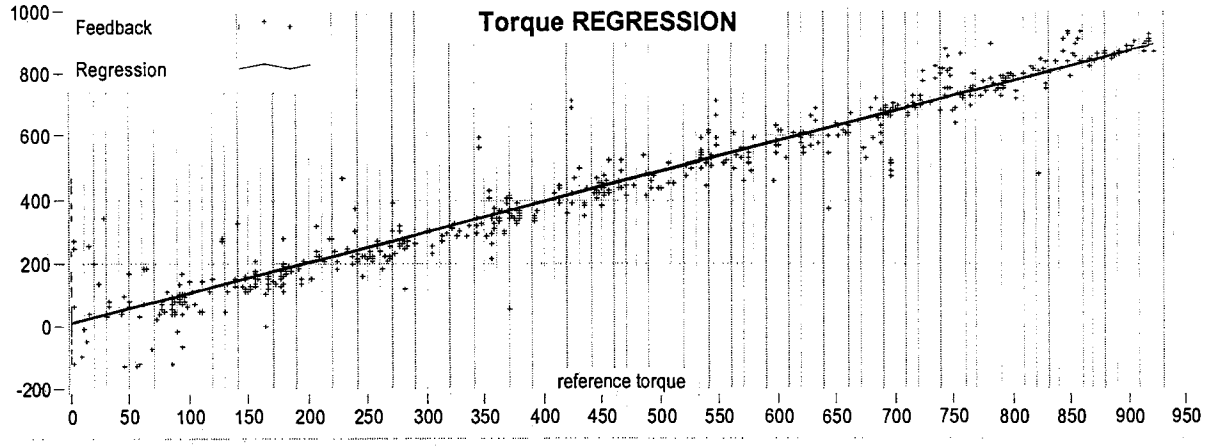
WORK PASS

	SPEED	TORQUE	POWER
SE	20	6	5
M	0.992	0.96	0.97
R2	0.9968	0.9589	0.9758
B	-1	10	0.8
NO. PTS.	1174	1011	1011

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 5/31/02
Time: 10:00 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M02DXFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 993

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

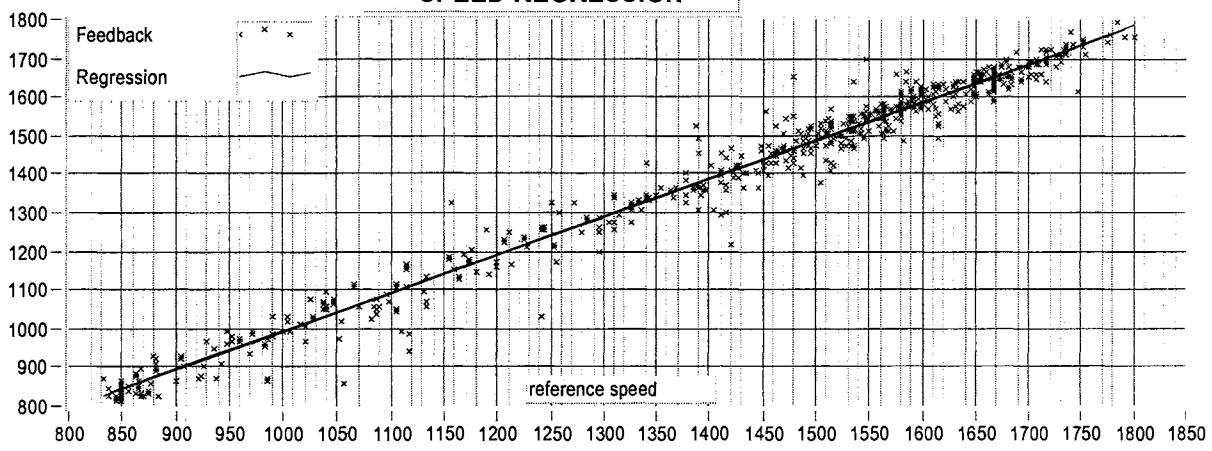
STATS PASS

WORK PASS

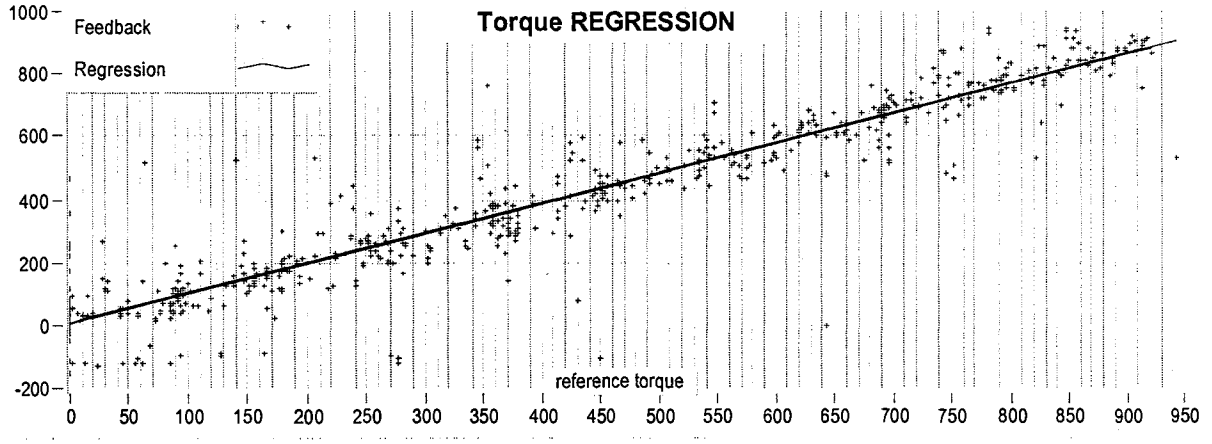
	SPEED	TORQUE	POWER
SE	30	8	7
M	0.988	0.95	0.96
R2	0.9925	0.9382	0.9475
B	4	8	0.6
NO. PTS.	1174	1015	1015

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	19.66
REFERENCE WORK [HP-HR]	19.34
PERCENT DIFFERENCE	1.65

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/13/02
Time: 10:07 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M42DBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 46

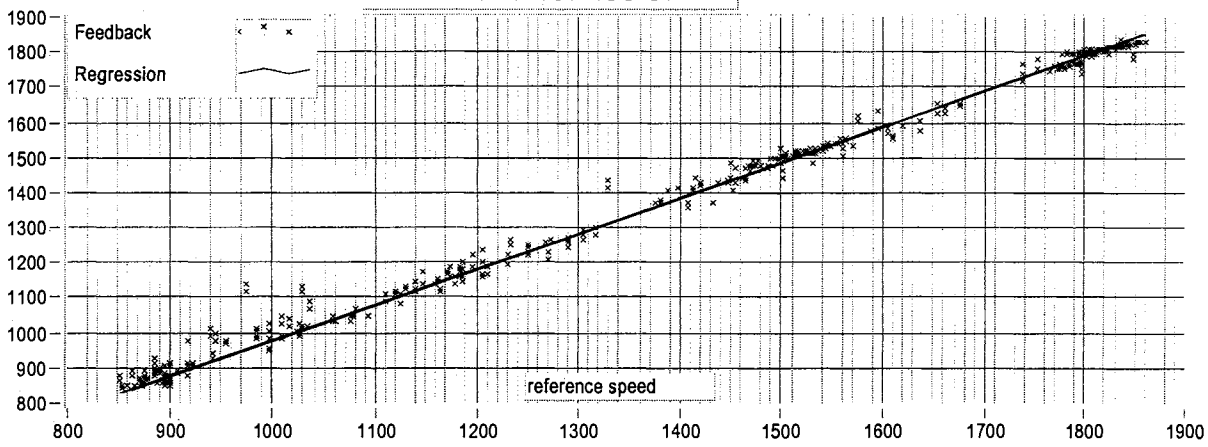
	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

STATS FAIL **WORK PASS**

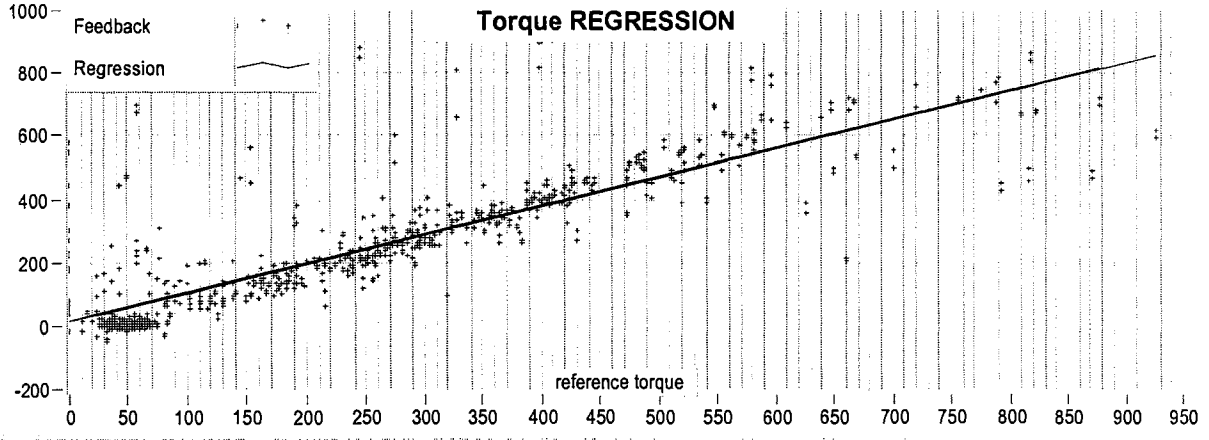
TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	16.02
REFERENCE WORK [HP-HR]	16.17
PERCENT DIFFERENCE	-0.95

	SPEED	TORQUE	POWER
SE	21	13	10
M	1.017	0.91	0.96
R2	0.9971	0.6921	0.8029
B	-40	13	1.5
NO. PTS.	915	940	940

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/13/02
Time: 10:43 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M42DBHL2
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 47

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

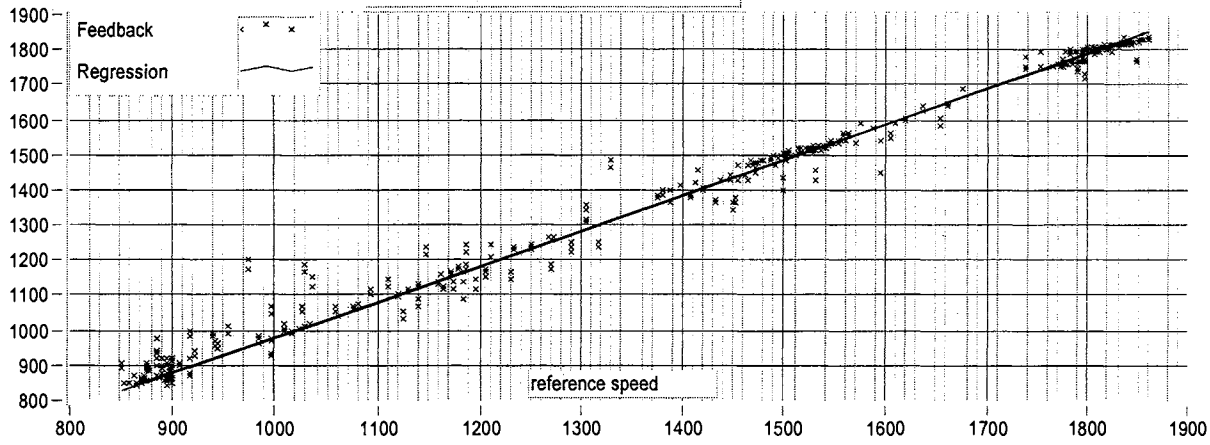
STATS FAIL

WORK PASS

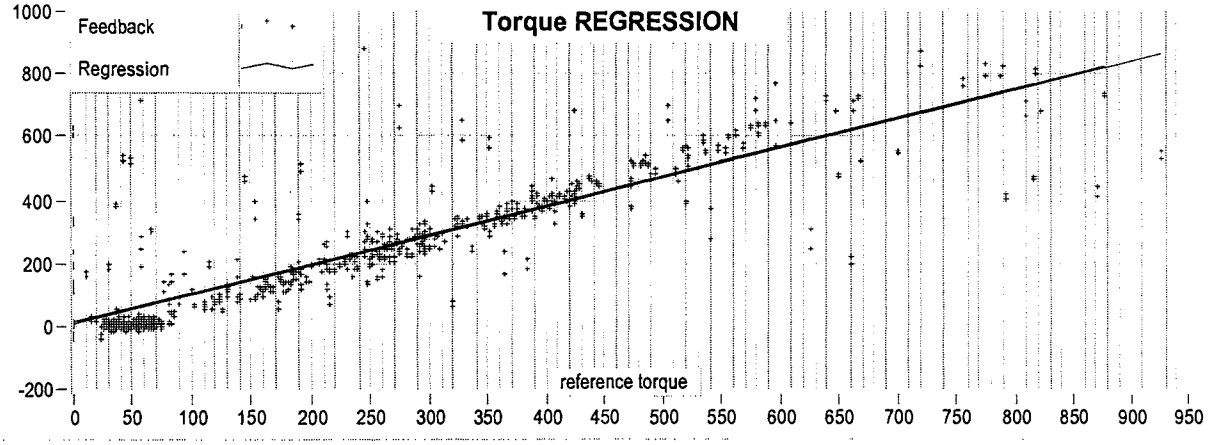
	SPEED	TORQUE	POWER
SE	29	13	11
M	1.014	0.93	0.96
R2	0.9947	0.6815	0.7880
B	-36	10	1.2
NO. PTS.	915	938	938

TIME DELAY [sec]	0.60
CYCLE WORK [HP-HR]	16.06
REFERENCE WORK [HP-HR]	16.17
PERCENT DIFFERENCE	-0.66

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 5/31/02
Time: 1:55 PM
Engine ID.
CUMMINS M-11
34872033
Test No.
M02DSAT1
No. of Bags: 1
Cycle Type: Hot,
User Specified
EVENT NO. 997

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

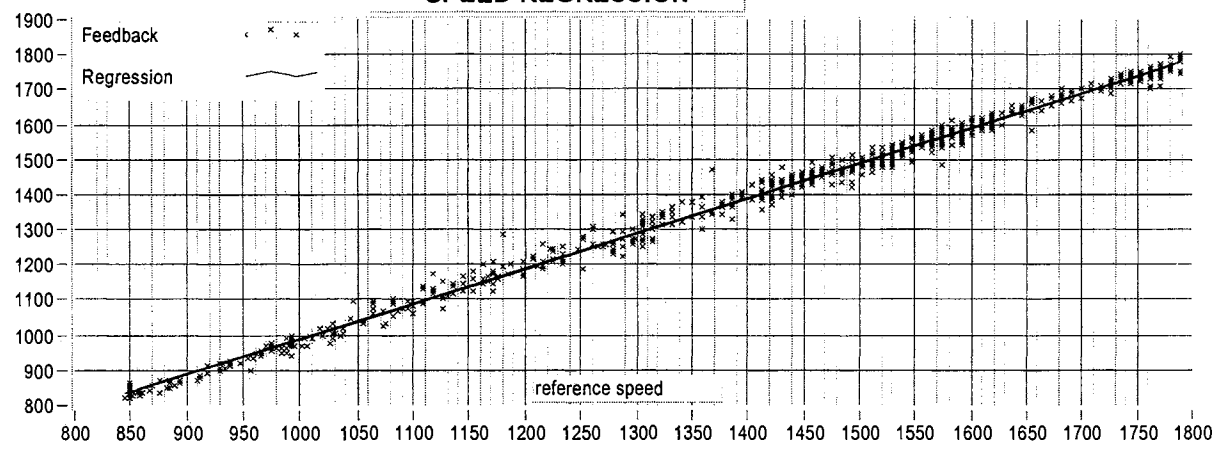
STATS FAIL

WORK PASS

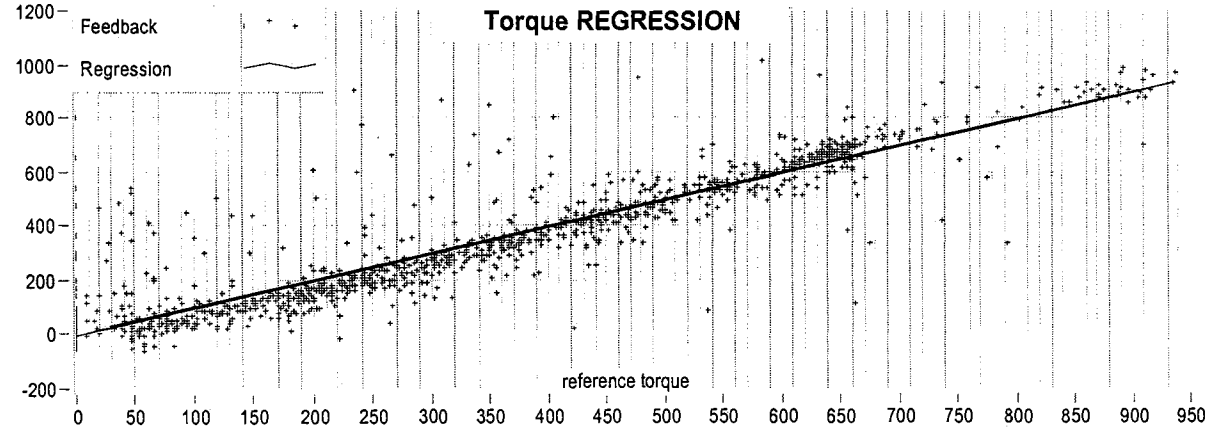
	SPEED	TORQUE	POWER
SE	19	11	10
M	0.999	0.99	1.01
R2	0.9948	0.8345	0.8737
B	-12	-1	-2.6
NO. PTS.	1213	1219	1219

TIME DELAY [sec]	0.30
CYCLE WORK [HP-HR]	34.41
REFERENCE WORK [HP-HR]	34.60
PERCENT DIFFERENCE	-0.54

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 5/31/02
Time: 2:38 PM
Engine ID.
CUMMINS M-11
34872033
Test No.
M02DXSAT2
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 998

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

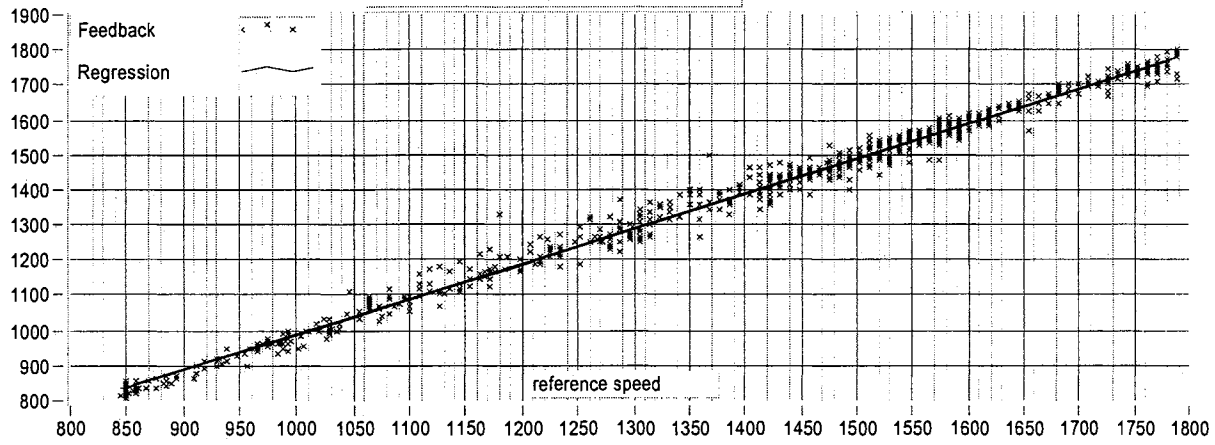
STATS FAIL

WORK PASS

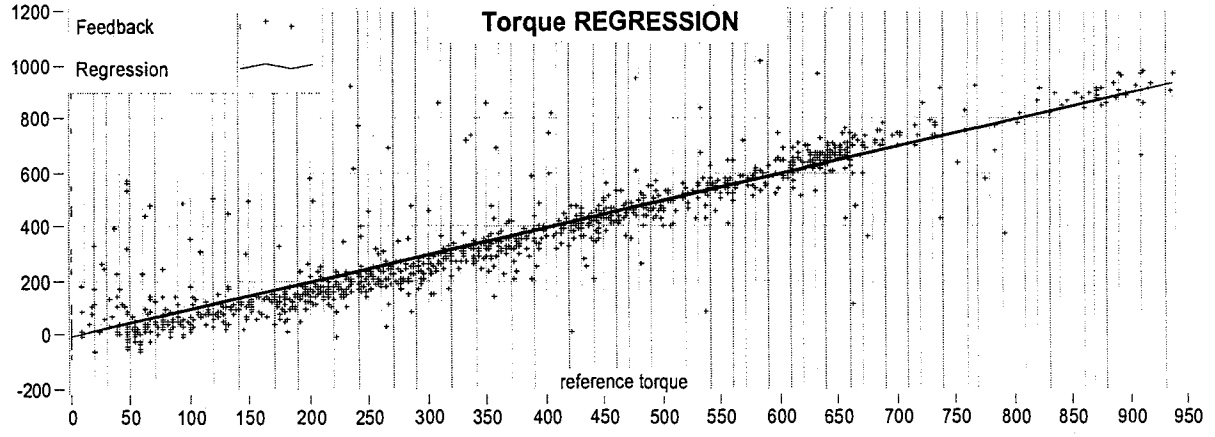
	SPEED	TORQUE	POWER
SE	22	11	10
M	0.999	1.00	1.00
R2	0.9930	0.8312	0.8671
B	-12	-3	-2.2
NO. PTS.	1213	1221	1221

TIME DELAY [sec]	0.30
CYCLE WORK [HP-HR]	34.43
REFERENCE WORK [HP-HR]	34.60
PERCENT DIFFERENCE	-0.48

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/6/02
Time: 9:27 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M12DFTP3
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 20

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

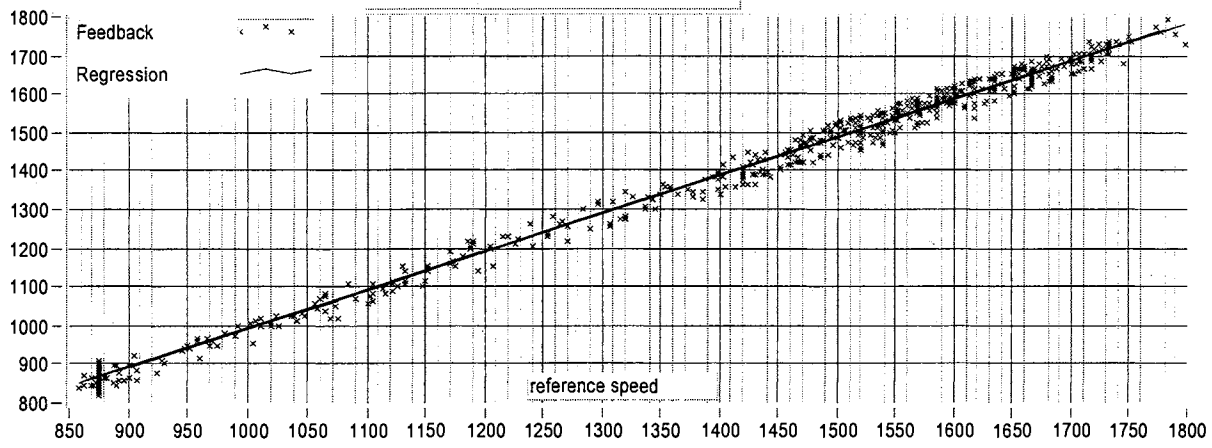
STATS PASS

TIME DELAY [sec]	0.30
CYCLE WORK [HP-HR]	19.89
REFERENCE WORK [HP-HR]	19.44
PERCENT DIFFERENCE	2.28

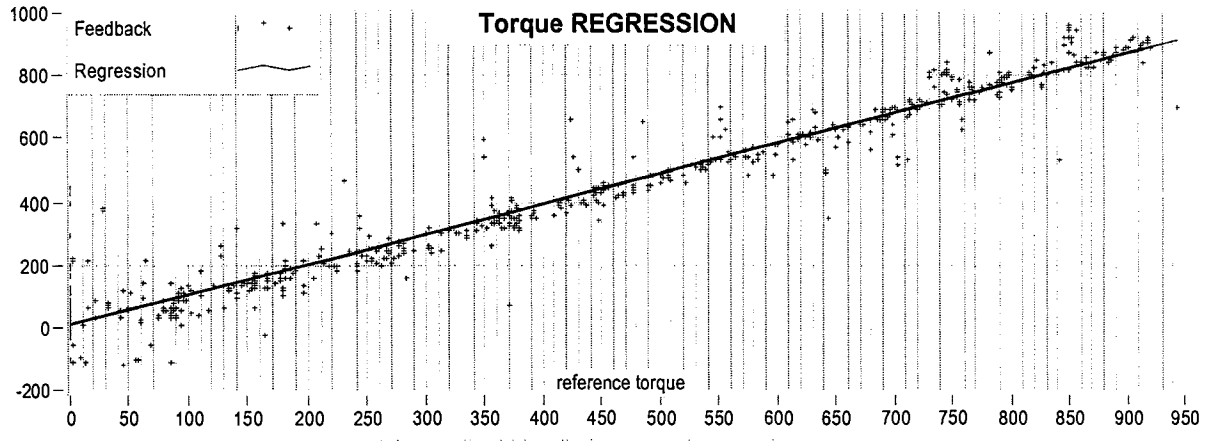
WORK PASS

	SPEED	TORQUE	POWER
SE	22	6	5
M	0.991	0.96	0.97
R2	0.9959	0.9622	0.9768
B	1	10	0.8
NO. PTS.	1174	1014	1014

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/6/02
Time: 10:12 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M12DFTP4
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 21

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

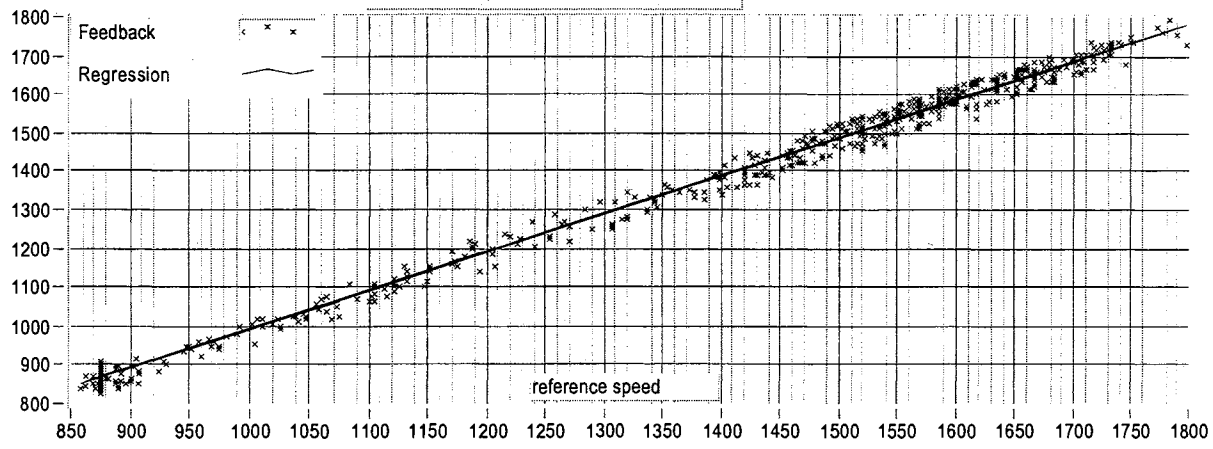
STATS PASS

WORK PASS

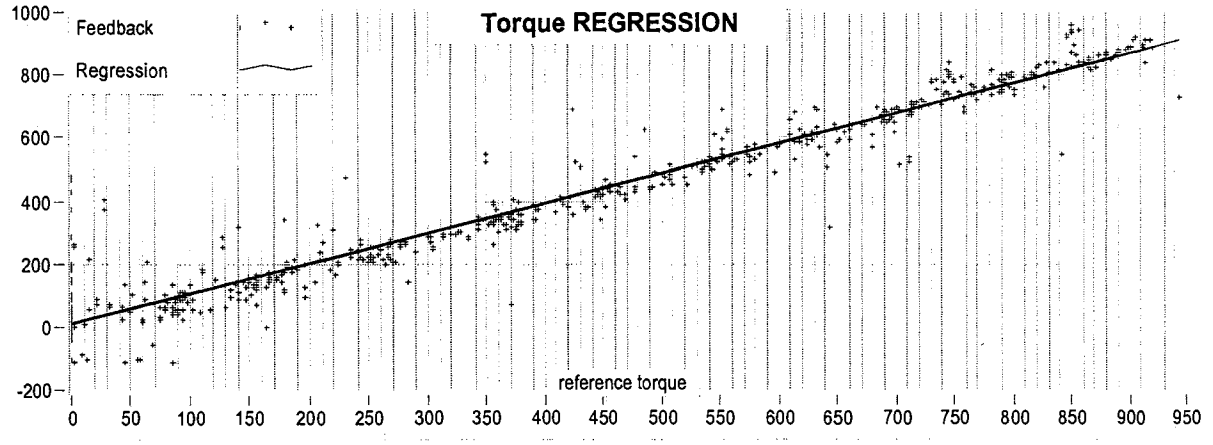
	SPEED	TORQUE	POWER
SE	21	6	5
M	0.991	0.96	0.97
R2	0.9961	0.9622	0.9769
B	1	10	0.9
NO. PTS.	1174	1013	1013

TIME DELAY [sec]	0.30
CYCLE WORK [HP-HR]	19.86
REFERENCE WORK [HP-HR]	19.44
PERCENT DIFFERENCE	2.17

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/6/02
Time: 11:15 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M12DBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 23

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

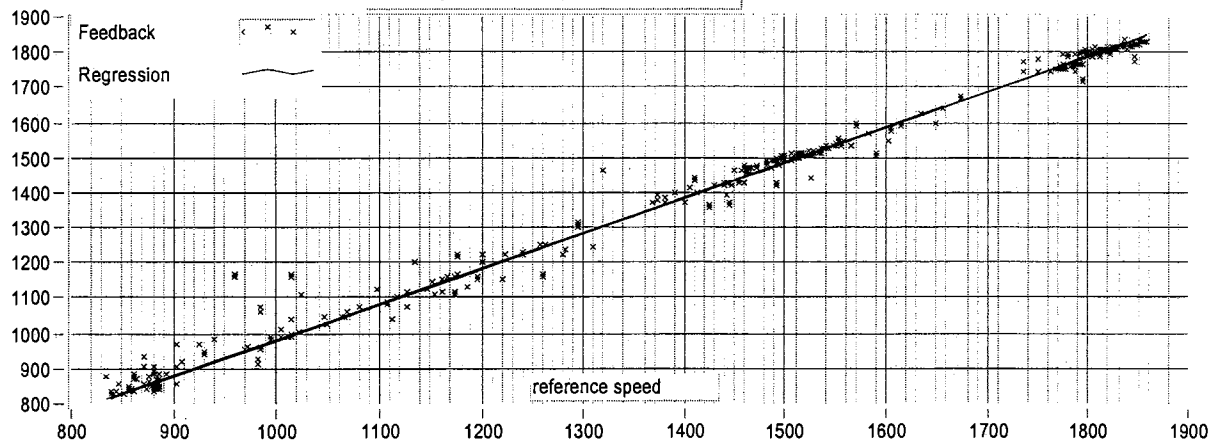
STATS FAIL

WORK PASS

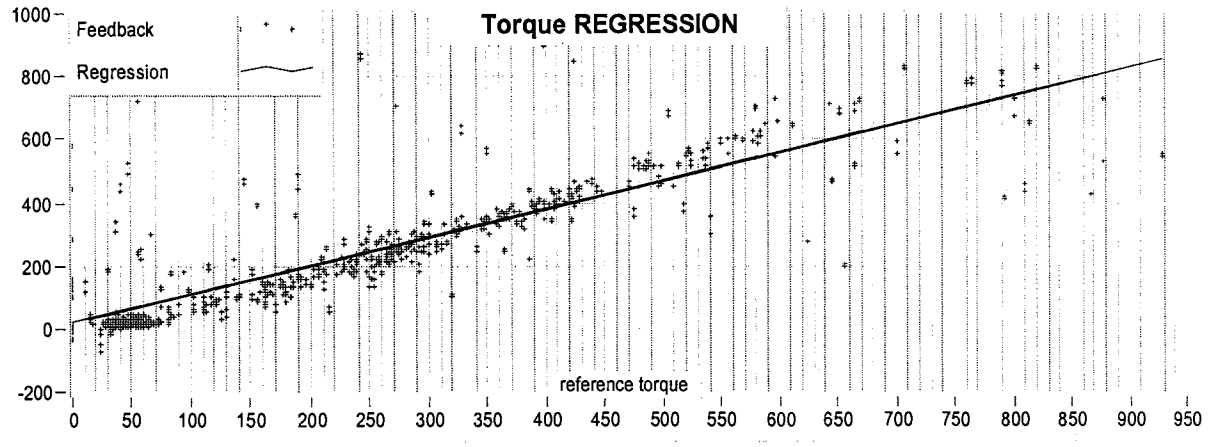
TIME DELAY [sec]	0.30
CYCLE WORK [HP-HR]	16.10
REFERENCE WORK [HP-HR]	16.11
PERCENT DIFFERENCE	-0.06

	SPEED	TORQUE	POWER
SE	26	13	11
M	1.011	0.90	0.94
R2	0.9957	0.6774	0.7886
B	-31	20	2.5
NO. PTS.	915	932	932

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/11/02
Time: 8:41 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M2NRFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 29

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

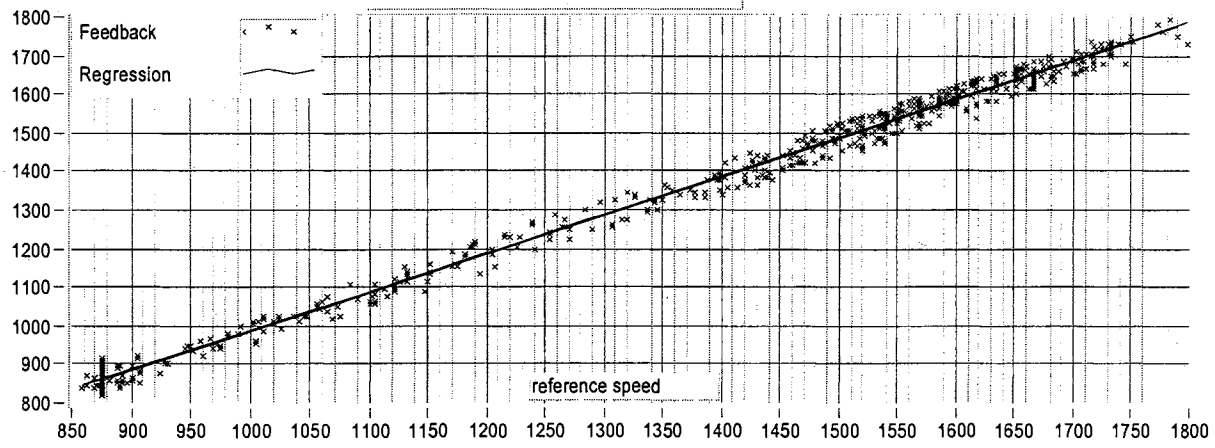
STATS PASS

TIME DELAY [sec]	0.41
CYCLE WORK [HP-HR]	20.01
REFERENCE WORK [HP-HR]	19.61
PERCENT DIFFERENCE	2.01

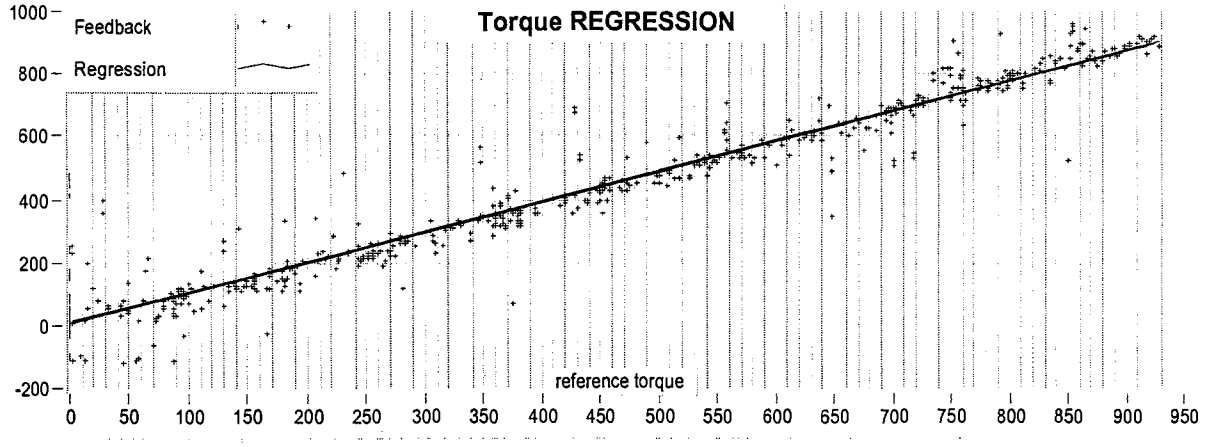
WORK PASS

	SPEED	TORQUE	POWER
SE	21	6	5
M	1.001	0.96	0.97
R2	0.9962	0.9632	0.9778
B	-14	8	0.6
NO. PTS.	1174	1013	1013

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/11/02
Time: 9:24 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M2NRFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 30

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

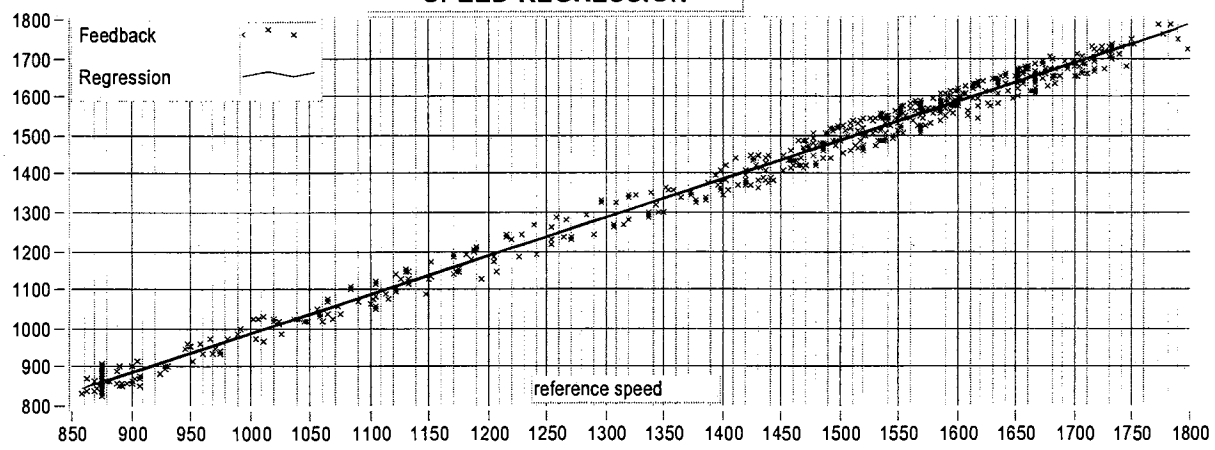
STATS PASS

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	20.02
REFERENCE WORK [HP-HR]	19.61
PERCENT DIFFERENCE	2.04

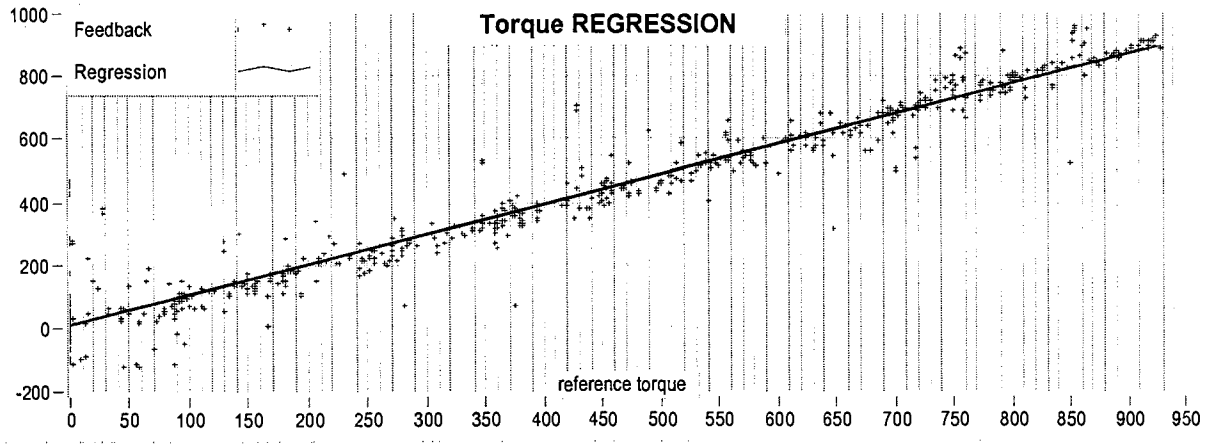
WORK PASS

	SPEED	TORQUE	POWER
SE	21	6	5
M	1.001	0.96	0.97
R2	0.9961	0.9612	0.9768
B	-15	10	0.9
NO. PTS.	1174	1013	1013

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 6/11/02
Time: 10:31 AM
Engine ID.
CUMMINS M-11
34872033
Test No.
M2NRBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 32

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

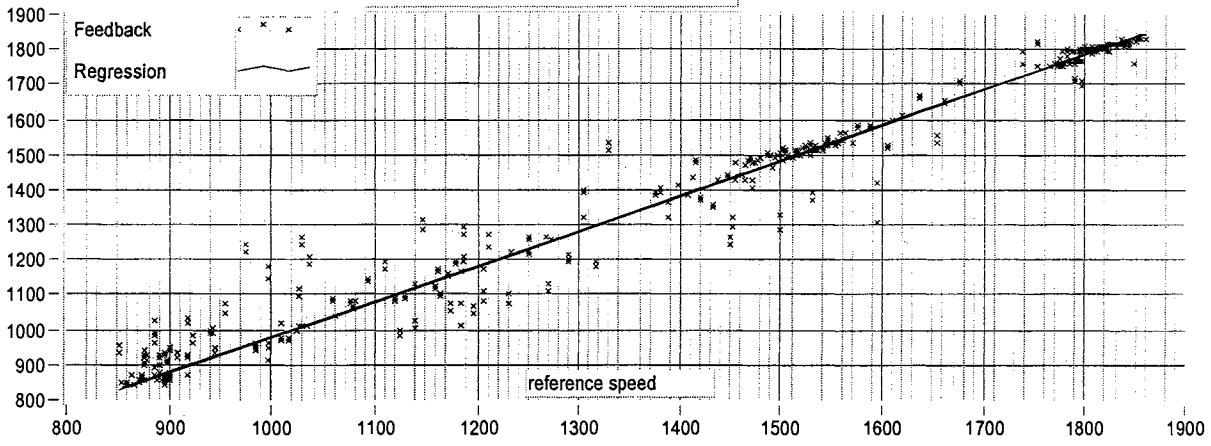
STATS FAIL

WORK PASS

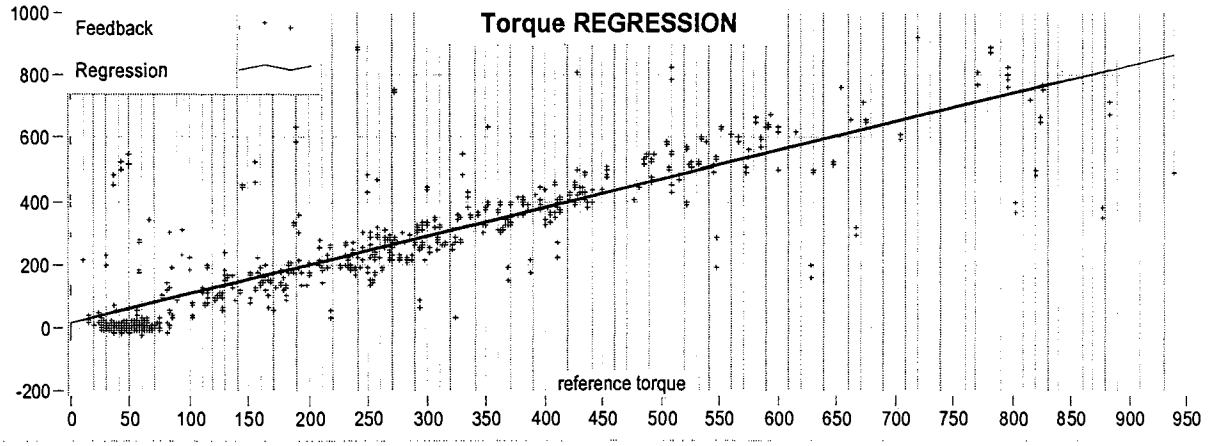
	SPEED	TORQUE	POWER
SE	44	14	12
M	1.009	0.91	0.93
R2	0.9871	0.6568	0.7519
B	-30	16	3.4
NO. PTS.	915	940	940

TIME DELAY [sec]	0.60
CYCLE WORK [HP-HR]	16.30
REFERENCE WORK [HP-HR]	16.39
PERCENT DIFFERENCE	-0.60

SPEED REGRESSION



Torque REGRESSION



APPENDIX E

DETAILED COMPUTER PRINTOUTS FOR TRANSIENT EMISSION TESTS ON A CATERPILLAR 3196 ENGINE OVER FTP, BHL, AND SAT CYCLES USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
E02DFTP1	FTP	2D	Without	Transient Cycle Emissions Summary	E-1
E02DFTP2	FTP	2D	Without	Transient Cycle Emissions Summary	E-2
E02DBHL1	BHL	2D	Without	Transient Cycle Emissions Summary	E-3
E02DBHL2	BHL	2D	Without	Transient Cycle Emissions Summary	E-4
E02DSAT1	SAT	2D	Without	Transient Cycle Emissions Summary	E-5
E02DSAT2	SAT	2D	Without	Transient Cycle Emissions Summary	E-6
E12DFTP1	FTP	2D	Yes	Transient Cycle Emissions Summary	E-7
E12DFTP2	FTP	2D	Yes	Transient Cycle Emissions Summary	E-9
E12DBHL1	BHL	2D	Yes	Transient Cycle Emissions Summary	E-11
E2NRFTP1	FTP	NR	Yes	Transient Cycle Emissions Summary	E-13
E2NRFTP2	FTP	NR	Yes	Transient Cycle Emissions Summary	E-15
E2NRBHL1	BHL	NR	Yes	Transient Cycle Emissions Summary	E-17

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E02DFTP1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	07/31/2002 Time: 09:00	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Baseline			

Ambient/Test Cell Conditions

Barometer:	29.19	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	74.5	gr/lb	10.6 g/kg
Rel. Humidity:	60	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	76.7	gr/lb	11.0 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.57	ppm	
HC Bckgrd	n/a		4.60	ppm	
CO	15.3	2	14.61	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		37.34	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	45.8	1	0.3379	%	(Wet)
CO2 Bckgrd	7.7	1	0.0490	%	

Corrected Concentrations

HC	2.08	ppm
CO	14.03	ppm
NOx	36.48	ppm
CO2	0.2901	%

Mass Emissions

HC		3.533	grams	
CO		48.194	grams	
NOx		205.570	grams	
Particulate		4.506	grams	
CO2		15.659	kg	
Fuel	10.91	lb	4.95	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,049.7	86.37
Blower 2 Rate:	2,128.7	60.29
90 mm System:		
Gas Meter 1:	1.85	0.05
Gas Meter 2:	4.16	0.12
Sample Rate:	2.31	0.07
Total Flow Rate:	5,180.69	146.72

Particulate Data

Filter Number:	4215.0-450 (pair)	
Weight Gain:	2.012	mg
Sample Multiplier:	2.240	

Correction Factors

NOx Humidity CF:	0.999
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	40.04

Test Cycle Data

Sample Time:	1,206.50	sec		
Work:	31.64	hp-hr	23.59	kW-hr
Reference Work:	31.24	hp-hr	23.30	kW-hr
Total Volume (Vmix):	104,175.1	scf	2,950.30	scm

Brake-Specific Emission Results

BSHC (Cell)	0.112	g/hp-hr	0.150	g/kW-hr
CO	1.523	g/hp-hr	2.043	g/kW-hr
NOx (Cell)	6.497	g/hp-hr	8.713	g/kW-hr
Particulate	0.142	g/hp-hr	0.191	g/kW-hr
CO2	494.9	g/hp-hr	663.68	g/kW-hr
BSFC	0.345	lb/hp-hr	0.210	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E02DFTP2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	07/31/2002 Time: 09:40	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Baseline			

Ambient/Test Cell Conditions

Barometer:	29.18	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	58.8	°F	14.9 °C
Abs. Humidity:	76.2	gr/lb	10.9 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	50.3	gr/lb	7.2 g/kg
Rel. Humidity:	29	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		5.78	ppm	
HC Bckgrd	n/a		5.00	ppm	
CO	13.7	2	13.06	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		36.75	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	45.7	1	0.3370	%	(Wet)
CO2 Bckgrd	7.5	1	0.0477	%	

Corrected Concentrations

HC	0.90	ppm
CO	12.04	ppm
NOx	36.09	ppm
CO2	0.2905	%

Mass Emissions

HC	1.531	grams	
CO	41.309	grams	
NOx	204.004	grams	
Particulate	3.818	grams	
CO2	15.659	kg	
Fuel	10.89 lb	4.94	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,047.8	86.32
Blower 2 Rate:	2,127.9	60.26
90 mm System:		
Gas Meter 1:	1.84	0.05
Gas Meter 2:	4.22	0.12
Sample Rate:	2.38	0.07
Total Flow Rate:	5,178.08	146.65

Particulate Data

Filter Number:	4216.0-451 (pair)	
Weight Gain:	1.755	mg
Sample Multiplier:	2.176	

Correction Factors

NOx Humidity CF:	1.003
Dry-to-Wet CF, Sample:	0.986
Dry-to-Wet CF, Bckgrd:	0.989
Dilution Factor:	40.17

Test Cycle Data

Sample Time:	1,205.60	sec		
Work:	31.67	hp-hr	23.62	kW-hr
Reference Work:	31.24	hp-hr	23.30	kW-hr
Total Volume (Vmix):	104,044.8	scf	2,946.61	scm

Brake-Specific Emission Results

BSHC (Cell)	0.048	g/hp-hr	0.065	g/kW-hr
CO	1.304	g/hp-hr	1.749	g/kW-hr
NOx (Cell)	6.442	g/hp-hr	8.638	g/kW-hr
Particulate	0.121	g/hp-hr	0.162	g/kW-hr
CO2	494.4	g/hp-hr	663.05	g/kW-hr
BSFC	0.344	lb/hp-hr	0.209	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E02DBHL1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 07/31/2002 Time: 03:06	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Baseline	

Ambient/Test Cell Conditions

Barometer:	29.12	in Hg	98.6 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	61.7	°F	16.5 °C
Abs. Humidity:	84.8	gr/lb	12.1 g/kg
Rel. Humidity:	65	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	50.5	gr/lb	7.2 g/kg
Rel. Humidity:	29	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		5.99	ppm	
HC Bckgrd	n/a		3.40	ppm	
CO	14.6	2	13.93	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		37.54	ppm	(Dry)
NOx Bckgrd	0.2	1	0.05	ppm	
CO2 Sample	47.5	1	0.3537	%	(Wet)
CO2 Bckgrd	6.3	1	0.0400	%	

Corrected Concentrations

HC	2.68	ppm
CO	13.35	ppm
NOx	36.94	ppm
CO2	0.3147	%

Mass Emissions

HC		3.566	grams	
CO		36.014	grams	
NOx		168.009	grams	
Particulate		3.499	grams	
CO2		13.345	kg	
Fuel	9.29	lb	4.21	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,051.2	86.41
Blower 2 Rate:	2,129.6	60.31
90 mm System:		
Gas Meter 1:	1.25	0.04
Gas Meter 2:	4.17	0.12
Sample Rate:	2.92	0.08
Total Flow Rate:	5,183.73	146.81

Particulate Data

Filter Number:	4219.0-454 (pair)	
Weight Gain:	1.971	mg
Sample Multiplier:	1.775	

Correction Factors

NOx Humidity CF:	1.026
Dry-to-Wet CF, Sample:	0.985
Dry-to-Wet CF, Bckgrd:	0.989
Dilution Factor:	38.27

Test Cycle Data

Sample Time:	947.20	sec		
Work:	26.21	hp-hr	19.54	kW-hr
Reference Work:	24.95	hp-hr	18.61	kW-hr
Total Volume (Vmix):	81,833.8	scf	2,317.58	scm

Brake-Specific Emission Results

BSHC (Cell)	0.136	g/hp-hr	0.182	g/kW-hr
CO	1.374	g/hp-hr	1.843	g/kW-hr
NOx (Cell)	6.410	g/hp-hr	8.596	g/kW-hr
Particulate	0.134	g/hp-hr	0.179	g/kW-hr
CO2	509.1	g/hp-hr	682.77	g/kW-hr
BSFC	0.354	lb/hp-hr	0.216	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E02DBHL2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	07/31/2002 Time: 03:41	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code:	EM-3049-EO
		Baseline			

Ambient/Test Cell Conditions

Barometer:	29.10	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	62.2	°F	16.8 °C
Abs. Humidity:	86.4	gr/lb	12.3 g/kg
Rel. Humidity:	64	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	75.3	gr/lb	10.8 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.59	ppm	
HC Bckgrd	n/a		3.90	ppm	
CO	15.1	2	14.42	ppm	(Dry)
CO Bckgrd	0.8	2	0.75	ppm	
NOx Sample	n/a		37.29	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	47.7	1	0.3556	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	

Corrected Concentrations

HC	2.79	ppm
CO	13.40	ppm
NOx	36.41	ppm
CO2	0.3135	%

Mass Emissions

HC	3.703	grams		
CO	36.012	grams		
NOx	165.639	grams		
Particulate	2.988	grams		
CO2	13.240	kg		
Fuel	9.22	lb	4.18	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,037.9	86.03
Blower 2 Rate:	2,122.3	60.10
90 mm System:		
Gas Meter 1:	1.25	0.04
Gas Meter 2:	4.26	0.12
Sample Rate:	3.01	0.09
Total Flow Rate:	5,163.11	146.22

Particulate Data

Filter Number:	4331.0-455 (pair)	
Weight Gain:	1.742	mg
Sample Multiplier:	1.715	

Correction Factors

NOx Humidity CF:	1.031
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	38.06

Test Cycle Data

Sample Time:	947.20	sec		
Work:	26.25	hp-hr	19.57	kW-hr
Reference Work:	24.95	hp-hr	18.61	kW-hr
Total Volume (Vmix):	81,508.4	scf	2,308.37	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.141 g/hp-hr	0.189	g/kW-hr
CO		1.372 g/hp-hr	1.840	g/kW-hr
NOx	(Cell)	6.310 g/hp-hr	8.462	g/kW-hr
Particulate		0.114 g/hp-hr	0.153	g/kW-hr
CO2		504.4 g/hp-hr	676.41	g/kW-hr
BSFC		0.351 lb/hp-hr	0.214	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E02DSAT1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	07/31/2002 Time: 01:21	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Baseline			

Ambient/Test Cell Conditions

Barometer:	29.16	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	60.3	°F	15.7 °C
Abs. Humidity:	80.5	gr/lb	11.5 g/kg
Rel. Humidity:	62	%	
Dilution Air:			
Temperature:	84.0	°F	28.9 °C
Abs. Humidity	48.7	gr/lb	7.0 g/kg
Rel. Humidity:	27	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.20	ppm	
HC Bckgrd	n/a		3.00	ppm	
CO	15.8	2	15.10	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		54.92	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	62.7	1	0.5109	%	(Wet)
CO2 Bckgrd	6.7	1	0.0425	%	

Corrected Concentrations

HC	3.31	ppm
CO	14.47	ppm
NOx	53.94	ppm
CO2	0.4700	%

Mass Emissions

HC	5.778	grams	
CO	51.138	grams	
NOx	317.719	grams	
Particulate	5.118	grams	
CO2	26.107	kg	
Fuel	18.15 lb	8.23	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,041.0	86.12
Blower 2 Rate:	2,122.4	60.11
90 mm System:		
Gas Meter 1:	1.62	0.05
Gas Meter 2:	4.13	0.12
Sample Rate:	2.51	0.07
Total Flow Rate:	5,165.96	146.30

Particulate Data

Filter Number:	4217.0-452 (pair)	
Weight Gain:	2.490	mg
Sample Multiplier:	2.056	

Correction Factors

NOx Humidity CF:	1.014
Dry-to-Wet CF, Sample:	0.984
Dry-to-Wet CF, Bckgrd:	0.989
Dilution Factor:	26.53

Test Cycle Data

Sample Time:	1,245.20	sec		
Work:	55.01	hp-hr	41.02	kW-hr
Reference Work:	56.64	hp-hr	42.24	kW-hr
Total Volume (Vmix):	107,210.8	scf	3,036.27	scm

Brake-Specific Emission Results

BSHC (Cell)	0.105	g/hp-hr	0.141	g/kW-hr
CO	0.930	g/hp-hr	1.247	g/kW-hr
NOx (Cell)	5.776	g/hp-hr	7.745	g/kW-hr
Particulate	0.093	g/hp-hr	0.125	g/kW-hr
CO2	474.6	g/hp-hr	636.42	g/kW-hr
BSFC	0.330	lb/hp-hr	0.201	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E02DSAT2	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 07/31/2002 Time: 02:01	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Baseline	

Ambient/Test Cell Conditions

Barometer:	29.14	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	61.8	°F	16.6 °C
Abs. Humidity:	85.0	gr/lb	12.1 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	55.1	gr/lb	7.9 g/kg
Rel. Humidity:	32	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.42	ppm	
HC Bckgrd	n/a		3.30	ppm	
CO	15.0	2	14.32	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		54.34	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	62.7	1	0.5109	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	

Corrected Concentrations

HC	3.24	ppm
CO	13.85	ppm
NOx	53.31	ppm
CO2	0.4681	%

Mass Emissions

HC		5.652	grams	
CO		48.911	grams	
NOx		317.521	grams	
Particulate		5.121	grams	
CO2		25.971	kg	
Fuel	18.05	lb	8.19	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,037.7	86.03
Blower 2 Rate:	2,118.8	60.01
90 mm System:		
Gas Meter 1:	1.62	0.05
Gas Meter 2:	4.13	0.12
Sample Rate:	2.52	0.07
Total Flow Rate:	5,159.01	146.11

Particulate Data

Filter Number:	4218.0-453 (pair)	
Weight Gain:	2.497	mg
Sample Multiplier:	2.051	

Correction Factors

NOx Humidity CF:	1.027
Dry-to-Wet CF, Sample:	0.983
Dry-to-Wet CF, Bckgrd:	0.987
Dilution Factor:	26.54

Test Cycle Data

Sample Time:	1,245.50	sec		
Work:	55.02	hp-hr	41.03	kW-hr
Reference Work:	56.64	hp-hr	42.24	kW-hr
Total Volume (Vmix):	107,092.4	scf	3,032.92	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.103 g/hp-hr	0.138	g/kW-hr
CO		0.889 g/hp-hr	1.192	g/kW-hr
NOx	(Cell)	5.771 g/hp-hr	7.739	g/kW-hr
Particulate		0.093 g/hp-hr	0.125	g/kW-hr
CO2		472.0 g/hp-hr	633.00	g/kW-hr
BSFC		0.328 lb/hp-hr	0.200	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DFTP1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/06/2002 Time: 09:09	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

Ambient/Test Cell Conditions

Barometer:	29.15	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	56.7	°F	13.7 °C
Abs. Humidity:	70.6	gr/lb	10.1 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	71.6	gr/lb	10.2 g/kg
Rel. Humidity:	47	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,039.2	86.07
Blower 2 Rate:	2,113.0	59.84
90 mm System:		
Gas Meter 1:	1.54	0.04
Gas Meter 2:	4.21	0.12
Sample Rate:	2.67	0.08
20X20 Sample Rate:	56.55	1.60
47 mm Sample Rate:	51.50	1.46
Chemistry Sample Rate:	0.133	0.076
Total Flow Rate:	5,263.05	149.12

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.71	ppm	
HC Bckgrd	8.4	2	8.48	ppm	
CO	13.6	2	12.96	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		36.07	ppm	(Dry)
NOx Bckgrd	0.2	1	0.05	ppm	
CO2 Sample	45.2	1	0.3324	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	
CH4 Sample	n/a	n/a	2.39	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.50	ppm	

Particulate Data

Filter Number:	4396.0-500 (pair)	
Weight Gain:	1.911	mg
Sample Multiplier:	1.969	

Correction Factors

NOx Humidity CF:	0.989
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	40.68

Corrected Concentrations

HC	1.44	ppm	
CO	12.05	ppm	
NOx	35.33	ppm	
CO2	0.2890	%	
CH4	-0.05	ppm	(1.00)

Test Cycle Data

Sample Time:	1,206.30	sec		
Work:	31.62	hp-hr	23.58	kW-hr
Reference Work:	31.24	hp-hr	23.30	kW-hr
Total Volume (Vmix):	105,811.0	scf	2,996.63	scm

Mass Emissions

HC	2.476	grams	
CO	42.028	grams	
NOx	200.181	grams	
Particulate	3.763	grams	
CO2	15.843	kg	
CH4	0.000	grams	
Fuel	11.02 lb	5.00	kg

Brake-Specific Emission Results

BSHC (Cell)	0.078	g/hp-hr	0.105	g/kW-hr
CO	1.329	g/hp-hr	1.782	g/kW-hr
NOx (Cell)	6.331	g/hp-hr	8.490	g/kW-hr
Particulate	0.119	g/hp-hr	0.160	g/kW-hr
CO2	501.0	g/hp-hr	671.90	g/kW-hr
BSFC	0.349	lb/hp-hr	0.212	kg/kW-hr
NMHC	0.068	g/hp-hr	0.091	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DFTP1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/06/2002 Time: 09:09	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.125 ppm	0.005 ppm
Mass	443.12 mg	
Acetaldehyde		
Concentration	0.035 ppm	0.003 ppm
Mass	173.21 mg	
Acrolein		
Concentration	0.003 ppm	0.000 ppm
Mass	20.21 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	6.91 mg	
Crotonaldehyde		
Concentration	0.006 ppm	0.000 ppm
Mass	48.58 mg	
Isobutyr + MEK		
Concentration	0.004 ppm	0.000 ppm
Mass	30.93 mg	
Benzaldehyde		
Concentration	0.003 ppm	0.000 ppm
Mass	43.39 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	

Brake-Specific Results

Formaldehyde	14.014 mg/hp-hr	Crotonaldehyde	1.536 mg/hp-hr
Acetaldehyde	5.478 mg/hp-hr	Isobutyr + MEK	0.978 mg/hp-hr
Acrolein	0.639 mg/hp-hr	Benzaldehyde	1.372 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.000 mg/hp-hr
Propionaldehyde	0.219 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E12DFTP2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/06/2002 Time: 09:49	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.16	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	71.9	gr/lb	10.3 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.3	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,039.7	86.09
Blower 2 Rate:	2,113.6	59.86
90 mm System:		
Gas Meter 1:	1.54	0.04
Gas Meter 2:	4.21	0.12
Sample Rate:	2.67	0.08
20X20 Sample Rate:	58.84	1.67
47 mm Sample Rate:	51.28	1.45
Chemistry Sample Rate:	0.135	0.077
Total Flow Rate:	5,266.26	149.22

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		10.43	ppm	
HC Bckgrd	n/a		9.90	ppm	
CO	15.6	2	14.90	ppm	(Dry)
CO Bckgrd	2.3	2	2.16	ppm	
NOx Sample	n/a		35.97	ppm	(Dry)
NOx Bckgrd	0.7	1	0.18	ppm	
CO2 Sample	45.0	1	0.3306	%	(Wet)
CO2 Bckgrd	7.5	1	0.0477	%	
CH4 Sample	n/a	n/a	2.38	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.32	ppm	

Particulate Data

Filter Number:	4397.0-501 (pair)	
Weight Gain:	2.019	mg
Sample Multiplier:	1.971	

Correction Factors

NOx Humidity CF:	0.992
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	40.86

Corrected Concentrations

HC	0.77	ppm	
CO	12.51	ppm	
NOx	35.09	ppm	
CO2	0.2841	%	
CH4	0.12	ppm	(1.00)

Test Cycle Data

Sample Time:	1,206.40	sec		
Work:	31.56	hp-hr	23.53	kW-hr
Reference Work:	31.24	hp-hr	23.30	kW-hr
Total Volume (Vmix):	105,884.3	scf	2,998.70	scm

Mass Emissions

HC	1.330	grams	
CO	43.683	grams	
NOx	199.629	grams	
Particulate	3.980	grams	
CO2	15.584	kg	
CH4	0.241	grams	
Fuel	10.84 lb	4.92	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.042 g/hp-hr	0.057	g/kW-hr
CO		1.384 g/hp-hr	1.856	g/kW-hr
NOx	(Cell)	6.325 g/hp-hr	8.482	g/kW-hr
Particulate		0.126 g/hp-hr	0.169	g/kW-hr
CO2		493.8 g/hp-hr	662.16	g/kW-hr
BSFC		0.344 lb/hp-hr	0.209	kg/kW-hr
NMHC		0.037 g/hp-hr	0.049	g/kW-hr
CH4		0.008 g/hp-hr	0.010	g/kW-hr

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EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E12DFTP2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/06/2002 Time: 09:49	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

	Sample		Background	
Formaldehyde				
Concentration	0.128	ppm	0.005	ppm
Mass	452.20	mg		
Acetaldehyde				
Concentration	0.032	ppm	0.003	ppm
Mass	161.31	mg		
Acrolein				
Concentration	0.002	ppm	0.000	ppm
Mass	16.77	mg		
Acetone				
Concentration	0.000	ppm	0.000	ppm
Mass	0.00	mg		
Propionaldehyde				
Concentration	0.000	ppm	0.000	ppm
Mass	0.00	mg		
Crotonaldehyde				
Concentration	0.007	ppm	0.000	ppm
Mass	60.32	mg		
Isobutyr + MEK				
Concentration	0.003	ppm	0.000	ppm
Mass	28.07	mg		
Benzaldehyde				
Concentration	0.000	ppm	0.000	ppm
Mass	5.06	mg		
Hexanaldehyde				
Concentration	0.000	ppm	0.000	ppm
Mass	0.00	mg		

Brake-Specific Results

Formaldehyde	14.328	mg/hp-hr	Crotonaldehyde	1.911	mg/hp-hr
Acetaldehyde	5.111	mg/hp-hr	Isobutyr + MEK	0.889	mg/hp-hr
Acrolein	0.531	mg/hp-hr	Benzaldehyde	0.160	mg/hp-hr
Acetone	0.000	mg/hp-hr	Hexanaldehyde	0.000	mg/hp-hr
Propionaldehyde	0.000	mg/hp-hr			

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EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E12DBHL1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/06/2002 Time: 10:58	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.15	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	68.8	gr/lb	9.8 g/kg
Rel. Humidity:	57	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.3	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,070.5	86.96
Blower 2 Rate:	2,136.2	60.50
90 mm System:		
Gas Meter 1:	1.32	0.04
Gas Meter 2:	4.18	0.12
Sample Rate:	2.85	0.08
20X20 Sample Rate:	58.14	1.65
47 mm Sample Rate:	51.01	1.44
Chemistry Sample Rate:	0.132	0.059
Total Flow Rate:	5,318.82	150.69

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		8.67	ppm	
HC Bckgrd	n/a		6.60	ppm	
CO	13.5	2	12.87	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		38.10	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	46.5	1	0.3444	%	(Wet)
CO2 Bckgrd	7.4	1	0.0471	%	
CH4 Sample	n/a	n/a	2.10	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.07	ppm	

Particulate Data

Filter Number:	4398.0-502 (pair)	
Weight Gain:	1.867	mg
Sample Multiplier:	1.864	

Correction Factors

NOx Humidity CF:	0.984
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	39.28

Corrected Concentrations

HC	2.24	ppm	
CO	12.34	ppm	
NOx	37.27	ppm	
CO2	0.2985	%	
CH4	0.09	ppm	(1.00)

Test Cycle Data

Sample Time:	947.40	sec		
Work:	25.99	hp-hr	19.38	kW-hr
Reference Work:	24.95	hp-hr	18.61	kW-hr
Total Volume (Vmix):	83,982.2	scf	2,378.42	scm

Mass Emissions

HC	3.058	grams	
CO	34.174	grams	
NOx	166.827	grams	
Particulate	3.479	grams	
CO2	12.988	kg	
CH4	0.141	grams	
Fuel	9.04 lb	4.10	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.118 g/hp-hr	0.158	g/kW-hr
CO		1.315 g/hp-hr	1.763	g/kW-hr
NOx	(Cell)	6.419 g/hp-hr	8.608	g/kW-hr
Particulate		0.134 g/hp-hr	0.180	g/kW-hr
CO2		499.7 g/hp-hr	670.15	g/kW-hr
BSFC		0.348 lb/hp-hr	0.212	kg/kW-hr
NMHC		0.102 g/hp-hr	0.137	g/kW-hr
CH4		0.005 g/hp-hr	0.007	g/kW-hr

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EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DBHL1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/06/2002 Time: 10:58	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.120 ppm	0.005 ppm
Mass	336.93 mg	
Acetaldehyde		
Concentration	0.029 ppm	0.003 ppm
Mass	112.47 mg	
Acrolein		
Concentration	0.002 ppm	0.000 ppm
Mass	13.33 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Crotonaldehyde		
Concentration	0.007 ppm	0.000 ppm
Mass	44.35 mg	
Isobutyr + MEK		
Concentration	0.002 ppm	0.000 ppm
Mass	16.89 mg	
Benzaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	

Brake-Specific Results

Formaldehyde	12.964 mg/hp-hr	Crotonaldehyde	1.706 mg/hp-hr
Acetaldehyde	4.328 mg/hp-hr	Isobutyr + MEK	0.650 mg/hp-hr
Acrolein	0.513 mg/hp-hr	Benzaldehyde	0.000 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.000 mg/hp-hr
Propionaldehyde	0.000 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E2NRFTP1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/08/2002 Time: 09:07	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.15	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	55.1	°F	12.8 °C
Abs. Humidity:	66.6	gr/lb	9.5 g/kg
Rel. Humidity:	53	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.0	gr/lb	10.7 g/kg
Rel. Humidity:	48	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,044.5	86.22
Blower 2 Rate:	2,123.2	60.13
90 mm System:		
Gas Meter 1:	1.46	0.04
Gas Meter 2:	4.19	0.12
Sample Rate:	2.73	0.08
20X20 Sample Rate:	58.54	1.66
47 mm Sample Rate:	50.91	1.44
Chemistry Sample Rate:	0.133	0.076
Total Flow Rate:	5,280.02	149.61

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		8.93	ppm	
HC Bckgrd	7.5	2	7.58	ppm	
CO	13.7	2	13.06	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		36.62	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	45.6	1	0.3361	%	(Wet)
CO2 Bckgrd	7.7	1	0.0490	%	
CH4 Sample	n/a	n/a	2.11	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.20	ppm	

Particulate Data

Filter Number:	4433.0-545 (pair)	
Weight Gain:	2.921	mg
Sample Multiplier:	1.934	

Correction Factors

NOx Humidity CF:	0.979
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	40.24

Corrected Concentrations

HC	1.54	ppm	
CO	11.97	ppm	
NOx	35.79	ppm	
CO2	0.2883	%	
CH4	-0.03	ppm	(1.00)

Test Cycle Data

Sample Time:	1,206.30	sec		
Work:	32.04	hp-hr	23.89	kW-hr
Reference Work:	31.47	hp-hr	23.47	kW-hr
Total Volume (Vmix):	106,152.1	scf	3,006.29	scm

Mass Emissions

HC	2.657	grams	
CO	41.890	grams	
NOx	201.358	grams	
Particulate	5.648	grams	
CO2	15.857	kg	
CH4	0.000	grams	
Fuel	11.03 lb	5.00	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.083 g/hp-hr	0.111	g/kW-hr
CO		1.307 g/hp-hr	1.753	g/kW-hr
NOx	(Cell)	6.285 g/hp-hr	8.428	g/kW-hr
Particulate		0.176 g/hp-hr	0.236	g/kW-hr
CO2		494.9 g/hp-hr	663.68	g/kW-hr
BSFC		0.344 lb/hp-hr	0.209	kg/kW-hr
NMHC		0.072 g/hp-hr	0.097	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

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EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRFTP1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/08/2002 Time: 09:07	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.123 ppm	0.005 ppm
Mass	435.57 mg	
Acetaldehyde		
Concentration	0.030 ppm	0.002 ppm
Mass	153.78 mg	
Acrolein		
Concentration	0.006 ppm	0.000 ppm
Mass	39.17 mg	
Acetone		
Concentration	0.000 ppm	0.001 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.009 ppm	0.000 ppm
Mass	64.68 mg	
Crotonaldehyde		
Concentration	0.006 ppm	0.000 ppm
Mass	50.21 mg	
Isobutyr + MEK		
Concentration	0.004 ppm	0.001 ppm
Mass	30.92 mg	
Benzaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	

Brake-Specific Results

Formaldehyde	13.595 mg/hp-hr	Crotonaldehyde	1.567 mg/hp-hr
Acetaldehyde	4.800 mg/hp-hr	Isobutyr + MEK	0.965 mg/hp-hr
Acrolein	1.222 mg/hp-hr	Benzaldehyde	0.000 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.000 mg/hp-hr
Propionaldehyde	2.019 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRFTP2	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/08/2002 Time: 09:47	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

Ambient/Test Cell Conditions

Barometer:	29.16	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	57.4	°F	14.1 °C
Abs. Humidity:	72.4	gr/lb	10.3 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.3	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,045.4	86.25
Blower 2 Rate:	2,125.3	60.19
90 mm System:		
Gas Meter 1:	1.45	0.04
Gas Meter 2:	4.15	0.12
Sample Rate:	2.70	0.08
20X20 Sample Rate:	58.89	1.67
47 mm Sample Rate:	50.93	1.44
Chemistry Sample Rate:	0.135	0.077
Total Flow Rate:	5,283.30	149.70

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		8.54	ppm	
HC Bckgrd	7.2	2	7.28	ppm	
CO	13.9	2	13.25	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		35.49	ppm	(Dry)
NOx Bckgrd	0.9	1	0.23	ppm	
CO2 Sample	45.2	1	0.3324	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	
CH4 Sample	n/a	n/a	2.18	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.17	ppm	

Particulate Data

Filter Number:	4434.0-546 (pair)	
Weight Gain:	2.933	mg
Sample Multiplier:	1.958	

Correction Factors

NOx Humidity CF:	0.993
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	40.69

Corrected Concentrations

HC	1.44	ppm	
CO	12.34	ppm	
NOx	34.57	ppm	
CO2	0.2871	%	
CH4	0.06	ppm	(1.00)

Test Cycle Data

Sample Time:	1,206.30	sec		
Work:	31.88	hp-hr	23.77	kW-hr
Reference Work:	31.47	hp-hr	23.47	kW-hr
Total Volume (Vmix):	106,218.1	scf	3,008.16	scm

Mass Emissions

HC	2.486	grams	
CO	43.211	grams	
NOx	197.561	grams	
Particulate	5.743	grams	
CO2	15.802	kg	
CH4	0.128	grams	
Fuel	11.00 lb	4.99	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.078 g/hp-hr	0.105	g/kW-hr
CO		1.355 g/hp-hr	1.818	g/kW-hr
NOx	(Cell)	6.197 g/hp-hr	8.310	g/kW-hr
Particulate		0.180 g/hp-hr	0.242	g/kW-hr
CO2		495.7 g/hp-hr	664.70	g/kW-hr
BSFC		0.345 lb/hp-hr	0.210	kg/kW-hr
NMHC		0.068 g/hp-hr	0.091	g/kW-hr
CH4		0.004 g/hp-hr	0.005	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRFTP2	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/08/2002 Time: 09:47	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.129 ppm	0.005 ppm
Mass	457.24 mg	
Acetaldehyde		
Concentration	0.032 ppm	0.002 ppm
Mass	162.49 mg	
Acrolein		
Concentration	0.005 ppm	0.000 ppm
Mass	37.10 mg	
Acetone		
Concentration	0.000 ppm	0.001 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.010 ppm	0.000 ppm
Mass	67.95 mg	
Crotonaldehyde		
Concentration	0.006 ppm	0.000 ppm
Mass	49.95 mg	
Isobutyr + MEK		
Concentration	0.004 ppm	0.001 ppm
Mass	31.10 mg	
Benzaldehyde		
Concentration	0.002 ppm	0.000 ppm
Mass	14.15 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	

Brake-Specific Results

Formaldehyde	14.342 mg/hp-hr	Crotonaldehyde	1.567 mg/hp-hr
Acetaldehyde	5.097 mg/hp-hr	Isobutyr + MEK	0.975 mg/hp-hr
Acrolein	1.164 mg/hp-hr	Benzaldehyde	0.444 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.000 mg/hp-hr
Propionaldehyde	2.131 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E2NRBHL1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/08/2002 Time: 10:54	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.17	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	61.1	°F	16.2 °C
Abs. Humidity:	82.8	gr/lb	11.8 g/kg
Rel. Humidity:	60	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.0	gr/lb	10.7 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		8.10	ppm	
HC Bckgrd	6.5	2	6.57	ppm	
CO	14.8	2	14.13	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		36.77	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	46.6	1	0.3453	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	
CH4 Sample	n/a	n/a	2.22	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.14	ppm	

Corrected Concentrations

HC	1.70	ppm	
CO	13.64	ppm	
NOx	35.94	ppm	
CO2	0.3032	%	
CH4	0.13	ppm	(1.00)

Mass Emissions

HC	2.308	grams	
CO	37.579	grams	
NOx	166.046	grams	
Particulate	4.880	grams	
CO2	13.129	kg	
CH4	0.210	grams	
Fuel	9.14 lb	4.14 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,051.3	86.42
Blower 2 Rate:	2,129.9	60.32
90 mm System:		
Gas Meter 1:	1.18	0.03
Gas Meter 2:	4.14	0.12
Sample Rate:	2.96	0.08
20X20 Sample Rate:	58.52	1.66
47 mm Sample Rate:	50.89	1.44
Chemistry Sample Rate:	0.135	0.060
Total Flow Rate:	5,293.70	149.98

Particulate Data

Filter Number:	4435.0-547 (pair)	
Weight Gain:	2.730	mg
Sample Multiplier:	1.788	

Correction Factors

NOx Humidity CF:	1.021
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	39.17

Test Cycle Data

Sample Time:	947.30	sec		
Work:	26.20	hp-hr	19.54	kW-hr
Reference Work:	25.09	hp-hr	18.71	kW-hr
Total Volume (Vmix):	83,576.5	scf	2,366.94	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.088 g/hp-hr	0.118	g/kW-hr
CO		1.434 g/hp-hr	1.923	g/kW-hr
NOx	(Cell)	6.338 g/hp-hr	8.499	g/kW-hr
Particulate		0.186 g/hp-hr	0.250	g/kW-hr
CO2		501.1 g/hp-hr	671.99	g/kW-hr
BSFC		0.349 lb/hp-hr	0.212	kg/kW-hr
NMHC		0.077 g/hp-hr	0.103	g/kW-hr
CH4		0.008 g/hp-hr	0.011	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E2NRBHL1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/08/2002 Time: 10:54	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

	Sample	Background
Formaldehyde		
Concentration	0.121 ppm	0.005 ppm
Mass	337.26 mg	
Acetaldehyde		
Concentration	0.029 ppm	0.002 ppm
Mass	117.27 mg	
Acrolein		
Concentration	0.006 ppm	0.000 ppm
Mass	31.99 mg	
Acetone		
Concentration	0.196 ppm	0.001 ppm
Mass	1,097.34 mg	
Propionaldehyde		
Concentration	0.009 ppm	0.000 ppm
Mass	47.92 mg	
Crotonaldehyde		
Concentration	0.006 ppm	0.000 ppm
Mass	38.47 mg	
Isobutyr + MEK		
Concentration	0.004 ppm	0.001 ppm
Mass	23.09 mg	
Benzaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	

Brake-Specific Results

Formaldehyde	12.872 mg/hp-hr	Crotonaldehyde	1.468 mg/hp-hr
Acetaldehyde	4.476 mg/hp-hr	Isobutyr + MEK	0.881 mg/hp-hr
Acrolein	1.221 mg/hp-hr	Benzaldehyde	0.000 mg/hp-hr
Acetone	41.883 mg/hp-hr	Hexanaldehyde	0.000 mg/hp-hr
Propionaldehyde	1.829 mg/hp-hr		

APPENDIX F

GRAPHICAL SUMMARIES OF TRANSIENT CYCLE REGRESSION STATISTICS FOR FTP, BHL, AND SAT TESTING ON A CATERPILLAR 3196 USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
E02DFTP1	FTP	2D	Without	Transient Cycle Regression Summary	F-1
E02DFTP2	FTP	2D	Without	Transient Cycle Regression Summary	F-2
E02DBHL1	BHL	2D	Without	Transient Cycle Regression Summary	F-3
E02DBHL2	BHL	2D	Without	Transient Cycle Regression Summary	F-4
E02DSAT1	SAT	2D	Without	Transient Cycle Regression Summary	F-5
E02DSAT2	SAT	2D	Without	Transient Cycle Regression Summary	F-6
E12DFTP1	FTP	2D	Yes	Transient Cycle Regression Summary	F-7
E12DFTP2	FTP	2D	Yes	Transient Cycle Regression Summary	F-8
E12DBHL1	BHL	2D	Yes	Transient Cycle Regression Summary	F-9
E2NRFTP1	FTP	NR	Yes	Transient Cycle Regression Summary	F-10
E2NRFTP2	FTP	NR	Yes	Transient Cycle Regression Summary	F-11
E2NRBHL1	BHL	NR	Yes	Transient Cycle Regression Summary	F-12

HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/31/02
Time: 8:37 AM
Engine ID. CAT 3196
6AR02540
Test No.
E02DFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 163

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

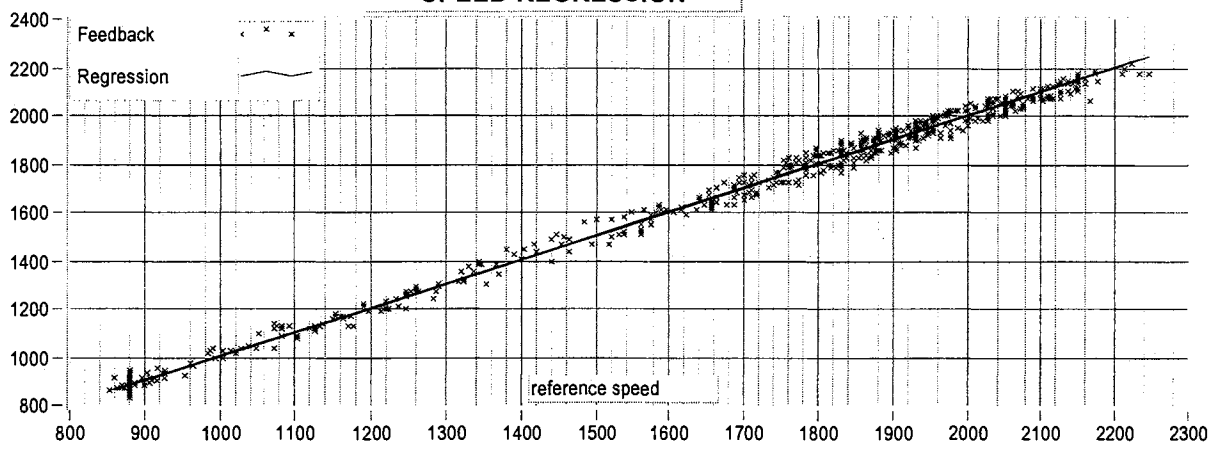
STATS PASS

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	31.64
REFERENCE WORK [HP-HR]	31.24
PERCENT DIFFERENCE	1.30

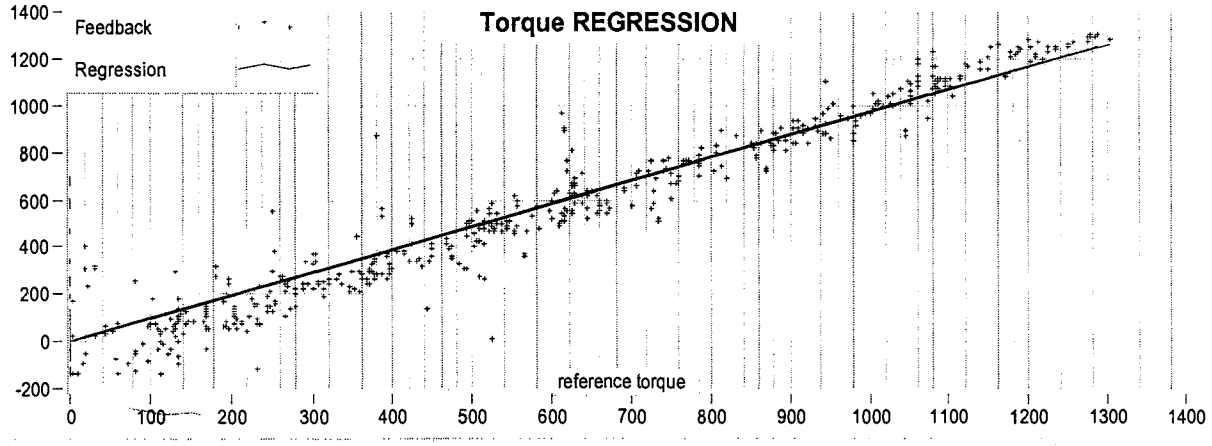
WORK PASS

	SPEED	TORQUE	POWER
SE	25	7	6
M	0.998	0.97	1.00
R2	0.9976	0.9430	0.9659
B	6	1	-2.7
NO. PTS.	1174	973	973

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/31/02
Time: 9:18 AM
Engine ID. CAT 3196
6AR02540
Test No. E02DFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 164

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

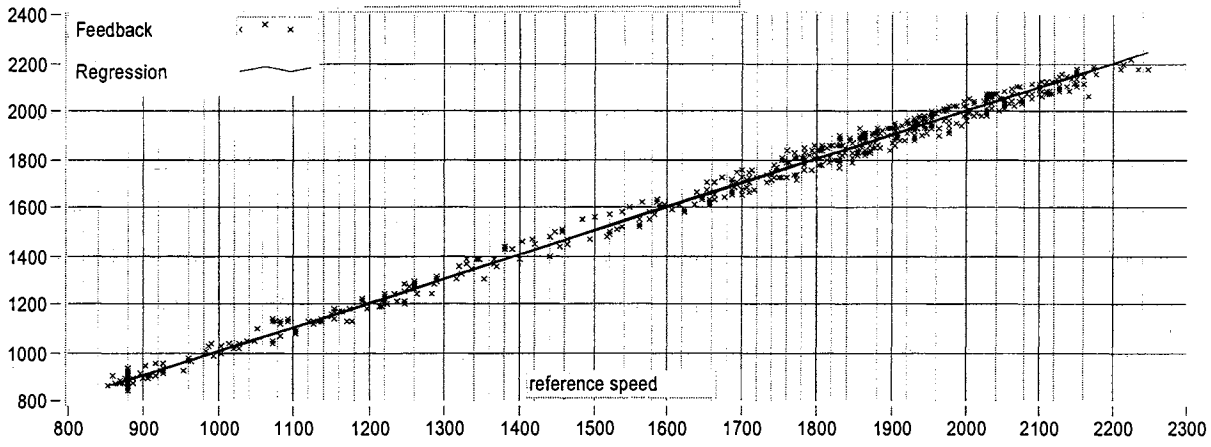
STATS PASS

TIME DELAY [sec]	0.52
CYCLE WORK [HP-HR]	31.67
REFERENCE WORK [HP-HR]	31.24
PERCENT DIFFERENCE	1.40

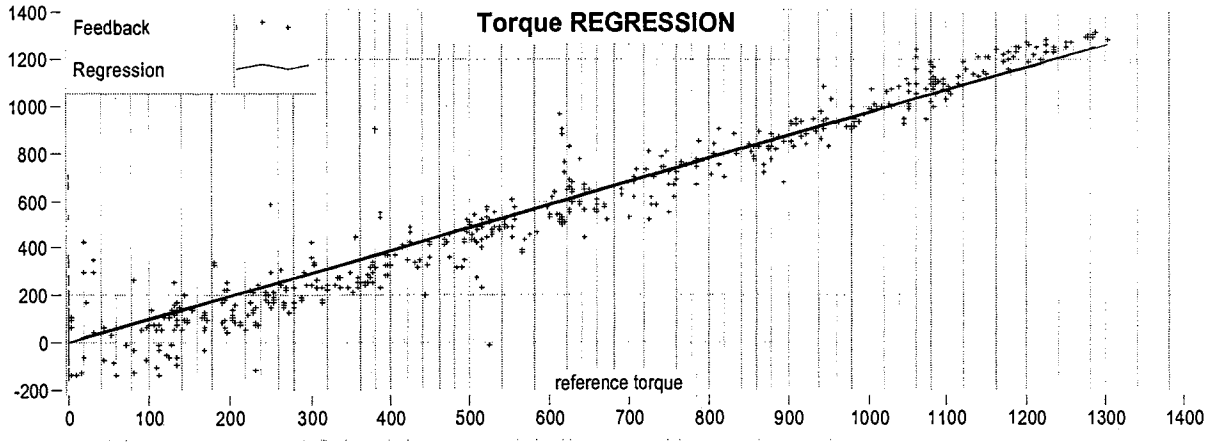
WORK PASS

	SPEED	TORQUE	POWER
SE	25	7	6
M	0.997	0.97	0.99
R2	0.9976	0.9453	0.9658
B	6	3	-2.1
NO. PTS.	1174	975	975

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/31/02
Time: 2:44 PM
Engine ID. CAT 3196
6AR02540
Test No.
E02DBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 170

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

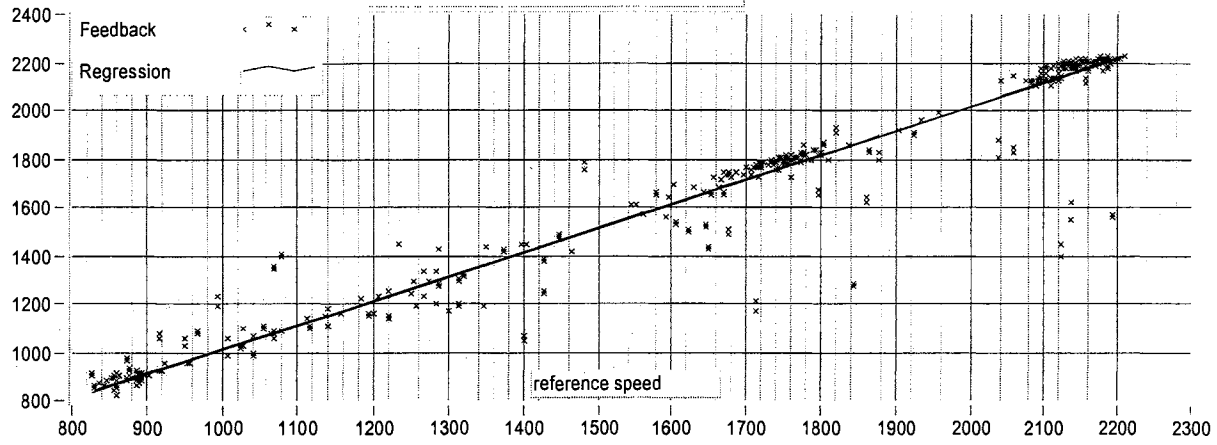
STATS FAIL

WORK FAIL

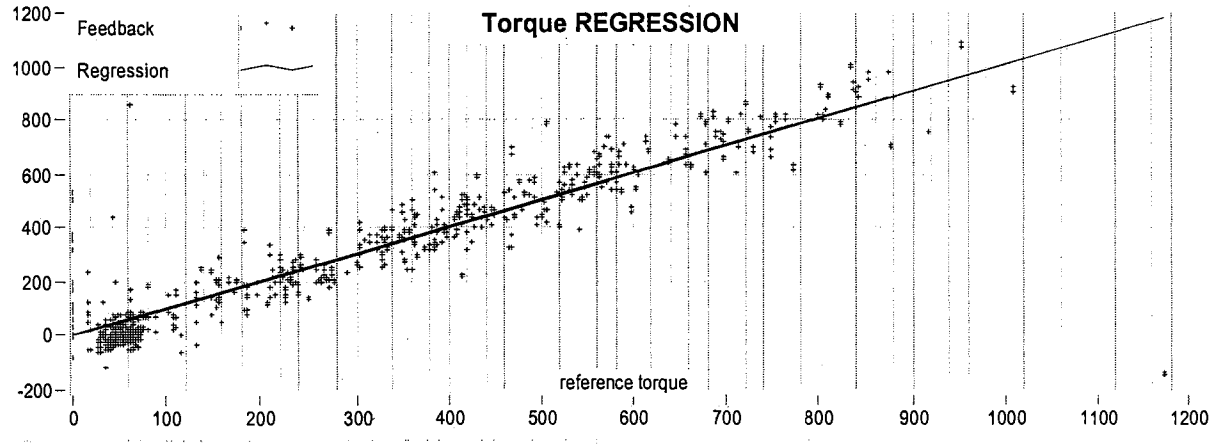
	SPEED	TORQUE	POWER
SE	83	10	8
M	1.006	1.01	1.03
R2	0.9760	0.7878	0.8529
B	4	0	0.6
NO. PTS.	915	788	788

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	26.21
REFERENCE WORK [HP-HR]	24.95
PERCENT DIFFERENCE	5.03

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/31/02
Time: 3:19 PM
Engine ID. CAT 3196
6AR02540
Test No.
E02DBHL2
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 171

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

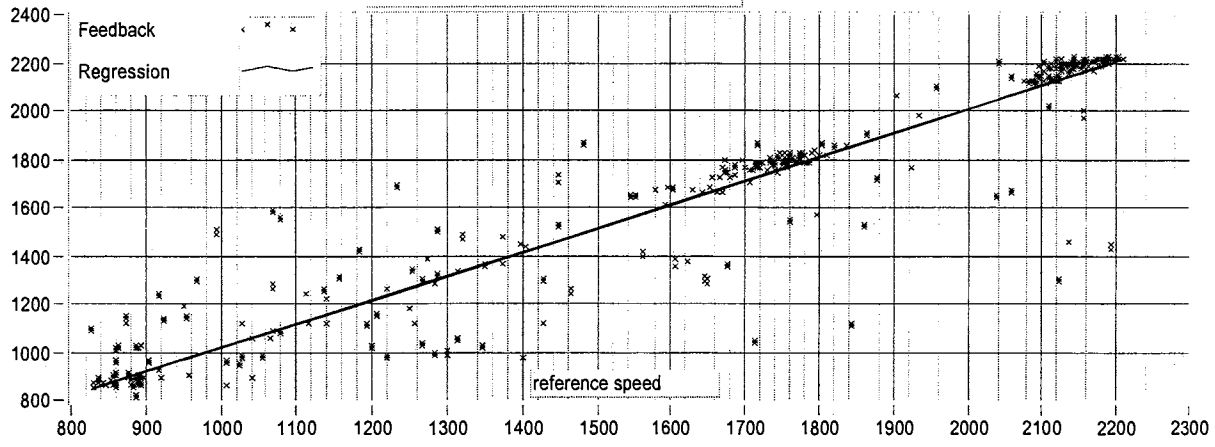
STATS FAIL

WORK FAIL

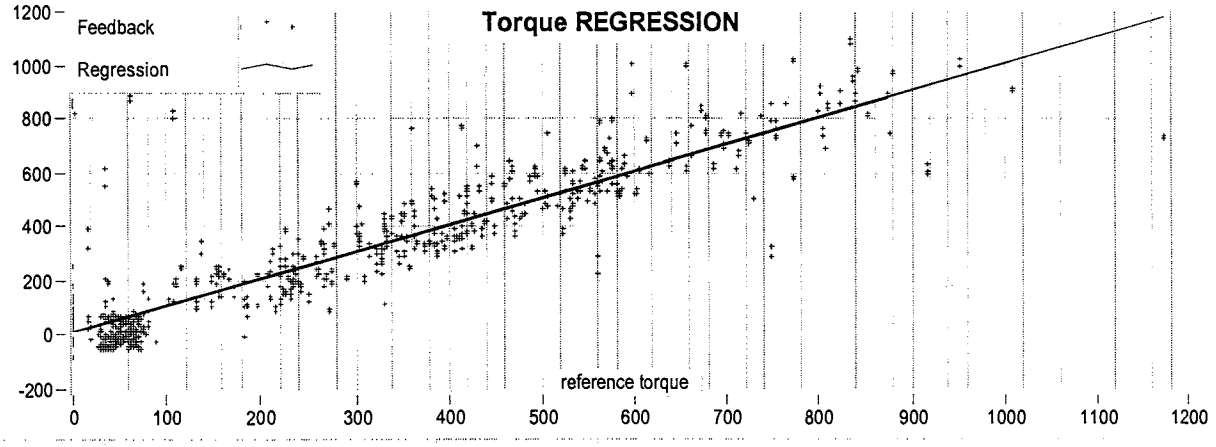
TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	26.25
REFERENCE WORK [HP-HR]	24.95
PERCENT DIFFERENCE	5.21

	SPEED	TORQUE	POWER
SE	127	9	9
M	0.989	1.00	1.01
R2	0.9443	0.7966	0.8356
B	27	9	4.0
NO. PTS.	915	802	802

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/31/02
Time: 12:57 PM
Engine ID. CAT 3196
6AR02540
Test No.
E02DSAT1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 167

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

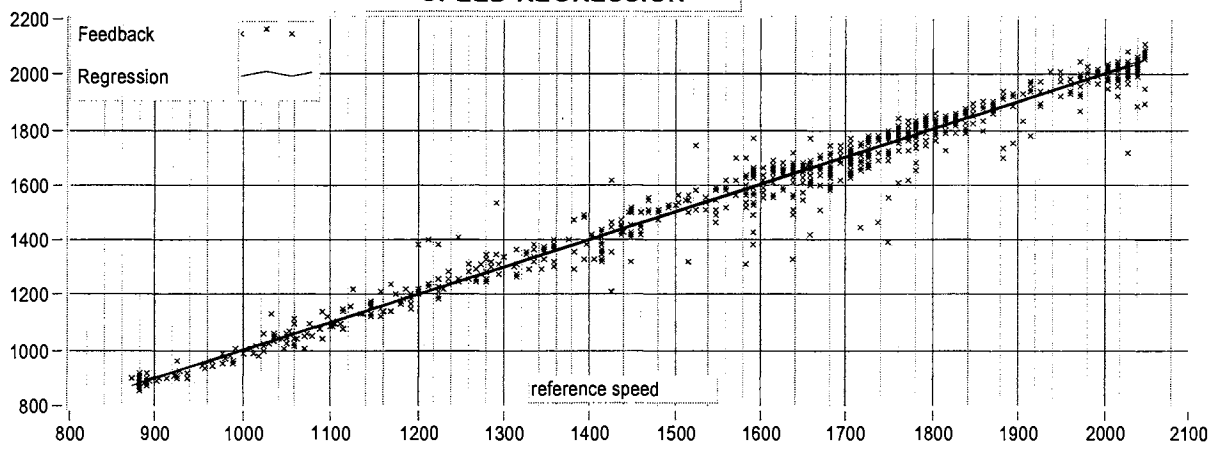
STATS FAIL

WORK PASS

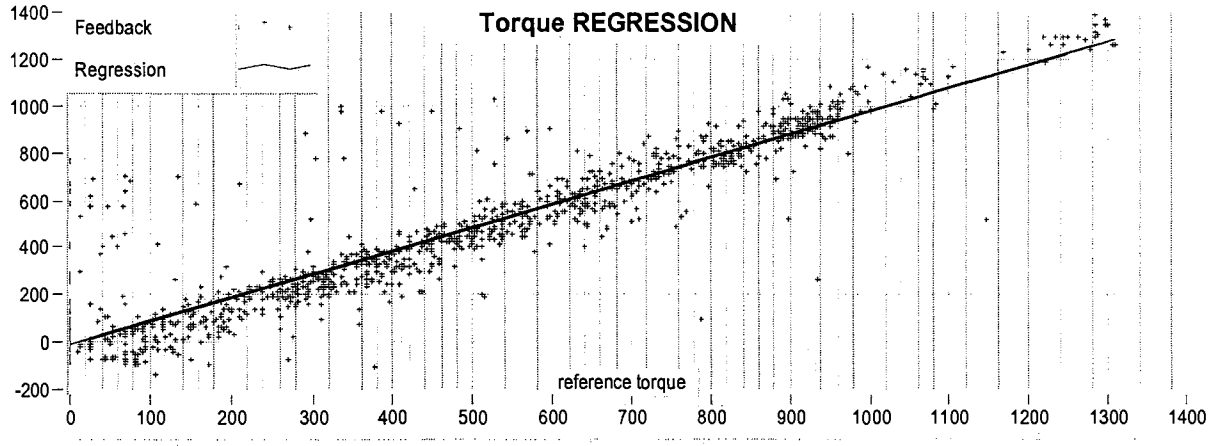
	SPEED	TORQUE	POWER
SE	46	9	8
M	1.003	0.99	1.01
R2	0.9802	0.8647	0.8959
B	-2	-10	-5.4
NO. PTS.	1213	1178	1178

TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	55.01
REFERENCE WORK [HP-HR]	56.64
PERCENT DIFFERENCE	-2.86

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 7/31/02
Time: 1:39 PM
Engine ID. CAT 3196
6AR02540
Test No.
E02DSAT2
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 168

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

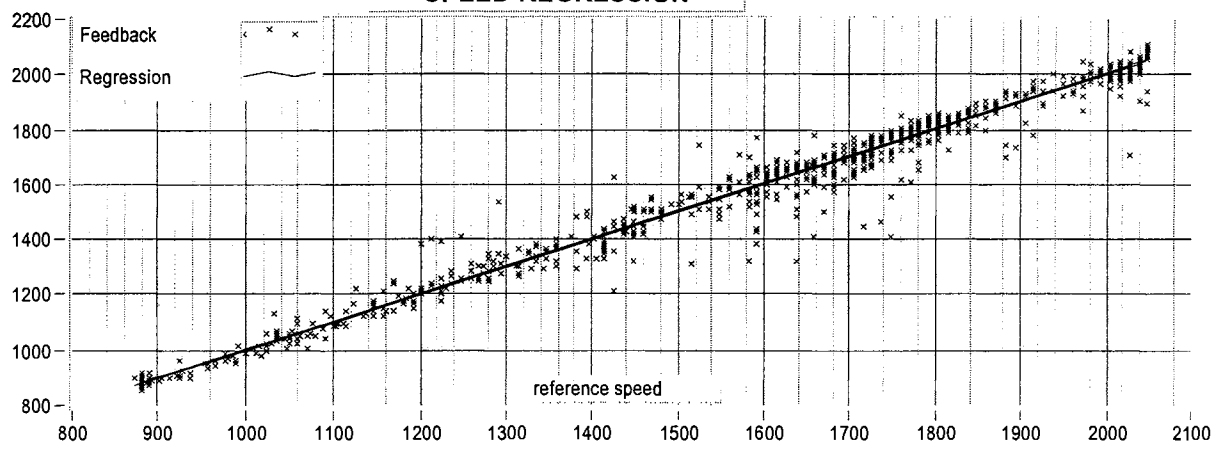
STATS FAIL

WORK PASS

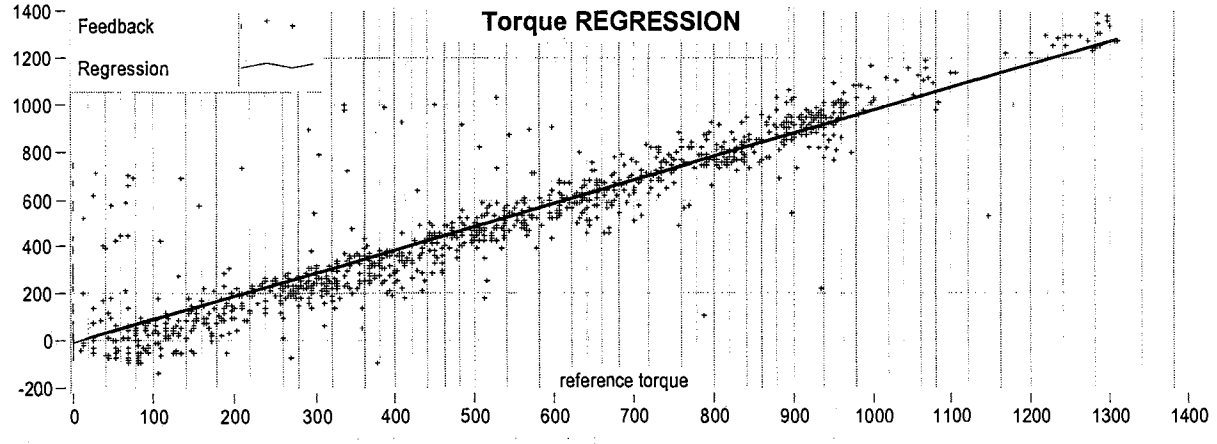
TIME DELAY [sec]	0.40
CYCLE WORK [HP-HR]	55.02
REFERENCE WORK [HP-HR]	56.64
PERCENT DIFFERENCE	-2.85

	SPEED	TORQUE	POWER
SE	46	9	9
M	1.003	0.98	1.00
R2	0.9799	0.8626	0.8950
B	-2	-7	-4.9
NO. PTS.	1213	1183	1183

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 8/6/02
Time: 8:50 AM
Engine ID. CAT 3196
6AR02540
Test No.
E12DFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 174

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

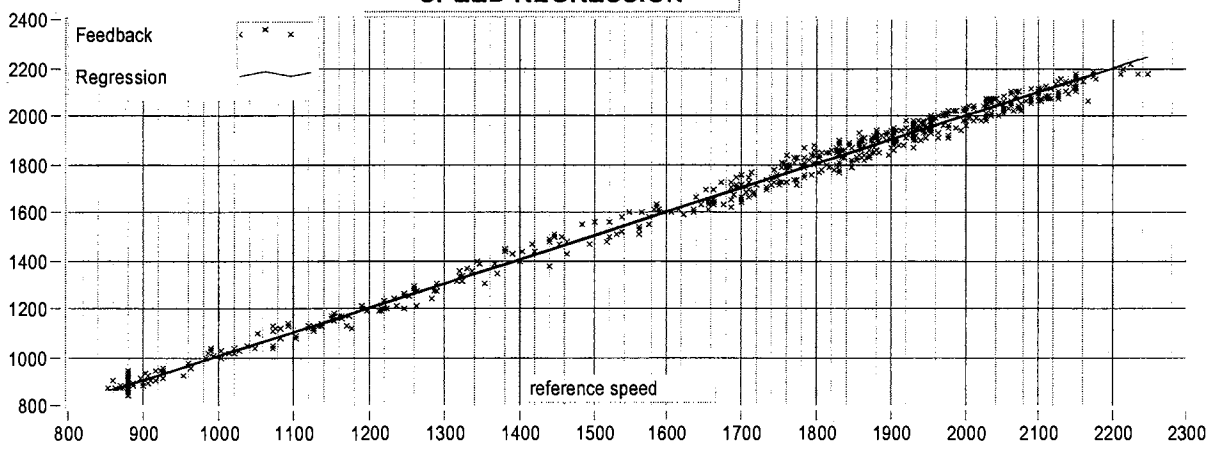
STATS PASS

WORK PASS

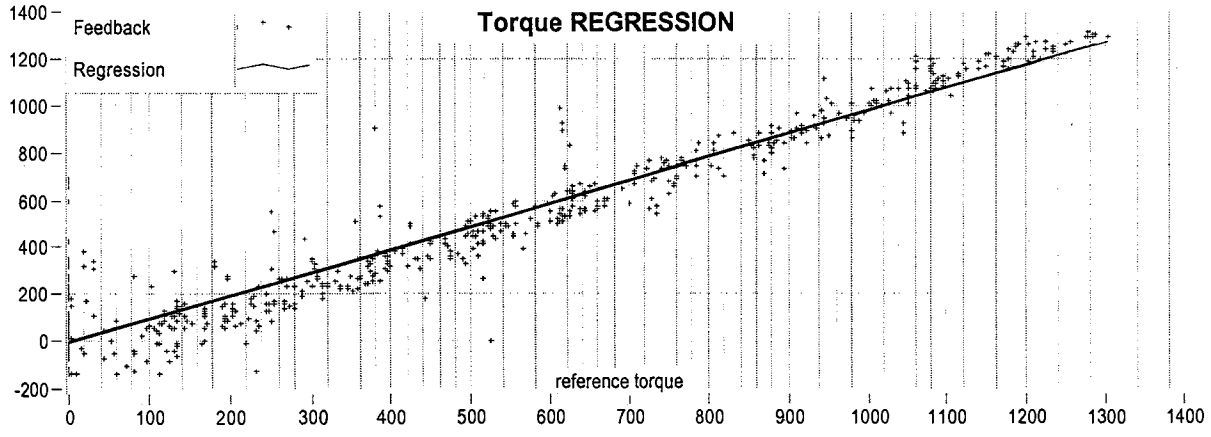
	SPEED	TORQUE	POWER
SE	25	7	6
M	0.998	0.98	1.00
R2	0.9975	0.9448	0.9663
B	5	-4	-3.5
NO. PTS.	1174	972	972

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	31.62
REFERENCE WORK [HP-HR]	31.24
PERCENT DIFFERENCE	1.22

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 8/6/02
Time: 9:27 AM
Engine ID. CAT 3196
6AR02540
Test No. E12DFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 175

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

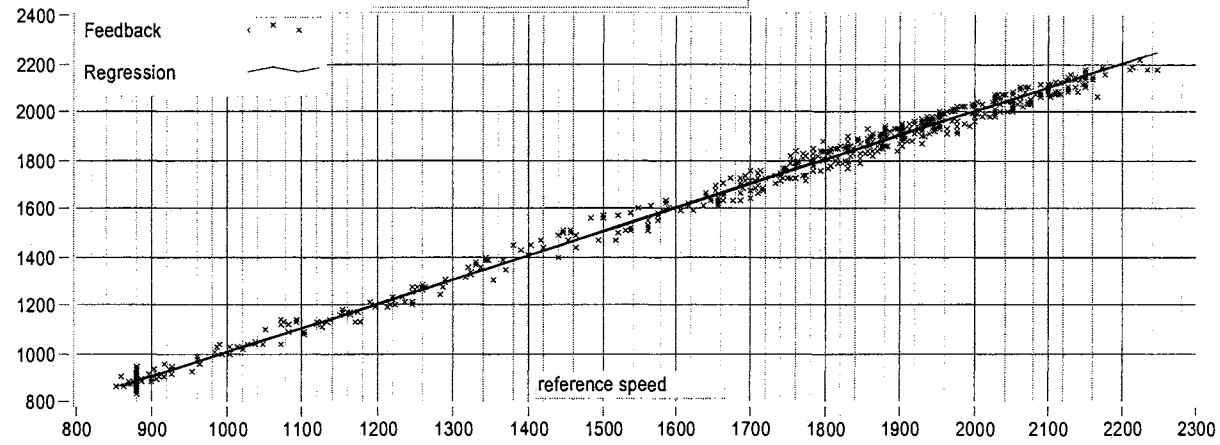
STATS PASS

WORK PASS

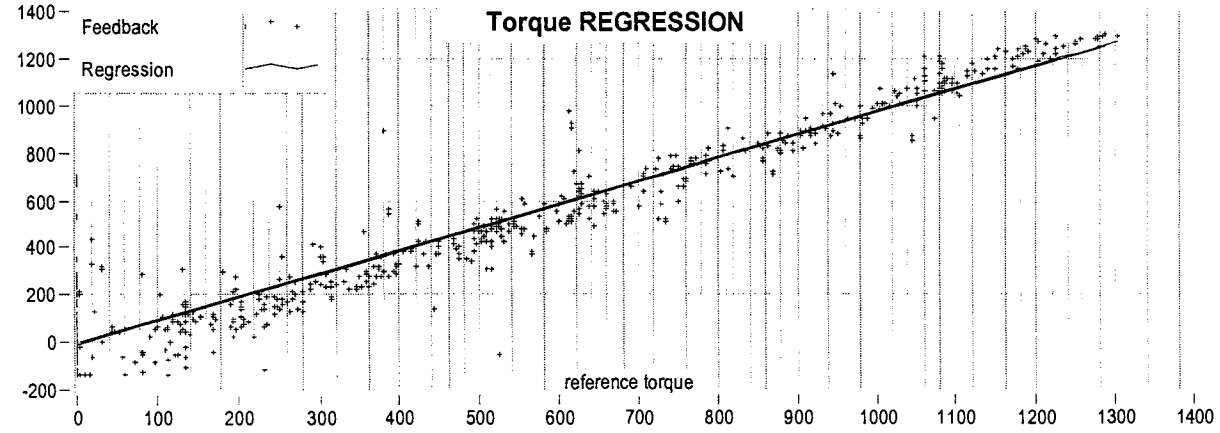
	SPEED	TORQUE	POWER
SE	25	7	6
M	0.998	0.98	1.00
R2	0.9976	0.9457	0.9657
B	5	-6	-3.7
NO. PTS.	1174	976	976

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	31.56
REFERENCE WORK [HP-HR]	31.24
PERCENT DIFFERENCE	1.03

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 8/6/02
Time: 10:40 AM
Engine ID. CAT 3196
6AR02540
Test No.
E12DBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 177

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

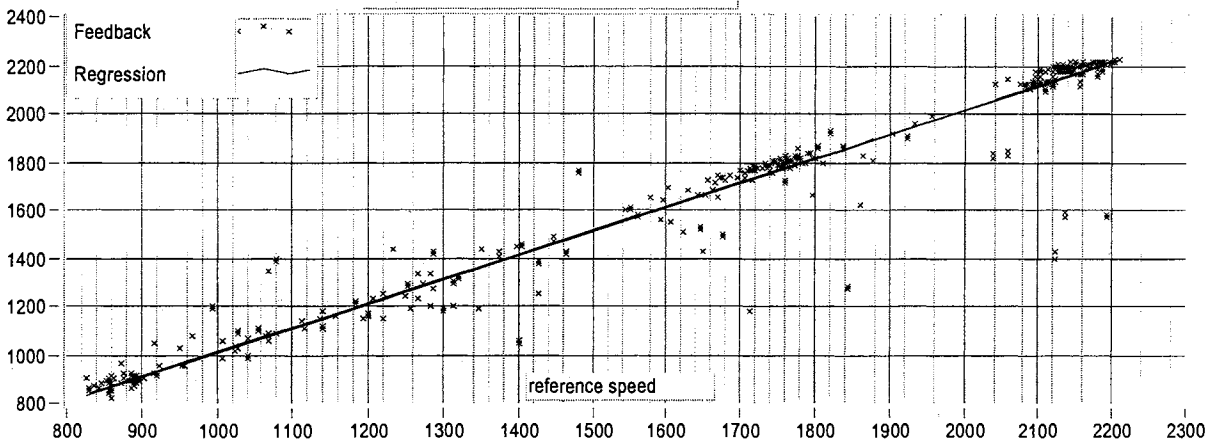
STATS FAIL

WORK PASS

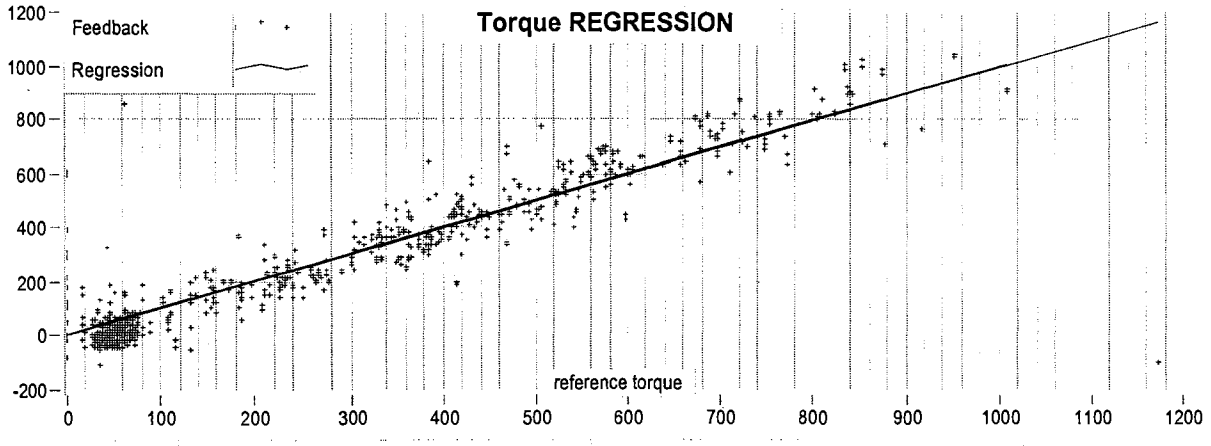
	SPEED	TORQUE	POWER
SE	83	9	8
M	1.006	0.99	1.01
R2	0.9760	0.7887	0.8543
B	3	7	1.8
NO. PTS.	915	793	793

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	25.99
REFERENCE WORK [HP-HR]	24.95
PERCENT DIFFERENCE	4.14

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 8/8/02
Time: 8:42 AM
Engine ID. CAT 3196
6AR02540
Test No.
E2NRFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 184

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

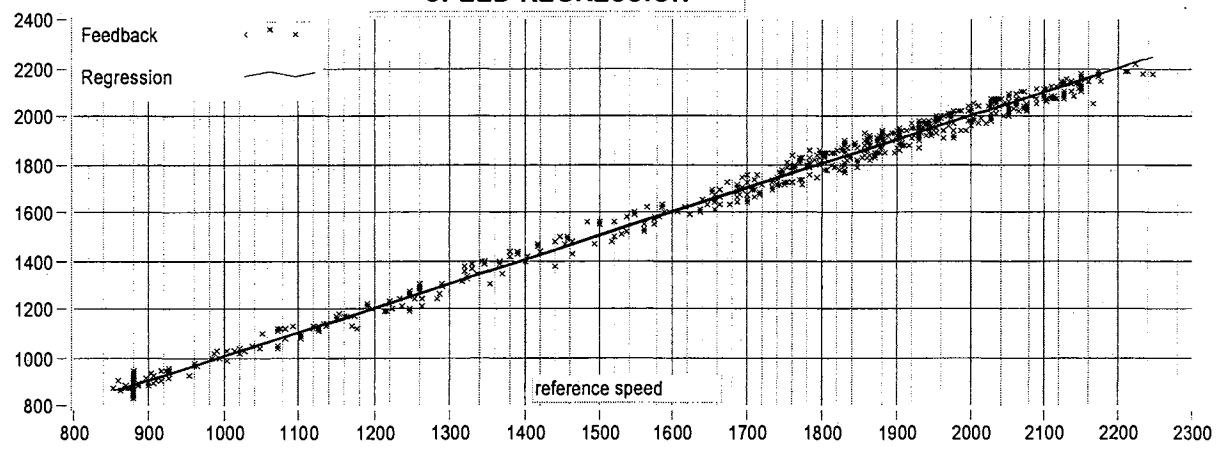
STATS PASS

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	32.04
REFERENCE WORK [HP-HR]	31.47
PERCENT DIFFERENCE	1.80

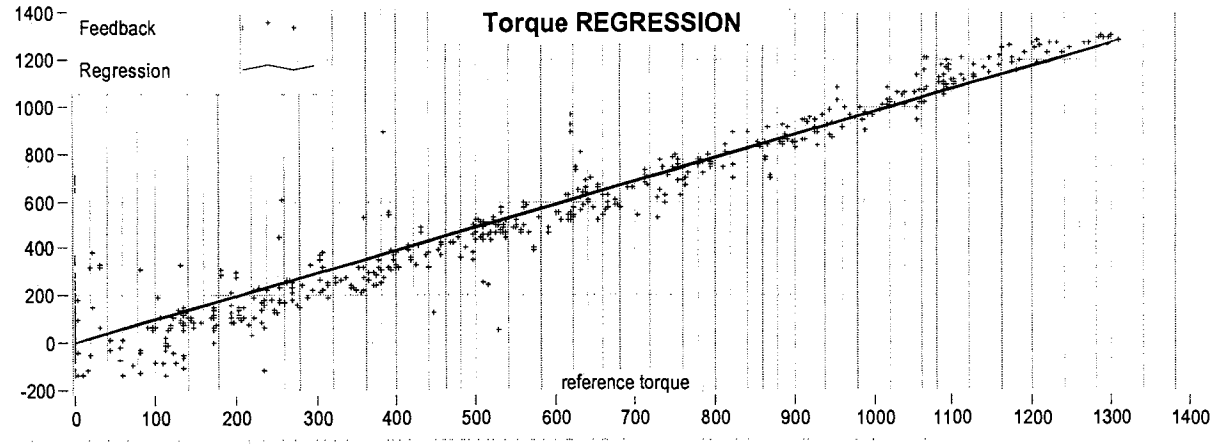
WORK PASS

	SPEED	TORQUE	POWER
SE	25	7	6
M	0.998	0.98	1.00
R2	0.9975	0.9474	0.9669
B	5	1	-2.7
NO. PTS.	1174	965	965

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 8/8/02
Time: 9:25 AM
Engine ID. CAT 3196
6AR02540
Test No.
E2NRFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 185

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

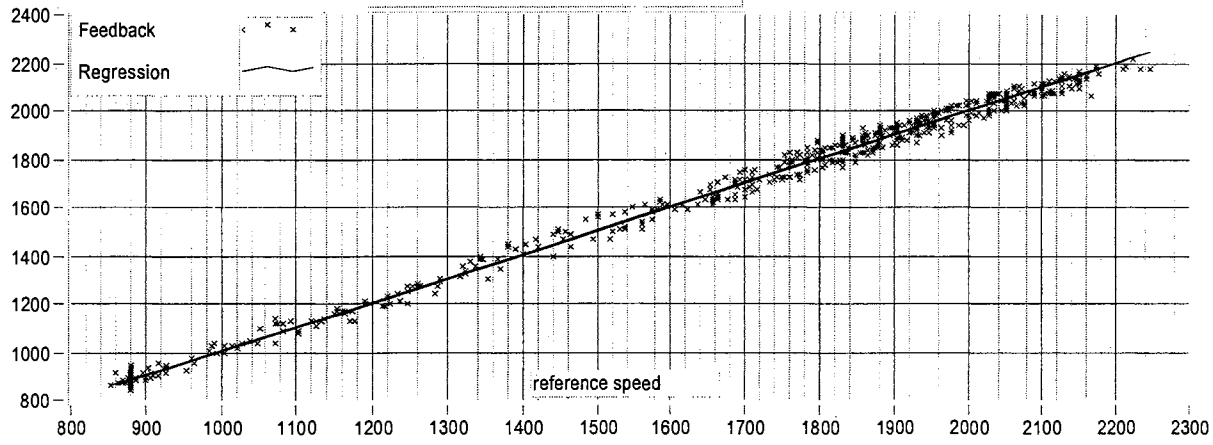
STATS PASS

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	31.88
REFERENCE WORK [HP-HR]	31.47
PERCENT DIFFERENCE	1.30

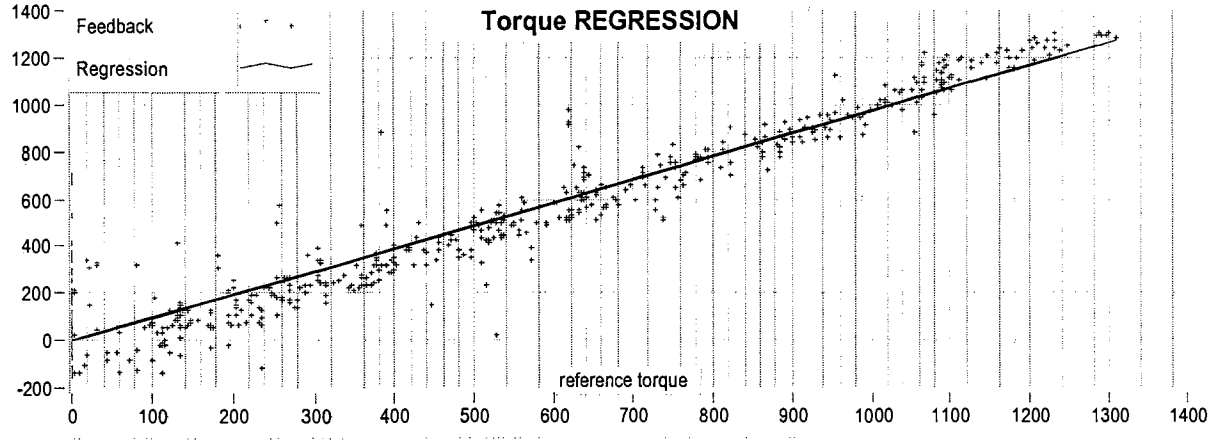
WORK PASS

	SPEED	TORQUE	POWER
SE	25	7	6
M	0.997	0.97	0.99
R2	0.9975	0.9423	0.9645
B	6	-1	-2.8
NO. PTS.	1174	965	965

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 8/8/02
Time: 10:28 AM
Engine ID. CAT 3196
6AR02540
Test No.
E2NRBHL1
No. of Bags: 1
Cycle Type: Hot, User Specified
EVENT NO. 187

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

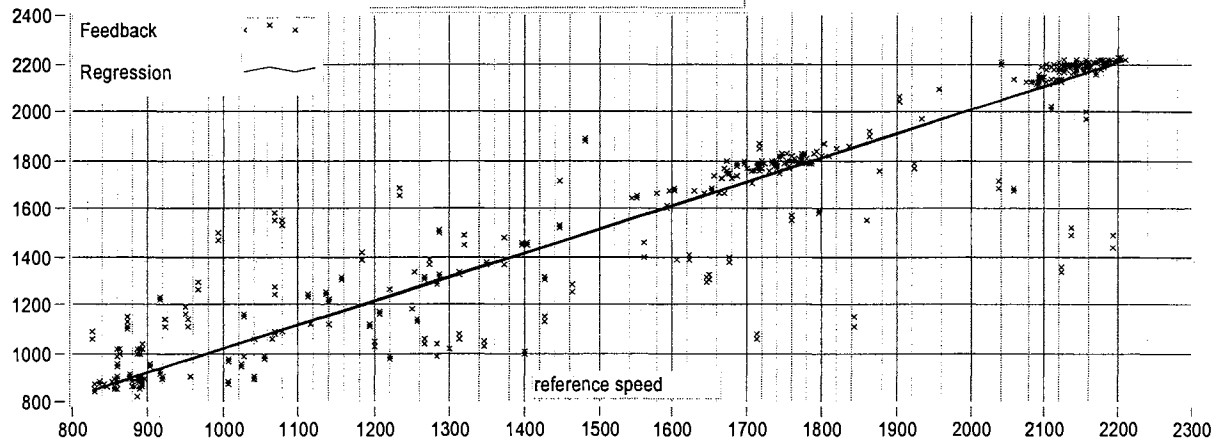
STATS FAIL

WORK PASS

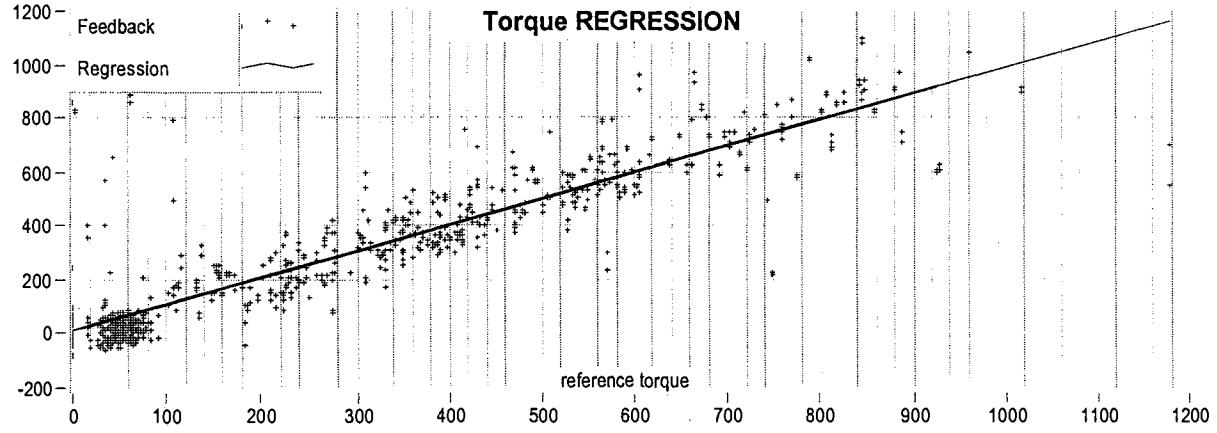
	SPEED	TORQUE	POWER
SE	121	9	9
M	0.991	0.98	1.00
R2	0.9489	0.7979	0.8397
B	26	12	4.1
NO. PTS.	915	798	798

TIME DELAY [sec]	0.60
CYCLE WORK [HP-HR]	26.20
REFERENCE WORK [HP-HR]	25.09
PERCENT DIFFERENCE	4.42

SPEED REGRESSION



Torque REGRESSION



APPENDIX G

DETAILED COMPUTER PRINTOUTS FOR TRANSIENT EMISSION TESTS ON A CUMMINS ISB190 ENGINE OVER FTP, BHL AND SAT CYCLES USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
B02DFTP1	FTP	2D	Without	Transient Cycle Emissions Summary	G-1
B02DFTP2	FTP	2D	Without	Transient Cycle Emissions Summary	G-2
B02DBHL1	BHL	2D	Without	Transient Cycle Emissions Summary	G-3
B02DBHL2	BHL	2D	Without	Transient Cycle Emissions Summary	G-4
B02DSAT1	SAT	2D	Without	Transient Cycle Emissions Summary	G-5
B02DSAT2	SAT	2D	Without	Transient Cycle Emissions Summary	G-6
B12DFTP1	FTP	2D	Yes	Transient Cycle Emissions Summary	G-7
B12DFTP2	FTP	2D	Yes	Transient Cycle Emissions Summary	G-9
B12DBHL1	BHL	2D	Yes	Transient Cycle Emissions Summary	G-11
B2NRFTP1	FTP	NR	Yes	Transient Cycle Emissions Summary	G-13
B2NRFTP2	FTP	NR	Yes	Transient Cycle Emissions Summary	G-15
B2NRBHL1	BHL	NR	Yes	Transient Cycle Emissions Summary	G-17

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B02DFTP1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/16/2002 Time: 10:30	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

Ambient/Test Cell Conditions

Barometer:	29.19	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	70.8	gr/lb	10.1 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	76.6	gr/lb	10.9 g/kg
Rel. Humidity:	50	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.43	ppm	
HC Bckgrd	4.4	2	4.46	ppm	
CO	10.4	2	9.88	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		23.14	ppm	(Dry)
NOx Bckgrd	0.7	1	0.18	ppm	
CO2 Sample	50.3	1	0.3805	%	(Wet)
CO2 Bckgrd	7.2	1	0.0458	%	

Corrected Concentrations

HC	2.10	ppm
CO	9.29	ppm
NOx	22.49	ppm
CO2	0.3360	%

Mass Emissions

HC	1.498	grams
CO	13.470	grams
NOx	52.950	grams
Particulate	1.227	grams
CO2	7.652	kg
Fuel	5.32 lb	2.41 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,183.1	61.83
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.11	0.03
Gas Meter 2:	4.19	0.12
Sample Rate:	3.08	0.09
Total Flow Rate:	2,186.16	61.91

Particulate Data

Filter Number:	5951 (pair)	
Weight Gain:	1.730	mg
Sample Multiplier:	0.709	

Correction Factors

NOx Humidity CF:	0.989
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	35.62

Test Cycle Data

Sample Time:	1,206.40	sec		
Work:	12.98	hp-hr	9.68	kW-hr
Reference Work:	12.70	hp-hr	9.47	kW-hr
Total Volume (Vmix):	43,956.3	scf	1,244.87	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.115 g/hp-hr	0.155	g/kW-hr
CO		1.038 g/hp-hr	1.392	g/kW-hr
NOx	(Cell)	4.079 g/hp-hr	5.470	g/kW-hr
Particulate		0.095 g/hp-hr	0.127	g/kW-hr
CO2		589.5 g/hp-hr	790.53	g/kW-hr
BSFC		0.410 lb/hp-hr	0.249	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B02DFTP2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/16/2002 Time: 11:08	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.20	in Hg	98.9 kPa
Engine Inlet Air			
Temperature:	74.2	°F	23.4 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	74.5	gr/lb	10.6 g/kg
Rel. Humidity:	57	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	76.6	gr/lb	10.9 g/kg
Rel. Humidity:	50	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.40	ppm	
HC Bckgrd	n/a		6.70	ppm	
CO	10.4	2	9.88	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		22.33	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	50.0	1	0.3776	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	

Corrected Concentrations

HC	0.89	ppm
CO	9.29	ppm
NOx	21.77	ppm
CO2	0.3350	%

Mass Emissions

HC	0.638	grams
CO	13.562	grams
NOx	52.109	grams
Particulate	1.270	grams
CO2	7.681	kg
Fuel	5.34 lb	2.42 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,197.5	62.23
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.11	0.03
Gas Meter 2:	4.20	0.12
Sample Rate:	3.09	0.09
Total Flow Rate:	2,200.59	62.32

Particulate Data

Filter Number:	6104.0 (pair)	
Weight Gain:	1.781	mg
Sample Multiplier:	0.713	

Correction Factors

NOx Humidity CF:	0.999
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	35.89

Test Cycle Data

Sample Time:	1,206.60	sec		
Work:	12.96	hp-hr	9.66	kW-hr
Reference Work:	12.70	hp-hr	9.47	kW-hr
Total Volume (Vmix):	44,253.9	scf	1,253.30	scm

Brake-Specific Emission Results

BSHC (Cell)	0.049	g/hp-hr	0.066	g/kW-hr
CO	1.046	g/hp-hr	1.403	g/kW-hr
NOx (Cell)	4.021	g/hp-hr	5.392	g/kW-hr
Particulate	0.098	g/hp-hr	0.131	g/kW-hr
CO2	592.7	g/hp-hr	794.82	g/kW-hr
BSFC	0.412	lb/hp-hr	0.250	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B02DBHL1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/16/2002 Time: 01:25	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.18	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	74.6	°F	23.7 °C
Dew Point:	64.9	°F	18.3 °C
Abs. Humidity:	94.9	gr/lb	13.6 g/kg
Rel. Humidity:	72	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	76.6	gr/lb	10.9 g/kg
Rel. Humidity:	50	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		10.52	ppm	
HC Bckgrd	n/a		8.37	ppm	
CO	13.1	2	12.48	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		24.43	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	51.7	1	0.3942	%	(Wet)
CO2 Bckgrd	6.6	1	0.0419	%	

Corrected Concentrations

HC	2.39	ppm
CO	11.83	ppm
NOx	23.79	ppm
CO2	0.3535	%

Mass Emissions

HC	1.355	grams
CO	13.572	grams
NOx	47.287	grams
Particulate	1.054	grams
CO2	6.373	kg
Fuel	4.43 lb	2.01 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,200.9	62.33
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.11	0.03
Gas Meter 2:	4.25	0.12
Sample Rate:	3.14	0.09
Total Flow Rate:	2,204.05	62.42

Particulate Data

Filter Number:	6105.0 (pair)	
Weight Gain:	1.502	mg
Sample Multiplier:	0.701	

Correction Factors

NOx Humidity CF:	1.055
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	34.33

Test Cycle Data

Sample Time:	947.20	sec		
Work:	10.75	hp-hr	8.02	kW-hr
Reference Work:	10.89	hp-hr	8.12	kW-hr
Total Volume (Vmix):	34,794.6	scf	985.40	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.126 g/hp-hr	0.169	g/kW-hr
CO		1.262 g/hp-hr	1.693	g/kW-hr
NOx	(Cell)	4.399 g/hp-hr	5.899	g/kW-hr
Particulate		0.098 g/hp-hr	0.131	g/kW-hr
CO2		592.8 g/hp-hr	795.00	g/kW-hr
BSFC		0.412 lb/hp-hr	0.251	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B02DBHL2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/16/2002 Time: 01:59	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.17	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	63.1	°F	17.3 °C
Abs. Humidity:	89.0	gr/lb	12.7 g/kg
Rel. Humidity:	67	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	80.2	gr/lb	11.5 g/kg
Rel. Humidity:	51	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.00	ppm	
HC Bckgrd	n/a		5.50	ppm	
CO	12.8	2	12.19	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		25.14	ppm	(Dry)
NOx Bckgrd	0.9	1	0.23	ppm	
CO2 Sample	51.5	1	0.3922	%	(Wet)
CO2 Bckgrd	7.1	1	0.0451	%	

Corrected Concentrations

HC	1.66	ppm
CO	11.63	ppm
NOx	24.37	ppm
CO2	0.3484	%

Mass Emissions

HC		0.939	grams	
CO		13.341	grams	
NOx		47.659	grams	
Particulate		1.052	grams	
CO2		6.279	kg	
Fuel	4.37 lb		1.98	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,200.2	62.31
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.11	0.03
Gas Meter 2:	4.24	0.12
Sample Rate:	3.13	0.09
Total Flow Rate:	2,203.37	62.40

Particulate Data

Filter Number:	6106.0 (pair)	
Weight Gain:	1.496	mg
Sample Multiplier:	0.703	

Correction Factors

NOx Humidity CF:	1.038
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.982
Dilution Factor:	34.54

Test Cycle Data

Sample Time:	947.30	sec		
Work:	10.67	hp-hr	7.96	kW-hr
Reference Work:	10.89	hp-hr	8.12	kW-hr
Total Volume (Vmix):	34,787.5	scf	985.20	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.088 g/hp-hr	0.118	g/kW-hr
CO		1.250 g/hp-hr	1.677	g/kW-hr
NOx	(Cell)	4.467 g/hp-hr	5.990	g/kW-hr
Particulate		0.099 g/hp-hr	0.132	g/kW-hr
CO2		588.5 g/hp-hr	789.21	g/kW-hr
BSFC		0.409 lb/hp-hr	0.249	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B02DSAT1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/16/2002 Time: 03:10	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.16	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	61.0	°F	16.1 °C
Abs. Humidity:	82.6	gr/lb	11.8 g/kg
Rel. Humidity:	64	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	78.5	gr/lb	11.2 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		8.14	ppm	
HC Bckgrd	4.0	2	4.05	ppm	
CO	14.2	2	13.55	ppm	(Dry)
CO Bckgrd	0.8	2	0.75	ppm	
NOx Sample	n/a		34.06	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	65.8	1	0.5469	%	(Wet)
CO2 Bckgrd	6.7	1	0.0425	%	

Corrected Concentrations

HC	4.25	ppm
CO	12.49	ppm
NOx	33.16	ppm
CO2	0.5061	%

Mass Emissions

HC	3.164	grams
CO	18.828	grams
NOx	83.775	grams
Particulate	1.909	grams
CO2	11.989	kg
Fuel	8.33 lb	3.78 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,200.3	62.31
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.31	0.04
Gas Meter 2:	4.15	0.12
Sample Rate:	2.84	0.08
Total Flow Rate:	2,203.18	62.40

Particulate Data

Filter Number:	6107 (pair)	
Weight Gain:	2.461	mg
Sample Multiplier:	0.776	

Correction Factors

NOx Humidity CF:	1.020
Dry-to-Wet CF, Sample:	0.977
Dry-to-Wet CF, Bckgrd:	0.982
Dilution Factor:	24.79

Test Cycle Data

Sample Time:	1,245.20	sec		
Work:	21.12	hp-hr	15.75	kW-hr
Reference Work:	22.58	hp-hr	16.84	kW-hr
Total Volume (Vmix):	45,723.2	scf	1,294.91	scm

Brake-Specific Emission Results

BSHC (Cell)	0.150	g/hp-hr	0.201	g/kW-hr
CO	0.891	g/hp-hr	1.196	g/kW-hr
NOx (Cell)	3.967	g/hp-hr	5.319	g/kW-hr
Particulate	0.090	g/hp-hr	0.121	g/kW-hr
CO2	567.7	g/hp-hr	761.27	g/kW-hr
BSFC	0.394	lb/hp-hr	0.240	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B02DSAT2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/16/2002 Time: 03:50	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.15	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	74.2	°F	23.4 °C
Dew Point:	59.9	°F	15.5 °C
Abs. Humidity:	79.4	gr/lb	11.3 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	78.5	gr/lb	11.2 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		8.05	ppm	
HC Bckgrd	n/a		5.00	ppm	
CO	16.6	2	15.87	ppm	(Dry)
CO Bckgrd	2.4	2	2.25	ppm	
NOx Sample	n/a		34.61	ppm	(Dry)
NOx Bckgrd	0.9	1	0.23	ppm	
CO2 Sample	66.1	1	0.5504	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	

Corrected Concentrations

HC	3.25	ppm
CO	13.33	ppm
NOx	33.60	ppm
CO2	0.5059	%

Mass Emissions

HC	2.421	grams	
CO	20.108	grams	
NOx	84.214	grams	
Particulate	1.932	grams	
CO2	11.990	kg	
Fuel	8.33 lb	3.78	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,201.2	62.34
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.31	0.04
Gas Meter 2:	4.18	0.12
Sample Rate:	2.86	0.08
Total Flow Rate:	2,204.08	62.42

Particulate Data

Filter Number:	6108.0 (pair)	
Weight Gain:	2.509	mg
Sample Multiplier:	0.770	

Correction Factors

NOx Humidity CF:	1.011
Dry-to-Wet CF, Sample:	0.977
Dry-to-Wet CF, Bckgrd:	0.982
Dilution Factor:	24.63

Test Cycle Data

Sample Time:	1,245.30	sec		
Work:	21.14	hp-hr	15.76	kW-hr
Reference Work:	22.58	hp-hr	16.84	kW-hr
Total Volume (Vmix):	45,745.6	scf	1,295.54	scm

Brake-Specific Emission Results

BSHC (Cell)	0.115	g/hp-hr	0.154	g/kW-hr
CO	0.951	g/hp-hr	1.276	g/kW-hr
NOx (Cell)	3.984	g/hp-hr	5.342	g/kW-hr
Particulate	0.091	g/hp-hr	0.123	g/kW-hr
CO2	567.2	g/hp-hr	760.58	g/kW-hr
BSFC	0.394	lb/hp-hr	0.240	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DFTP1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/11/2002 Time: 11:20	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	77.0	°F	25.0 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	72.1	gr/lb	10.3 g/kg
Rel. Humidity:	50	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	70.2	gr/lb	10.0 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.88	ppm	
HC Bckgrd	n/a		8.30	ppm	
CO	11.0	2	10.45	ppm	(Dry)
CO Bckgrd	1.6	2	1.50	ppm	
NOx Sample	n/a		21.90	ppm	(Dry)
NOx Bckgrd	0.3	1	0.08	ppm	
CO2 Sample	48.2	1	0.3603	%	(Wet)
CO2 Bckgrd	6.6	1	0.0419	%	
CH4 Sample	n/a	n/a	2.00	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.11	ppm	

Corrected Concentrations

HC	1.80	ppm	
CO	8.79	ppm	
NOx	21.40	ppm	
CO2	0.3195	%	
CH4	-0.06	ppm	(1.00)

Mass Emissions

HC	1.368	grams
CO	13.527	grams
NOx	53.707	grams
Particulate	1.227	grams
CO2	7.727	kg
CH4	0.000	grams
Fuel	5.37 lb	2.44 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,200.1	62.31
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.22	0.03
Gas Meter 2:	4.26	0.12
Sample Rate:	3.04	0.09
20X20 Sample Rate:	67.50	1.91
47 mm Sample Rate:	51.17	1.45
Chemistry Sample Rate:	0.134	0.076
Total Flow Rate:	2,321.93	65.83

Particulate Data

Filter Number:	5043.0 (pair)	
Weight Gain:	1.606	mg
Sample Multiplier:	0.764	

Correction Factors

NOx Humidity CF:	0.993
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	37.57

Test Cycle Data

Sample Time:	1,206.30	sec		
Work:	12.98	hp-hr	9.68	kW-hr
Reference Work:	12.70	hp-hr	9.47	kW-hr
Total Volume (Vmix):	46,679.7	scf	1,322.00	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.105 g/hp-hr	0.141	g/kW-hr
CO		1.042 g/hp-hr	1.398	g/kW-hr
NOx	(Cell)	4.138 g/hp-hr	5.549	g/kW-hr
Particulate		0.095 g/hp-hr	0.127	g/kW-hr
CO2		595.3 g/hp-hr	798.35	g/kW-hr
BSFC		0.414 lb/hp-hr	0.252	kg/kW-hr
NMHC		0.092 g/hp-hr	0.123	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B12DFTP1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/11/2002 Time: 11:20	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

	Sample		Background	
Formaldehyde				
Concentration	0.131	ppm	0.006	ppm
Mass	203.21	mg		
Acetaldehyde				
Concentration	0.031	ppm	0.001	ppm
Mass	70.15	mg		
Acrolein				
Concentration	0.009	ppm	0.000	ppm
Mass	26.76	mg		
Acetone				
Concentration	0.001	ppm	0.000	ppm
Mass	1.99	mg		
Propionaldehyde				
Concentration	0.006	ppm	0.001	ppm
Mass	17.74	mg		
Crotonaldehyde				
Concentration	0.011	ppm	0.002	ppm
Mass	32.29	mg		
Isobutyr + MEK				
Concentration	0.001	ppm	0.000	ppm
Mass	4.29	mg		
Benzaldehyde				
Concentration	0.001	ppm	0.000	ppm
Mass	5.57	mg		
Hexanaldehyde				
Concentration	0.000	ppm	0.000	ppm
Mass	2.49	mg		

Brake-Specific Results

Formaldehyde	15.655	mg/hp-hr	
Acetaldehyde	5.404	mg/hp-hr	
Acrolein	2.061	mg/hp-hr	
Acetone	0.153	mg/hp-hr	
Propionaldehyde	1.366	mg/hp-hr	
Crotonaldehyde	2.488	mg/hp-hr	
Isobutyr + MEK	0.331	mg/hp-hr	
Benzaldehyde	0.429	mg/hp-hr	
Hexanaldehyde	0.191	mg/hp-hr	

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DFTP2	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/11/2002 Time: 12:00	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	69.0	gr/lb	9.9 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	71.9	gr/lb	10.3 g/kg
Rel. Humidity:	47	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.78	ppm	
HC Bckgrd	n/a		8.30	ppm	
CO	13.2	2	12.58	ppm	(Dry)
CO Bckgrd	4.8	2	4.52	ppm	
NOx Sample	n/a		21.92	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	48.1	1	0.3594	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	
CH4 Sample	n/a	n/a	2.26	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.10	ppm	

Corrected Concentrations

HC	1.70	ppm	
CO	7.97	ppm	
NOx	21.37	ppm	
CO2	0.3142	%	
CH4	0.21	ppm	(1.00)

Mass Emissions

HC	1.286	grams	
CO	12.216	grams	
NOx	52.972	grams	
Particulate	1.225	grams	
CO2	7.569	kg	
CH4	0.185	grams	
Fuel	5.26 lb	2.38 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,192.9	62.10
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.22	0.03
Gas Meter 2:	4.20	0.12
Sample Rate:	2.98	0.08
20X20 Sample Rate:	67.45	1.91
47 mm Sample Rate:	50.81	1.44
Chemistry Sample Rate:	0.134	0.076
Total Flow Rate:	2,314.28	65.61

Particulate Data

Filter Number:	5042.0 (pair)	
Weight Gain:	1.580	mg
Sample Multiplier:	0.775	

Correction Factors

NOx Humidity CF:	0.985
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	37.64

Test Cycle Data

Sample Time:	1,205.40	sec		
Work:	12.90	hp-hr	9.62	kW-hr
Reference Work:	12.70	hp-hr	9.47	kW-hr
Total Volume (Vmix):	46,491.1	scf	1,316.66	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.100 g/hp-hr	0.134	g/kW-hr
CO		0.947 g/hp-hr	1.270	g/kW-hr
NOx	(Cell)	4.106 g/hp-hr	5.507	g/kW-hr
Particulate		0.095 g/hp-hr	0.127	g/kW-hr
CO2		586.7 g/hp-hr	786.83	g/kW-hr
BSFC		0.408 lb/hp-hr	0.248	kg/kW-hr
NMHC		0.087 g/hp-hr	0.116	g/kW-hr
CH4		0.014 g/hp-hr	0.019	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DFTP2	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/11/2002 Time: 12:00	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.124 ppm	0.006 ppm
Mass	191.00 mg	
Acetaldehyde		
Concentration	0.029 ppm	0.001 ppm
Mass	66.52 mg	
Acrolein		
Concentration	0.008 ppm	0.000 ppm
Mass	25.13 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.006 ppm	0.001 ppm
Mass	18.00 mg	
Crotonaldehyde		
Concentration	0.009 ppm	0.002 ppm
Mass	25.72 mg	
Isobutyr + MEK		
Concentration	0.001 ppm	0.000 ppm
Mass	2.38 mg	
Benzaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	4.08 mg	
Hexanaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	4.52 mg	

Brake-Specific Results

Formaldehyde	14.807 mg/hp-hr	Crotonaldehyde	1.994 mg/hp-hr
Acetaldehyde	5.156 mg/hp-hr	Isobutyr + MEK	0.184 mg/hp-hr
Acrolein	1.948 mg/hp-hr	Benzaldehyde	0.316 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.351 mg/hp-hr
Propionaldehyde	1.396 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DBHL1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/10/2002 Time: 11:18	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.2	°F	13.4 °C
Abs. Humidity:	69.5	gr/lb	9.9 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.6	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,193.9	62.13
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.20	0.03
Gas Meter 2:	4.22	0.12
Sample Rate:	3.03	0.09
20X20 Sample Rate:	67.47	1.91
47 mm Sample Rate:	51.34	1.45
Chemistry Sample Rate:	0.133	0.059
Total Flow Rate:	2,315.82	65.64

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		10.39	ppm	
HC Bckgrd	8.0	2	8.08	ppm	
CO	12.5	2	11.90	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		24.65	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	49.6	1	0.3737	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	
CH4 Sample	n/a	n/a	2.01	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.04	ppm	

Particulate Data

Filter Number:	5004.0-637 (pair)	
Weight Gain:	1.328	mg
Sample Multiplier:	0.765	

Correction Factors

NOx Humidity CF:	0.986
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	36.21

Corrected Concentrations

HC	2.53	ppm	
CO	11.29	ppm	
NOx	24.01	ppm	
CO2	0.3304	%	
CH4	0.02	ppm	(1.00)

Test Cycle Data

Sample Time:	947.10	sec		
Work:	10.55	hp-hr	7.87	kW-hr
Reference Work:	10.89	hp-hr	8.12	kW-hr
Total Volume (Vmix):	36,553.2	scf	1,035.21	scm

Mass Emissions

HC	1.506	grams	
CO	13.603	grams	
NOx	46.868	grams	
Particulate	1.016	grams	
CO2	6.258	kg	
CH4	0.014	grams	
Fuel	4.35 lb	1.97	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.143 g/hp-hr	0.191	g/kW-hr
CO		1.289 g/hp-hr	1.729	g/kW-hr
NOx	(Cell)	4.442 g/hp-hr	5.957	g/kW-hr
Particulate		0.096 g/hp-hr	0.129	g/kW-hr
CO2		593.1 g/hp-hr	795.43	g/kW-hr
BSFC		0.413 lb/hp-hr	0.251	kg/kW-hr
NMHC		0.124 g/hp-hr	0.166	g/kW-hr
CH4		0.001 g/hp-hr	0.002	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B12DBHL1	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/10/2002 Time: 11:18	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

	Sample	Background
Formaldehyde		
Concentration	0.152 ppm	0.003 ppm
Mass	188.29 mg	
Acetaldehyde		
Concentration	0.037 ppm	0.001 ppm
Mass	66.03 mg	
Acrolein		
Concentration	0.010 ppm	0.000 ppm
Mass	23.85 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.010 ppm	0.001 ppm
Mass	22.00 mg	
Crotonaldehyde		
Concentration	0.008 ppm	0.000 ppm
Mass	23.64 mg	
Isobutyr + MEK		
Concentration	0.001 ppm	0.000 ppm
Mass	4.54 mg	
Benzaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	5.67 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	

Brake-Specific Results

Formaldehyde	17.847 mg/hp-hr	Crotonaldehyde	2.241 mg/hp-hr
Acetaldehyde	6.259 mg/hp-hr	Isobutyr + MEK	0.431 mg/hp-hr
Acrolein	2.261 mg/hp-hr	Benzaldehyde	0.537 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.000 mg/hp-hr
Propionaldehyde	2.085 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B2NRFTP1	DIESEL 2D, NR=EM2831F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/12/2002 Time: 11:21	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	74.8	gr/lb	10.7 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.3	gr/lb	10.8 g/kg
Rel. Humidity:	48	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,186.9	61.93
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.17	0.03
Gas Meter 2:	4.20	0.12
Sample Rate:	3.03	0.09
20X20 Sample Rate:	68.02	1.93
47 mm Sample Rate:	50.83	1.44
Chemistry Sample Rate:	0.135	0.077
Total Flow Rate:	2,308.92	65.46

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.93	ppm	
HC Bckgrd	n/a		9.60	ppm	
CO	10.2	2	9.68	ppm	(Dry)
CO Bckgrd	1.9	2	1.78	ppm	
NOx Sample	n/a		21.22	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	48.7	1	0.3651	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	
CH4 Sample	n/a	n/a	2.24	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.06	ppm	

Particulate Data

Filter Number:	5094.0- (pair)	
Weight Gain:	2.598	mg
Sample Multiplier:	0.762	

Correction Factors

NOx Humidity CF:	0.999
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	37.09

Corrected Concentrations

HC	0.59	ppm	
CO	7.76	ppm	
NOx	20.69	ppm	
CO2	0.3218	%	
CH4	0.23	ppm	(1.00)

Test Cycle Data

Sample Time:	1,206.70	sec		
Work:	13.02	hp-hr	9.71	kW-hr
Reference Work:	12.76	hp-hr	9.52	kW-hr
Total Volume (Vmix):	46,433.6	scf	1,315.03	scm

Mass Emissions

HC	0.445	grams	
CO	11.878	grams	
NOx	52.009	grams	
Particulate	1.979	grams	
CO2	7.742	kg	
CH4	0.202	grams	
Fuel	5.38 lb	2.44	kg

Brake-Specific Emission Results

BSHC	(Cell)	0.034 g/hp-hr	0.046	g/kW-hr
CO		0.912 g/hp-hr	1.223	g/kW-hr
NOx	(Cell)	3.995 g/hp-hr	5.357	g/kW-hr
Particulate		0.152 g/hp-hr	0.204	g/kW-hr
CO2		594.6 g/hp-hr	797.36	g/kW-hr
BSFC		0.413 lb/hp-hr	0.251	kg/kW-hr
NMHC		0.030 g/hp-hr	0.040	g/kW-hr
CH4		0.016 g/hp-hr	0.021	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRFTP1	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/12/2002 Time: 11:21	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.127 ppm	0.006 ppm
Mass	194.98 mg	
Acetaldehyde		
Concentration	0.033 ppm	0.003 ppm
Mass	69.99 mg	
Acrolein		
Concentration	0.005 ppm	0.000 ppm
Mass	14.57 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.005 ppm	0.001 ppm
Mass	12.39 mg	
Crotonaldehyde		
Concentration	0.006 ppm	0.000 ppm
Mass	22.18 mg	
Isobutyr + MEK		
Concentration	0.003 ppm	0.001 ppm
Mass	7.73 mg	
Benzaldehyde		
Concentration	0.002 ppm	0.000 ppm
Mass	8.99 mg	
Hexanaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	2.42 mg	

Brake-Specific Results

Formaldehyde	14.975 mg/hp-hr	Crotonaldehyde	1.704 mg/hp-hr
Acetaldehyde	5.376 mg/hp-hr	Isobutyr + MEK	0.594 mg/hp-hr
Acrolein	1.119 mg/hp-hr	Benzaldehyde	0.691 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.186 mg/hp-hr
Propionaldehyde	0.951 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B2NRFTP2	DIESEL 2D, NR=EM2831F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/12/2002 Time: 12:20	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	57.9	°F	14.4 °C
Abs. Humidity:	74.0	gr/lb	10.6 g/kg
Rel. Humidity:	53	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	70.2	gr/lb	10.0 g/kg
Rel. Humidity:	45	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,187.8	61.96
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.17	0.03
Gas Meter 2:	4.20	0.12
Sample Rate:	3.04	0.09
20X20 Sample Rate:	67.31	1.91
47 mm Sample Rate:	50.92	1.44
Chemistry Sample Rate:	0.136	0.078
Total Flow Rate:	2,309.20	65.47

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.92	ppm	
HC Bckgrd	8.0	2	8.08	ppm	
CO	9.5	2	9.01	ppm	(Dry)
CO Bckgrd	1.0	2	0.94	ppm	
NOx Sample	n/a		21.23	ppm	(Dry)
NOx Bckgrd	0.3	1	0.08	ppm	
CO2 Sample	48.5	1	0.3632	%	(Wet)
CO2 Bckgrd	6.7	1	0.0425	%	
CH4 Sample	n/a	n/a	2.11	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.12	ppm	

Particulate Data

Filter Number:	5095 (pair)	
Weight Gain:	2.621	mg
Sample Multiplier:	0.761	

Correction Factors

NOx Humidity CF:	0.997
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	37.28

Test Cycle Data

Sample Time:	1,206.10	sec		
Work:	13.08	hp-hr	9.75	kW-hr
Reference Work:	12.76	hp-hr	9.52	kW-hr
Total Volume (Vmix):	46,416.0	scf	1,314.53	scm

Corrected Concentrations

HC	2.06	ppm	
CO	7.92	ppm	
NOx	20.75	ppm	
CO2	0.3218	%	
CH4	0.05	ppm	(1.00)

Brake-Specific Emission Results

BSHC	(Cell)	0.119 g/hp-hr	0.159	g/kW-hr
CO		0.926 g/hp-hr	1.242	g/kW-hr
NOx	(Cell)	3.977 g/hp-hr	5.333	g/kW-hr
Particulate		0.152 g/hp-hr	0.204	g/kW-hr
CO2		591.7 g/hp-hr	793.50	g/kW-hr
BSFC		0.411 lb/hp-hr	0.250	kg/kW-hr
NMHC		0.103 g/hp-hr	0.138	g/kW-hr
CH4		0.003 g/hp-hr	0.004	g/kW-hr

Mass Emissions

HC	1.553	grams	
CO	12.115	grams	
NOx	52.017	grams	
Particulate	1.993	grams	
CO2	7.740	kg	
CH4	0.041	grams	
Fuel	5.38 lb	2.44	kg

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRFTP2	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/12/2002 Time: 12:20	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.123 ppm	0.006 ppm
Mass	188.70 mg	
Acetaldehyde		
Concentration	0.031 ppm	0.003 ppm
Mass	67.05 mg	
Acrolein		
Concentration	0.004 ppm	0.000 ppm
Mass	11.07 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.005 ppm	0.001 ppm
Mass	13.29 mg	
Crotonaldehyde		
Concentration	0.007 ppm	0.000 ppm
Mass	22.74 mg	
Isobutyr + MEK		
Concentration	0.004 ppm	0.001 ppm
Mass	11.09 mg	
Benzaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	6.86 mg	
Hexanaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	3.37 mg	

Brake-Specific Results

Formaldehyde	14.427 mg/hp-hr	Crotonaldehyde	1.738 mg/hp-hr
Acetaldehyde	5.126 mg/hp-hr	Isobutyr + MEK	0.848 mg/hp-hr
Acrolein	0.846 mg/hp-hr	Benzaldehyde	0.524 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.258 mg/hp-hr
Propionaldehyde	1.016 mg/hp-hr		

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B2NRBHL1	DIESEL 2D, NR=EM2831F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/13/2002 Time: 10:42	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	

Ambient/Test Cell Conditions

Barometer:	29.05	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	57.9	°F	14.4 °C
Abs. Humidity:	74.0	gr/lb	10.6 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.6	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,185.6	61.90
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.07	0.03
Gas Meter 2:	4.23	0.12
Sample Rate:	3.16	0.09
20X20 Sample Rate:	67.60	1.91
47 mm Sample Rate:	50.97	1.44
Chemistry Sample Rate:	0.134	0.060
Total Flow Rate:	2,307.50	65.41

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		11.43	ppm	
HC Bckgrd	9.5	2	9.59	ppm	
CO	11.7	2	11.13	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		24.88	ppm	(Dry)
NOx Bckgrd	1.1	1	0.28	ppm	
CO2 Sample	50.0	1	0.3776	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	
CH4 Sample	n/a	n/a	2.24	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.16	ppm	

Particulate Data

Filter Number:	5950 (pair)	
Weight Gain:	1.910	mg
Sample Multiplier:	0.731	

Correction Factors

NOx Humidity CF:	0.998
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	35.84

Corrected Concentrations

HC	2.11	ppm	
CO	10.63	ppm	
NOx	24.14	ppm	
CO2	0.3350	%	
CH4	0.13	ppm	(1.00)

Test Cycle Data

Sample Time:	947.10	sec		
Work:	10.73	hp-hr	8.00	kW-hr
Reference Work:	10.95	hp-hr	8.17	kW-hr
Total Volume (Vmix):	36,421.8	scf	1,031.49	scm

Mass Emissions

HC	1.249	grams
CO	12.765	grams
NOx	47.496	grams
Particulate	1.395	grams
CO2	6.322	kg
CH4	0.092	grams
Fuel	4.40 lb	1.99 kg

Brake-Specific Emission Results

BSHC	(Cell)	0.116 g/hp-hr	0.156	g/kW-hr
CO		1.190 g/hp-hr	1.595	g/kW-hr
NOx	(Cell)	4.426 g/hp-hr	5.936	g/kW-hr
Particulate		0.130 g/hp-hr	0.174	g/kW-hr
CO2		589.2 g/hp-hr	790.11	g/kW-hr
BSFC		0.410 lb/hp-hr	0.249	kg/kW-hr
NMHC		0.101 g/hp-hr	0.136	g/kW-hr
CH4		0.009 g/hp-hr	0.011	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRBHL1	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/13/2002 Time: 10:42	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO

	Sample	Background
Formaldehyde		
Concentration	0.140 ppm	0.001 ppm
Mass	176.07 mg	
Acetaldehyde		
Concentration	0.034 ppm	0.000 ppm
Mass	63.86 mg	
Acrolein		
Concentration	0.003 ppm	0.000 ppm
Mass	7.67 mg	
Acetone		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Propionaldehyde		
Concentration	0.006 ppm	0.000 ppm
Mass	14.98 mg	
Crotonaldehyde		
Concentration	0.099 ppm	0.000 ppm
Mass	292.76 mg	
Isobutyr + MEK		
Concentration	0.000 ppm	0.000 ppm
Mass	1.11 mg	
Benzaldehyde		
Concentration	0.000 ppm	0.000 ppm
Mass	0.00 mg	
Hexanaldehyde		
Concentration	0.001 ppm	0.000 ppm
Mass	2.53 mg	

Brake-Specific Results

Formaldehyde	16.409 mg/hp-hr	Crotonaldehyde	27.284 mg/hp-hr
Acetaldehyde	5.951 mg/hp-hr	Isobutyr + MEK	0.103 mg/hp-hr
Acrolein	0.715 mg/hp-hr	Benzaldehyde	0.000 mg/hp-hr
Acetone	0.000 mg/hp-hr	Hexanaldehyde	0.235 mg/hp-hr
Propionaldehyde	1.397 mg/hp-hr		

APPENDIX H

GRAPHICAL SUMMARIES OF TRANSIENT CYCLE REGRESSION STATISTICS FOR FTP, BHL, AND SAT TESTING ON A CUMMINS ISB190 USING HIGH AND LOW SULFUR DIESEL FUELS

Test Name	Cycle	Fuel	Toxics Information	Description	Page
B02DFTP1	FTP	2D	Without	Transient Cycle Regression Summary	H-1
B02DFTP2	FTP	2D	Without	Transient Cycle Regression Summary	H-2
B02DBHL1	BHL	2D	Without	Transient Cycle Regression Summary	H-3
B02DBHL2	BHL	2D	Without	Transient Cycle Regression Summary	H-4
B02DSAT1	SAT	2D	Without	Transient Cycle Regression Summary	H-5
B02DSAT2	SAT	2D	Without	Transient Cycle Regression Summary	H-6
B12DFTP1	FTP	2D	Yes	Transient Cycle Regression Summary	H-7
B12DFTP2	FTP	2D	Yes	Transient Cycle Regression Summary	H-8
B12DBHL1	BHL	2D	Yes	Transient Cycle Regression Summary	H-9
B2NRFTP1	FTP	NR	Yes	Transient Cycle Regression Summary	H-10
B2NRFTP2	FTP	NR	Yes	Transient Cycle Regression Summary	H-11
B2NRBHL1	BHL	NR	Yes	Transient Cycle Regression Summary	H-12

HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/16/02
Time: 10:09 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B02DFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 692

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

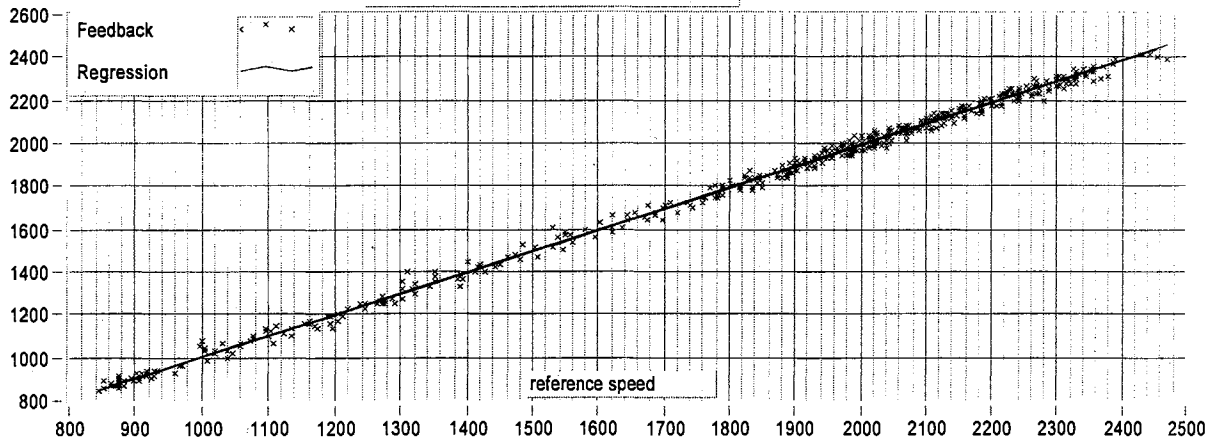
STATS PASS

WORK PASS

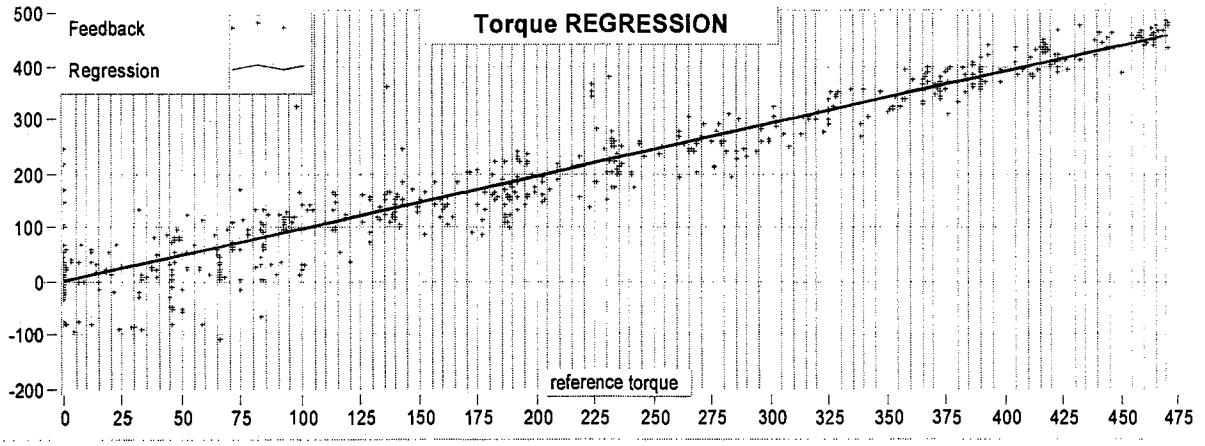
	SPEED	TORQUE	POWER
SE	17	7	6
M	0.990	0.97	0.99
R2	0.9991	0.9435	0.9628
B	10	1	-0.3
NO. PTS.	1174	1006	1006

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	12.98
REFERENCE WORK [HP-HR]	12.70
PERCENT DIFFERENCE	2.23

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 9/16/02
Time: 10:54 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B02DFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 693

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

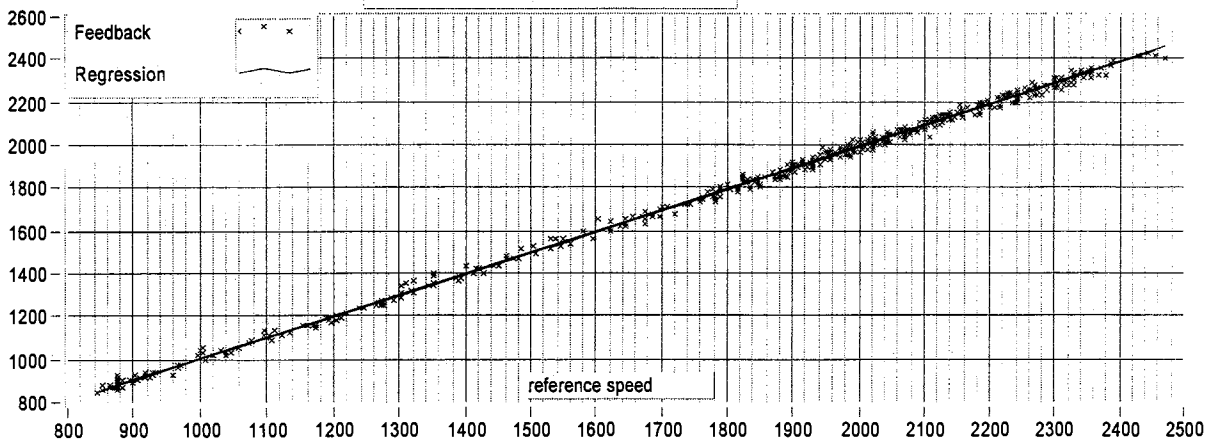
STATS PASS

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	12.96
REFERENCE WORK [HP-HR]	12.70
PERCENT DIFFERENCE	2.00

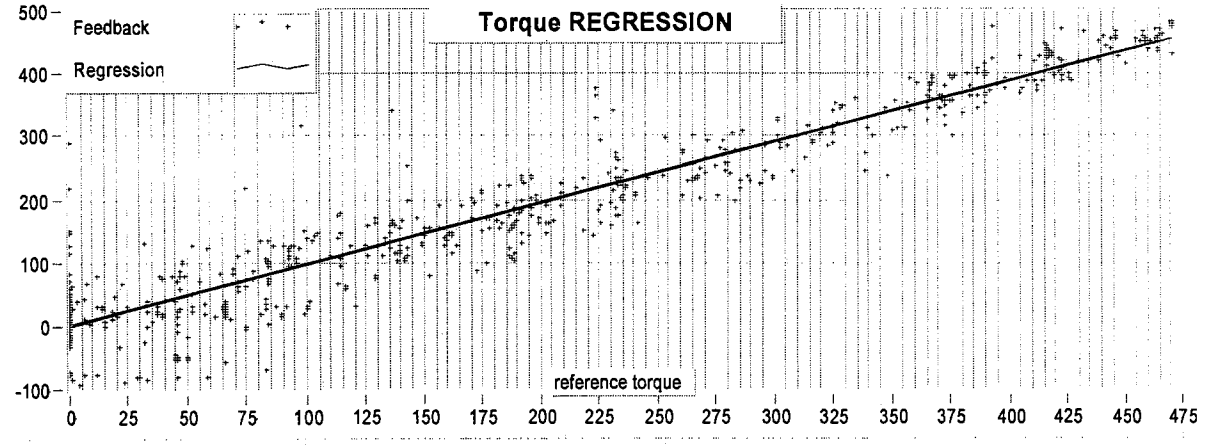
WORK PASS

	SPEED	TORQUE	POWER
SE	15	7	6
M	0.990	0.97	0.99
R2	0.9994	0.9418	0.9609
B	11	0	-0.5
NO. PTS.	1174	1009	1009

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/16/02
Time: 1:06 PM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B02DBHL1
No. of Bags: 1
Cycle Type: Hot,
User Specified
EVENT NO. 695

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

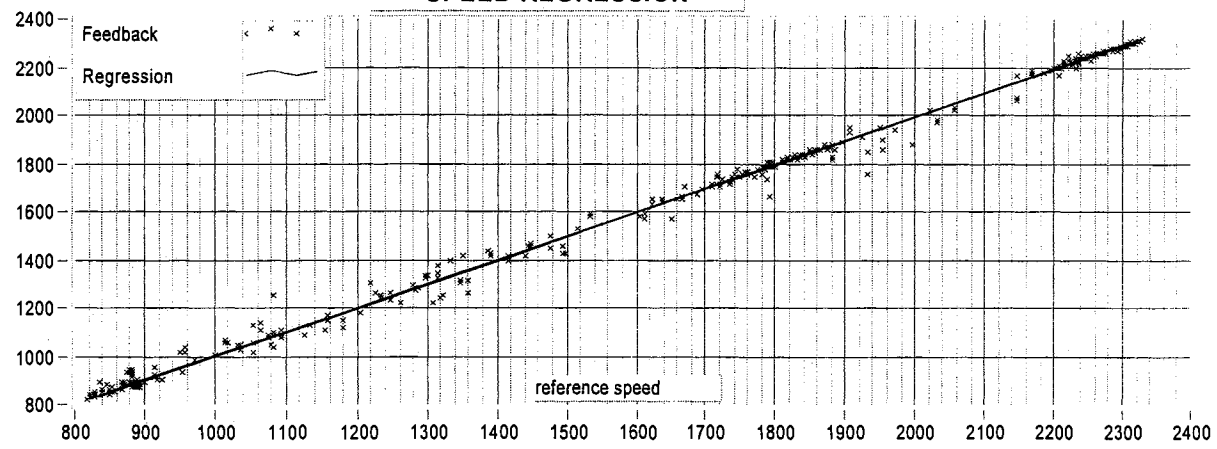
STATS FAIL

WORK PASS

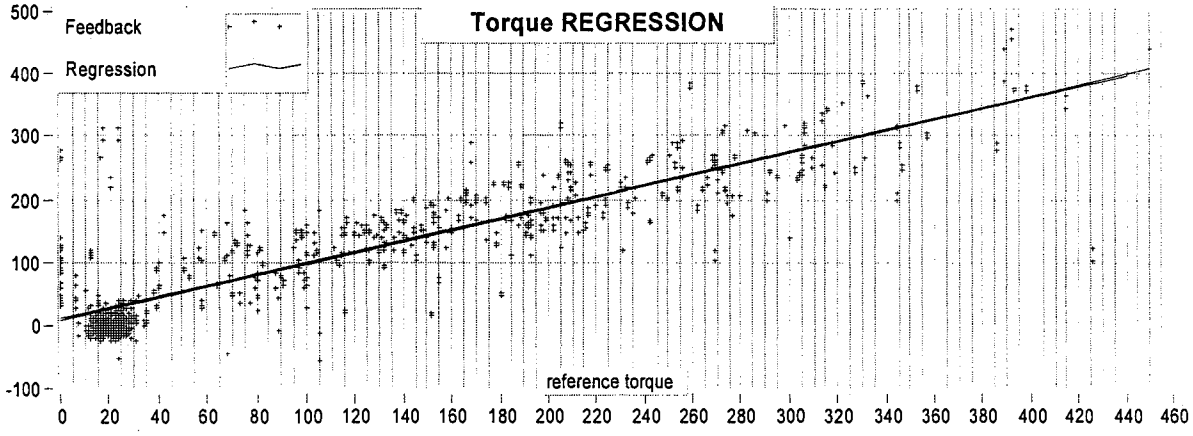
	SPEED	TORQUE	POWER
SE	23	10	7
M	0.993	0.89	0.93
R2	0.9984	0.7654	0.8789
B	7	9	2.5
NO. PTS.	915	918	918

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	10.75
REFERENCE WORK [HP-HR]	10.89
PERCENT DIFFERENCE	-1.31

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/16/02
Time: 1:43 PM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B02DBHL2
No. of Bags: 1
Cycle Type: Hot,
User Specified
EVENT NO. 696

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

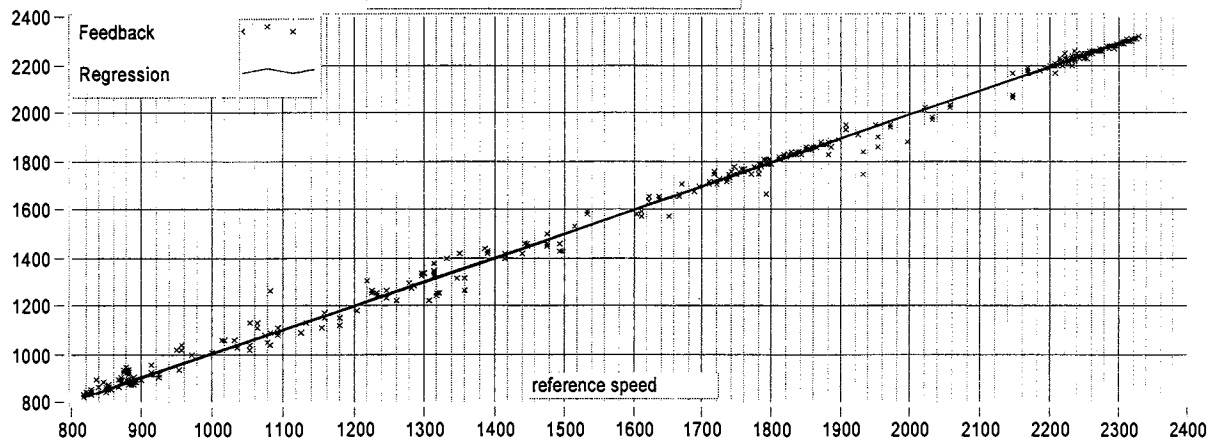
STATS FAIL

WORK PASS

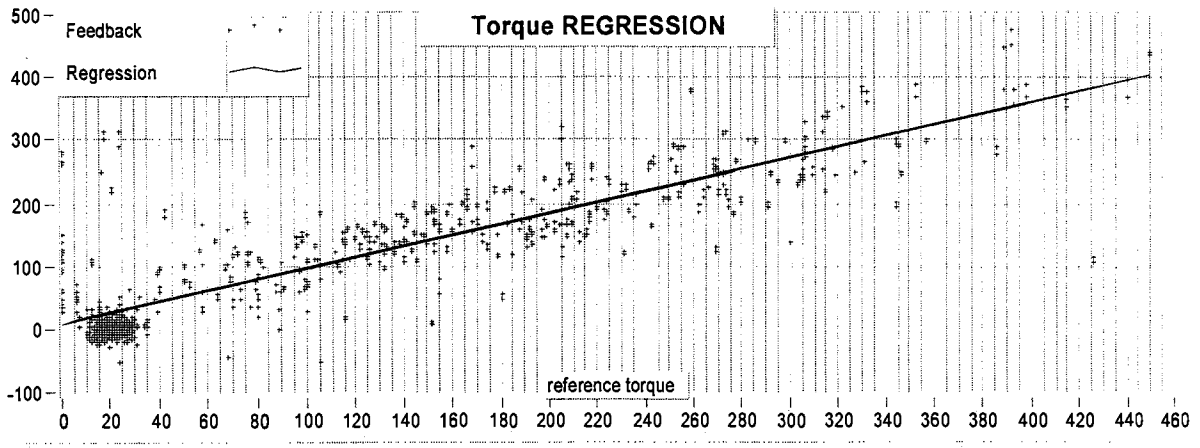
	SPEED	TORQUE	POWER
SE	23	10	7
M	0.992	0.88	0.92
R2	0.9984	0.7664	0.8797
B	7	9	2.4
NO. PTS.	915	918	918

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	10.67
REFERENCE WORK [HP-HR]	10.89
PERCENT DIFFERENCE	-2.10

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/16/02
Time: 2:56 PM
Engine ID.
46109691
CUMMINS ISB 190
Test No. B02DSAT1
No. of Bags: 1
Cycle Type: Hot,
User Specified
EVENT NO. 700

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

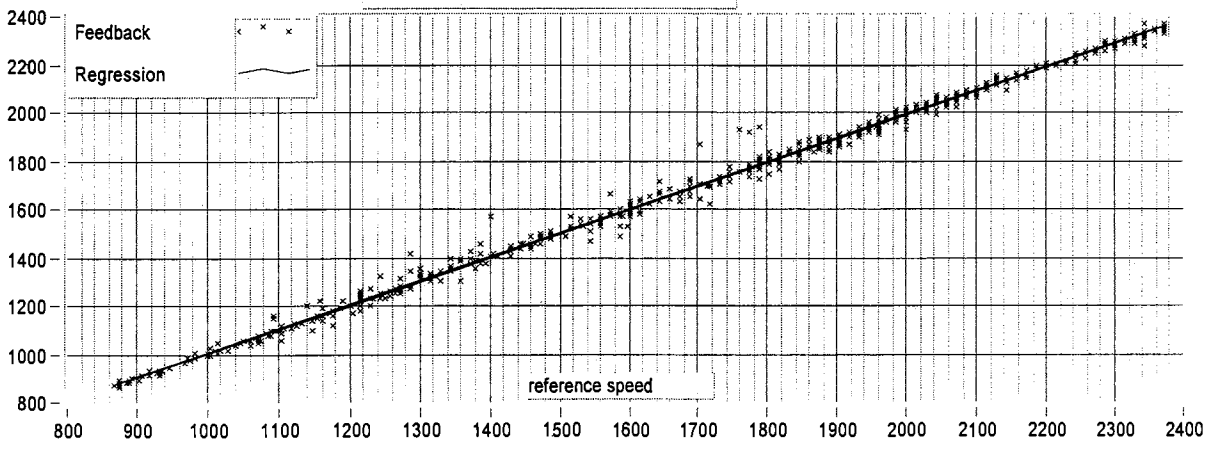
STATS FAIL

WORK PASS

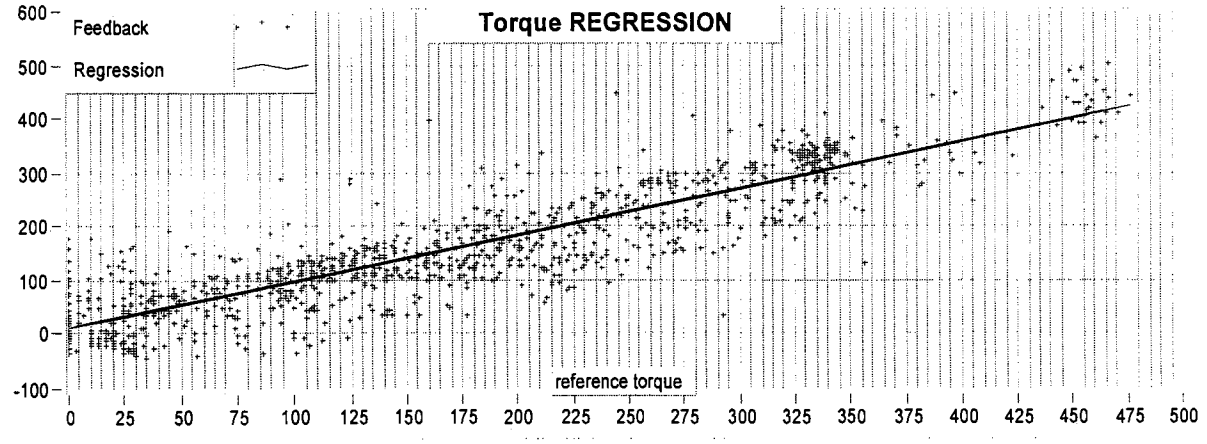
	SPEED	TORQUE	POWER
SE	19	10	9
M	0.988	0.87	0.90
R2	0.9978	0.8105	0.8587
B	15	11	2.4
NO. PTS.	1213	1229	1229

TIME DELAY [sec]	0.52
CYCLE WORK [HP-HR]	21.12
REFERENCE WORK [HP-HR]	22.58
PERCENT DIFFERENCE	-6.48

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/16/02
Time: 3:35 PM
Engine ID.
46109691
CUMMINS ISB 190
Test No. B02DSAT2
No. of Bags: 1
Cycle Type: Hot,
User Specified
EVENT NO. 701

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

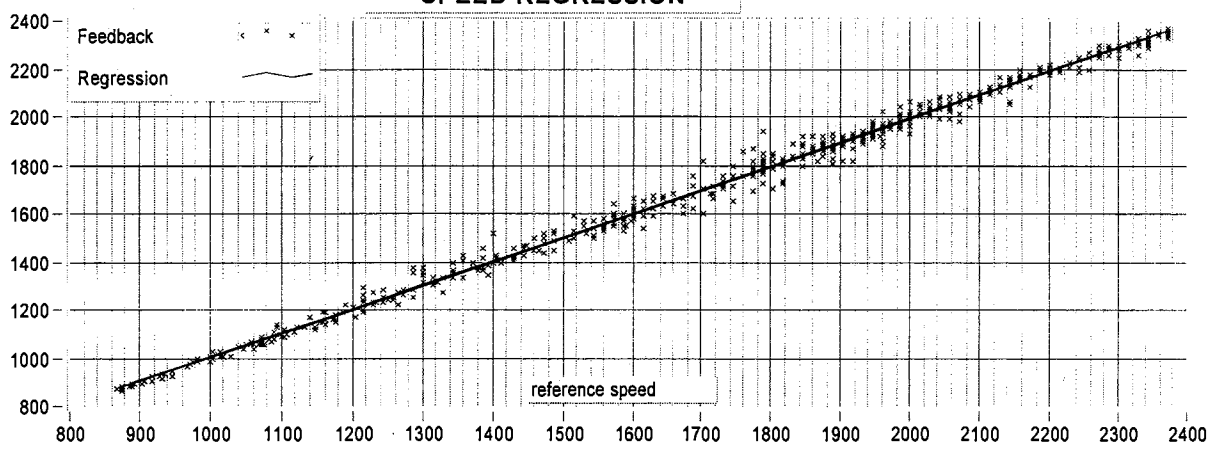
STATS FAIL

WORK PASS

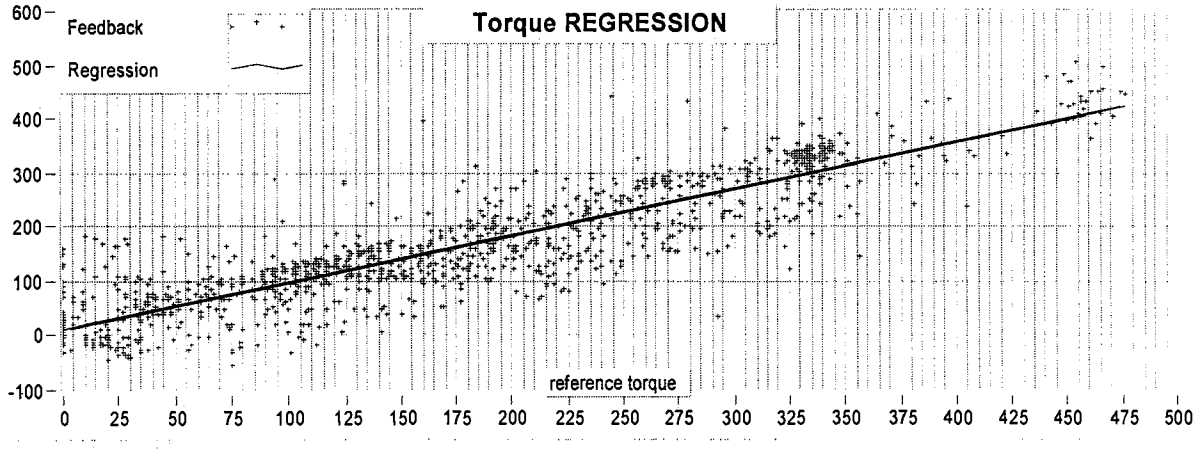
	SPEED	TORQUE	POWER
SE	21	10	9
M	0.989	0.87	0.90
R2	0.9972	0.8060	0.8582
B	14	10	2.2
NO. PTS.	1213	1229	1229

TIME DELAY [sec]	0.50
CYCLE WORK [HP-HR]	21.14
REFERENCE WORK [HP-HR]	22.58
PERCENT DIFFERENCE	-6.39

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/11/02
Time: 11:00 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B12DFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 678

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

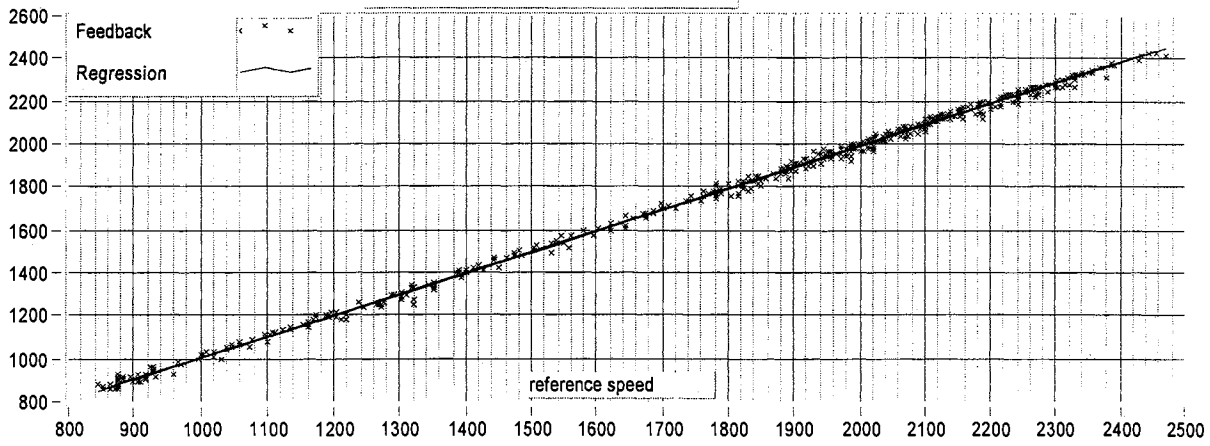
STATS PASS

TIME DELAY [sec]	0.72
CYCLE WORK [HP-HR]	12.98
REFERENCE WORK [HP-HR]	12.70
PERCENT DIFFERENCE	2.20

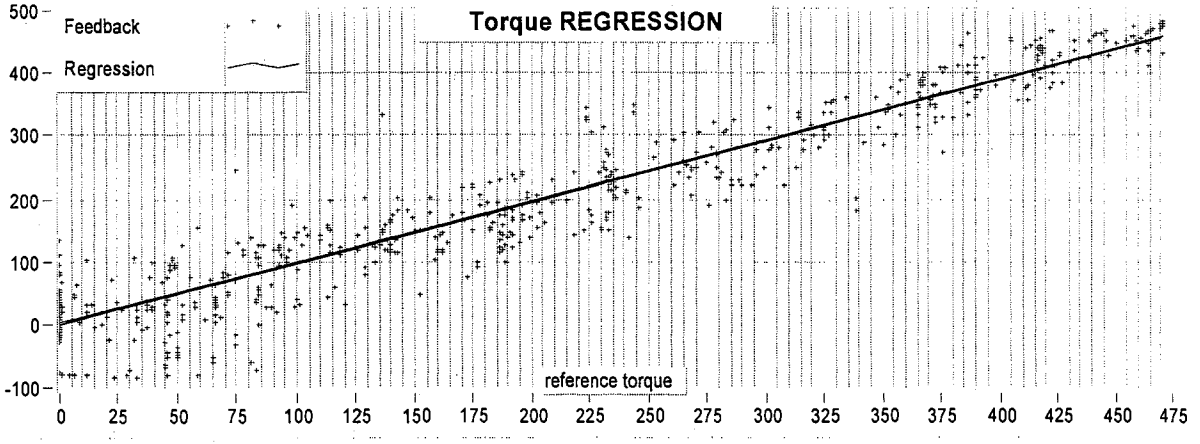
WORK PASS

	SPEED	TORQUE	POWER
SE	14	7	6
M	0.989	0.97	0.99
R2	0.9994	0.9413	0.9521
B	12	0	-0.5
NO. PTS.	1174	1004	1004

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/11/02
Time: 11:44 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B12DFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 679

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

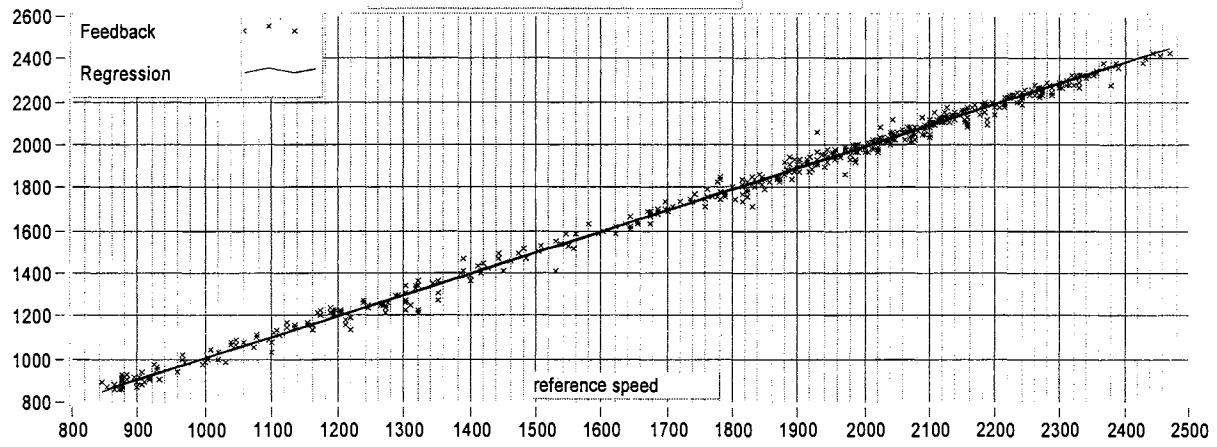
STATS PASS

WORK PASS

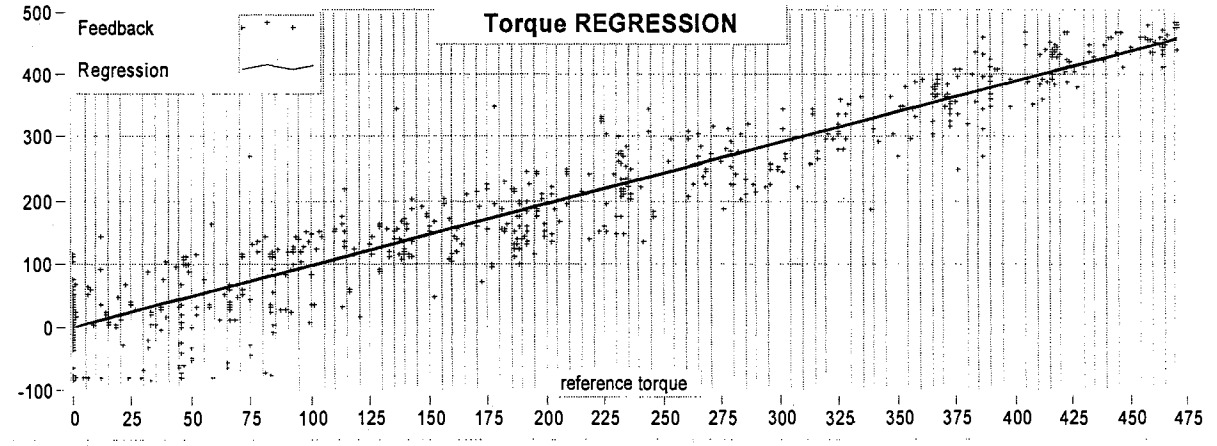
	SPEED	TORQUE	POWER
SE	20	8	7
M	0.988	0.97	0.98
R2	0.9988	0.9343	0.9465
B	14	-0	-0.5
NO. PTS.	1174	1004	1004

TIME DELAY [sec]	0.72
CYCLE WORK [HP-HR]	12.98
REFERENCE WORK [HP-HR]	12.70
PERCENT DIFFERENCE	2.18

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/10/02
Time: 11:04 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B12DBHL1
No. of Bags: 1
Cycle Type: Hot,
User Specified
EVENT NO. 674

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

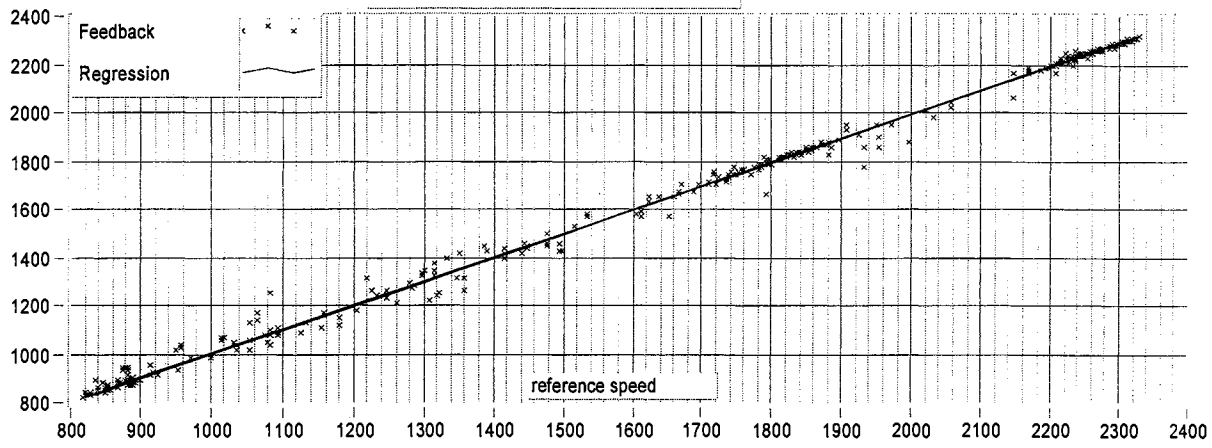
STATS FAIL

WORK PASS

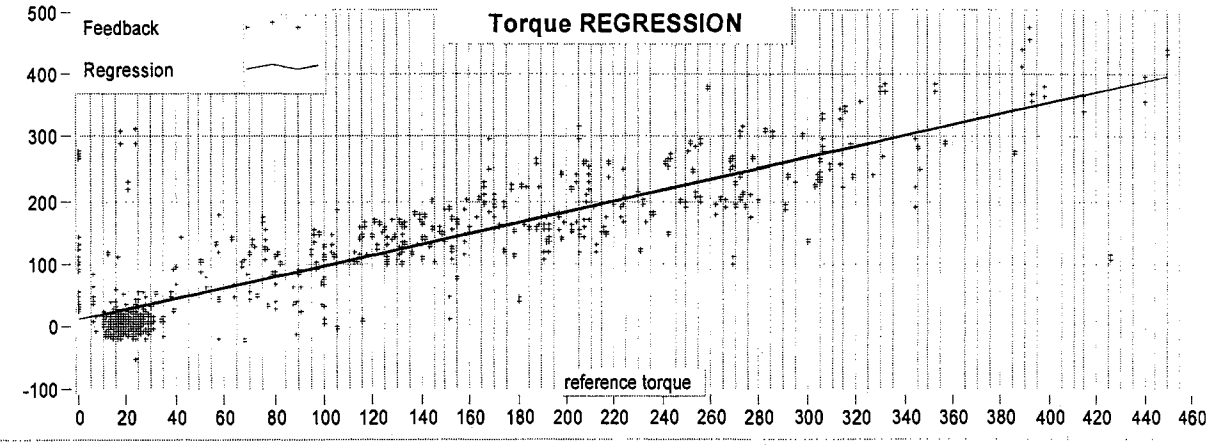
	TIME DELAY [sec]	CYCLE WORK [HP-HR]	REFERENCE WORK [HP-HR]	PERCENT DIFFERENCE
	0.51	10.55	10.89	-3.14

	SPEED	TORQUE	POWER
SE	23	10	8
M	0.993	0.86	0.91
R2	0.9983	0.7576	0.8661
B	6	10	2.7
NO. PTS.	915	918	918

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated statistical criteria for the engine being tested, based on Figure N90-11.

Date: 9/12/02
Time: 11:02 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B2NRFTP1
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 684

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

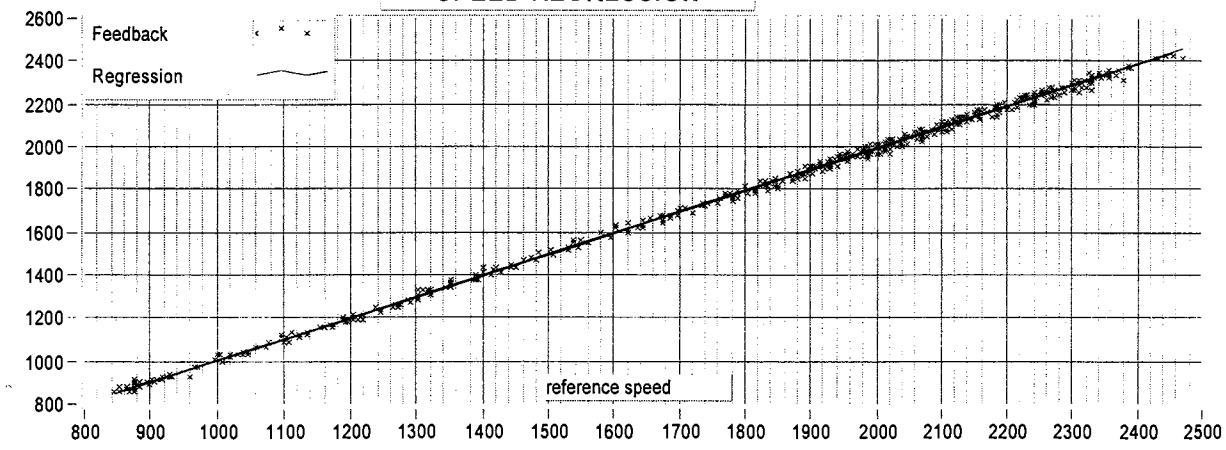
STATS PASS

WORK PASS

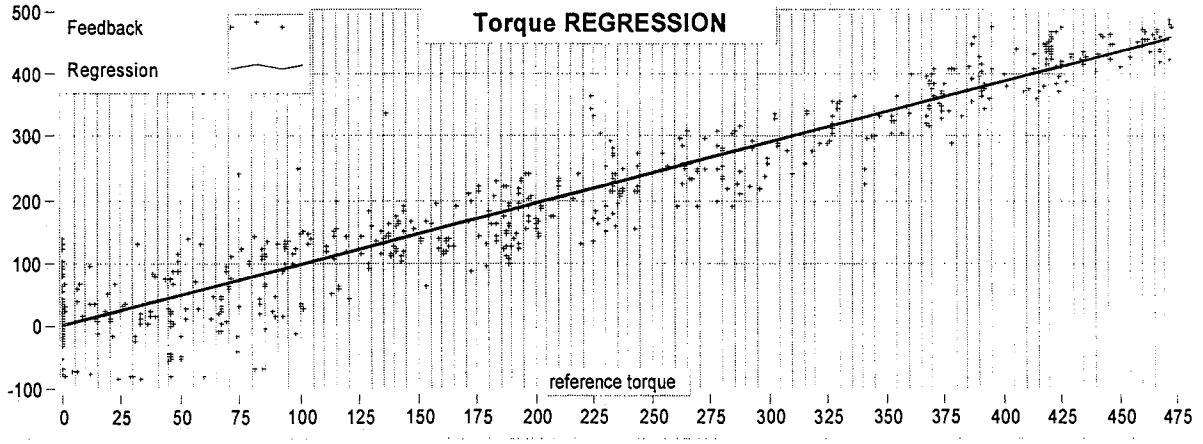
	SPEED	TORQUE	POWER
SE	13	7	6
M	0.991	0.97	0.99
R2	0.9995	0.9414	0.9549
B	10	1	-0.5
NO. PTS.	1174	1007	1007

TIME DELAY [sec]	0.70
CYCLE WORK [HP-HR]	13.02
REFERENCE WORK [HP-HR]	12.76
PERCENT DIFFERENCE	2.05

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/12/02
Time: 11:45 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B2NRFTP2
No. of Bags: 1
Cycle Type: Hot, Diesel
EVENT NO. 685

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

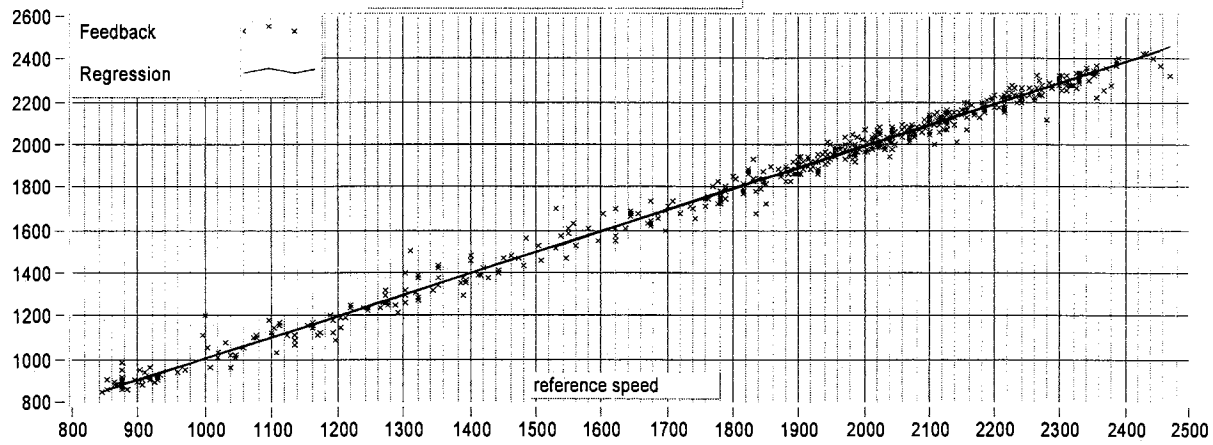
STATS PASS

WORK PASS

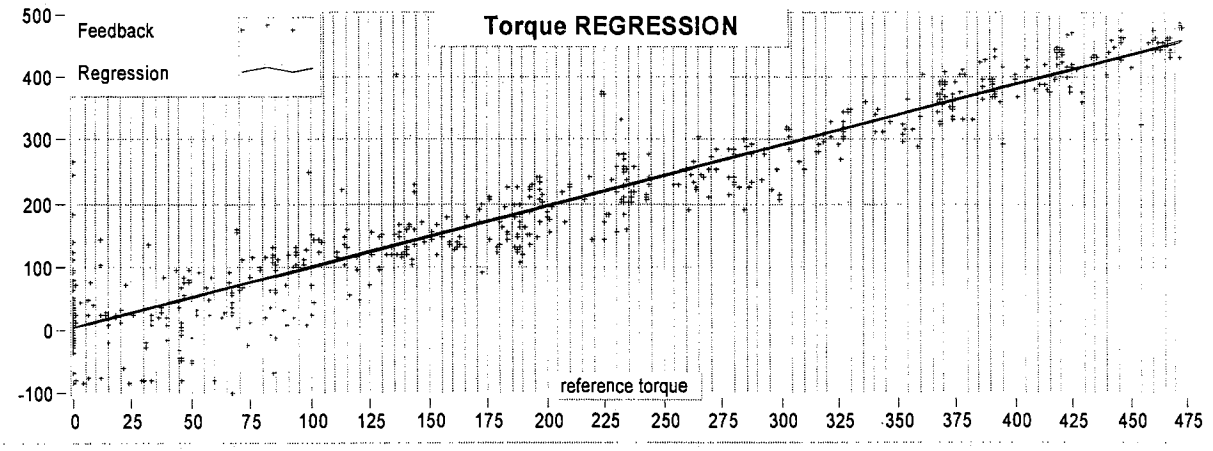
	SPEED	TORQUE	POWER
SE	29	8	6
M	0.990	0.96	0.98
R2	0.9976	0.9376	0.9594
B	12	3	0.0
NO. PTS.	1174	1006	1006

TIME DELAY [sec]	0.70
CYCLE WORK [HP-HR]	13.08
REFERENCE WORK [HP-HR]	12.76
PERCENT DIFFERENCE	2.52

SPEED REGRESSION



Torque REGRESSION



HDTRANSIENT FTP TEST CYCLE ANALYSIS SUMMARY

CFR 86.1341-90
Test Cycle Validation Criteria
The values below are the calculated
statistical criteria for the engine being tested,
based on Figure N90-11.

Date: 9/13/02
Time: 10:24 AM
Engine ID.
46109691
CUMMINS ISB 190
Test No.
B2NRBHL1
No. of Bags: 1
Cycle Type: Hot,
User Specified
EVENT NO. 689

	Speed Max	Speed Min	Torque Max	Torque Min	BHP Max	BHP Min
SE	100	0	13	0	8	0
M	1.030	0.970	1.03	0.83	1.03	0.89
R2	1.0000	0.9700	1.0000	0.8800	1.0000	0.9100
B	50	-50	15	-15	5.0	-5.0

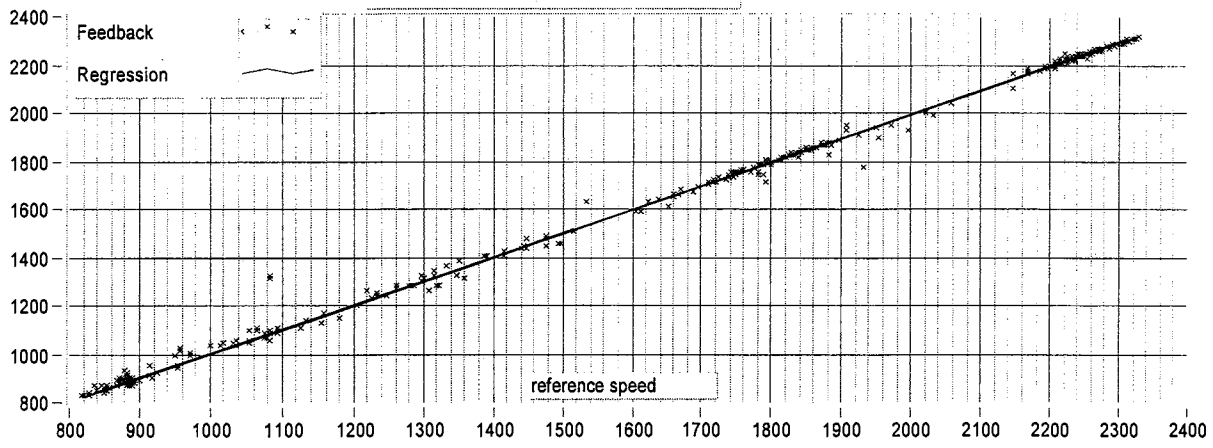
STATS FAIL

WORK PASS

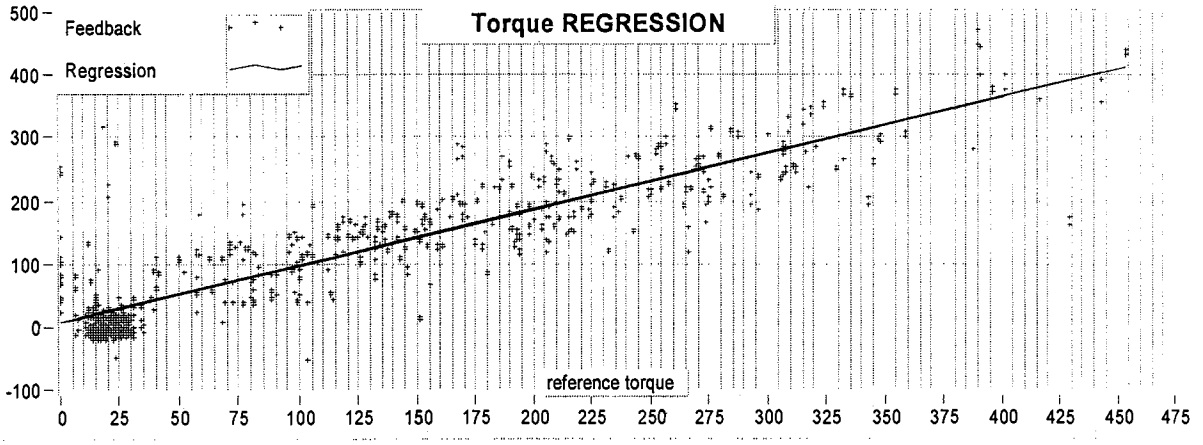
	SPEED	TORQUE	POWER
SE	19	10	7
M	0.993	0.89	0.93
R2	0.9989	0.7917	0.8838
B	7	7	2.4
NO. PTS.	915	924	924

TIME DELAY [sec]	0.52
CYCLE WORK [HP-HR]	10.73
REFERENCE WORK [HP-HR]	10.95
PERCENT DIFFERENCE	-2.03

SPEED REGRESSION



Torque REGRESSION



APPENDIX I

DETAILED COMPUTER PRINTOUTS FOR TYPE-C1 STEADY-STATE EMISSION TESTS ON A DEERE 6068T USING TWO FUELS

Test Name	Cycle or Mode	Fuel	Toxics Information	Description	Page
J02DXS8A	C1 Test	2D	Without	Steady-State Emissions Summary	I-1
J12DU8B-1	C1-1	2D	Yes	Steady-State Emissions Summary	I-4
J12DU8B-2	C1-2	2D	Yes	Steady-State Emissions Summary	I-5
J12DU8B-3	C1-3	2D	Yes	Steady-State Emissions Summary	I-6
J12DU8B-4	C1-4	2D	Yes	Steady-State Emissions Summary	I-7
J12DU8B-5	C1-5	2D	Yes	Steady-State Emissions Summary	I-8
J12DU8B-6	C1-6	2D	Yes	Steady-State Emissions Summary	I-9
J12DU8B-7	C1-7	2D	Yes	Steady-State Emissions Summary	I-10
J12DU8B-8	C1-8	2D	Yes	Steady-State Emissions Summary	I-11
J2NRU8E-1	C1-1	NR	Yes	Steady-State Emissions Summary	I-12
J2NRU8E-2	C1-2	NR	Yes	Steady-State Emissions Summary	I-13
J2NRU8E-3	C1-3	NR	Yes	Steady-State Emissions Summary	I-14
J2NRU8E-4	C1-4	NR	Yes	Steady-State Emissions Summary	I-15
J2NRU8E-5	C1-5	NR	Yes	Steady-State Emissions Summary	I-16
J2NRU8E-6	C1-6	NR	Yes	Steady-State Emissions Summary	I-17
J2NRU8E-7	C1-7	NR	Yes	Steady-State Emissions Summary	I-18
J2NRU8E-8	C1-8	NR	Yes	Steady-State Emissions Summary	I-19

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 0.0 L (0 CID) 6
Engine Cycle: Diesel
Engine S/N: 553469

Test No.: J02DXS8A
Date: 06/19/2002 Time:
Program SSDIL: 2.28-R
Cell: 16 Bag Cart: 1

DIESEL 2D, 2D=EM4619F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

	Target			Measured		C - B	Intake Air			Factors			
	Speed	Load	Torque	Time	Speed	Torque	Fuel	Temp	Humid	Baro.	NOx	Part.	Dry	F
Mode	rpm	pct	lb-ft	sec	rpm	lb-ft	lb/hr	°F	g/kg	in-Hg	Hum.	Hum.	Wet	(TC)
1	2,200	100.0	378.0	300	2,200	378.0	53.6	73.0	11.5	29.04	1.015	0.989	0.973	1.007
2	2,200	75.0	283.5	300	2,201	186.0	42.7	74.0	11.6	29.03	1.016	0.989	0.975	1.010
3	2,200	50.0	189.0	300	2,198	189.0	30.6	74.0	11.6	29.03	1.016	0.989	0.977	1.010
4	2,200	10.0	37.8	300	2,201	42.0	13.9	74.0	11.8	29.03	1.020	0.986	0.979	1.011
5	1,350	100.0	475.0	300	1,350	475.0	41.4	77.0	11.5	29.02	1.015	0.989	0.975	1.019
6	1,350	75.0	356.3	300	1,348	356.0	30.1	77.0	11.3	29.02	1.012	0.992	0.977	1.019
7	1,350	50.0	237.5	300	1,349	238.0	20.8	78.0	11.3	29.01	1.010	0.993	0.979	1.022
8	915	0.0	0.0	300	908	1.0	2.2	77.0	11.1	29.01	1.008	0.994	0.984	1.019

	BHP								Weighted Results				
	from	Grams/Hour					Mode	Power	Grams/Hour				
Mode	Work	HC	CO	NOx	Part.	CO2	wf	bhp	HC	CO	NOx	Part.	CO2
1	156.7	31.71	105.0	2,090.5	22.54	77,067	.150	23.5	4.76	15.74	313.58	3.38	11,560
2	120.0	30.86	42.6	1,204.5	15.09	61,461	.150	18.0	4.63	6.39	180.68	2.26	9,219
3	79.3	43.02	61.9	532.0	20.59	43,882	.150	11.9	6.45	9.28	79.79	3.09	6,582
4	17.9	64.59	106.4	134.6	9.40	19,746	.100	1.8	6.46	10.64	13.46	0.94	1,975
5	121.7	24.48	268.4	1,216.3	76.01	59,231	.100	12.2	2.45	26.84	121.63	7.60	5,923
6	91.2	25.96	26.3	960.1	13.74	43,290	.100	9.1	2.60	2.63	96.01	1.37	4,329
7	61.1	26.66	26.9	535.3	9.40	29,908	.100	6.1	2.67	2.69	53.53	0.94	2,991
8	0.2	16.22	31.7	45.5	3.03	3,093	.150	0.0	2.43	4.75	6.82	0.46	464
							Total	82.6	32.44	78.97	865.49	20.04	43,043

	Weighted Modal Contribution				
	g/hp-hr				
Mode	HC	CO	NOx	Part.	CO2
1	0.06	0.19	3.80	0.041	140
2	0.06	0.08	2.19	0.027	112
3	0.08	0.11	0.97	0.037	80
4	0.08	0.13	0.16	0.011	24
5	0.03	0.32	1.47	0.092	72
6	0.03	0.03	1.16	0.017	52
7	0.03	0.03	0.65	0.011	36
8	0.03	0.06	0.08	0.006	6

Composite Results

BSHC	=	0.39	g/hp-hr	=	0.53 g/kW-hr
BSCO	=	0.96	g/hp-hr	=	1.28 g/kW-hr
BSNOx	=	10.48	g/hp-hr	=	14.05 g/kW-hr
Particulate	=	0.243	g/hp-hr	=	0.325 g/kW-hr
BSCO2	=	521	g/hp-hr	=	699 g/kW-hr
BSFC	=	0.363	lb/hp-hr	=	0.221 kg/kW-hr

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 0.0 L (0 CID) 6
Engine Cycle: Diesel
Engine S/N: 553469

Test No.: J02DXS8A
Date: 06/19/2002 Time:
Program SSDIL: 2.28-R
Cell: 16 Bag Cart: 1

DIESEL 2D, 2D=EM4619F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

Mode Number	1	2	3	4
Barometer, kPa (in Hg)	98.3 (29.04)	98.3 (29.03)	98.3 (29.03)	98.3 (29.03)
Dil. Air: Temp, °C (°F) / AH, g/kg	26.7 (80.0) / 10.0	26.7 (80.0) / 10.0	27.2 (81.0) / 10.5	27.8 (82.0) / 11.0
Engine Air Dew Pt., °C (°F)	15.7 (60.3)	15.7 (60.3)	15.7 (60.3)	16.0 (60.8)
Engine Air Temp, °C (°F)	22.8 (73.0)	23.3 (74.0)	23.3 (74.0)	23.3 (74.0)
Engine Air: RH,% / AH, g/kg	64 / 11.5	62 / 11.6	62 / 11.6	63 / 11.8
NOx Humidity C.F.	1.015	1.016	1.016	1.020
Dry-to-Wet C.F.	.973	.975	.977	.979
Time, seconds	299.8	299.9	299.9	299.9
Tot. Blower Rate, scmm (scfm)*	57.03 (2,161.1)	57.16 (2,166.0)	57.24 (2,169.1)	57.07 (2,162.5)
90mm Sample Rate, scmm (scfm)*	0.0600 (2.27)	0.0620 (2.35)	0.0581 (2.20)	0.0636 (2.41)
Total Volume, scm (scf)*	285.3 (10,810)	286.0 (10,838)	286.4 (10,853)	285.6 (10,821)
HC Sample Meter/Range/ppm	0.0/0/18.4	0.0/0/18.1	0.0/0/24.0	0.0/0/34.3
HC Bckgrd Meter/Range/ppm	3.7/100/3.8	3.7/100/3.8	3.8/100/3.9	3.8/100/3.9
CO Sample Meter/Range/ppm (Dry)	27.2/100/26.3	11.9/100/11.3	16.9/100/16.2	27.9/100/26.9
CO Bckgrd Meter/Range/ppm	0.9/100/0.8	1.2/100/1.1	1.5/100/1.4	1.7/100/1.6
CO2 Sample Meter/Range/% (Wet)	62.7/2/1.1892	94.6/1/0.9520	77.2/1/0.6917	45.6/1/0.3361
CO2 Bckgrd Meter/Range/%	2.8/2/0.0474	6.8/1/0.0432	6.9/1/0.0438	6.9/1/0.0438
NOx Sample Meter/Range/ppm (Dry)	0.0/0/301.2	0.0/0/173.3	0.0/0/76.3	0.0/0/19.4
NOx Bckgrd Meter/Range/ppm	1.6/25/0.4	3.3/25/0.8	1.4/25/0.4	1.0/25/0.3
Dilution Factor	11.40	14.25	19.57	39.78
HC Concentration, ppm	15.02	14.58	20.30	30.57
CO Concentration, ppm	24.52	9.93	14.40	24.84
CO2 Concentration, %	1.15	0.91	0.65	0.29
NOx Concentration, ppm	292.83	168.33	74.24	18.76
HC Mass, grams	2.64	2.57	3.58	5.38
CO Mass, grams	8.74	3.55	5.15	8.86
CO2 Mass, grams	6,417.99	5,120.06	3,655.57	1,644.93
NOx Mass, grams	174.09	100.34	44.32	11.21
Part. Mass, grams	1.898	1.271	1.734	0.794
Fuel, kg (lb)	2.023 (4.46)	1.613 (3.56)	1.154 (2.55)	0.526 (1.16)
KW-HR (hp-hr)	9.73 (13.05)	7.46 (10.00)	4.93 (6.61)	1.11 (1.49)
Filter Number	1291.0-307	1292.0-308	1293.0-309	1294.0-310
Weight Gain, mg	1.995	1.377	1.759	0.884
Sample Multiplier	0.951	0.923	0.986	0.898
Blower 1, scf	10,798.4	10,826.2	10,841.7	10,809.1
Blower 2, scf	0.0	0.0	0.0	0.0
Gas Meter 1, scf	9.524	9.503	9.512	9.503
Gas Meter 2, scf	20.886	21.246	20.519	21.550

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.:	J02DXS8A	DIESEL 2D, 2D=EM4619F	
Engine Desc.:	0.0 L (0 CID) 6	Date:	06/19/2002 Time:	HCR: 1.796 FID Resp: 1.00	
Engine Cycle:	Diesel	Program SSDIL:	2.28-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	553469	Cell:	16 Bag Cart: 1	Oil Code: 15w40	

Mode Number	5	6	7	8
Barometer, kPa (in Hg)	98.3 (29.02)	98.3 (29.02)	98.2 (29.01)	98.2 (29.01)
Dil. Air: Temp, °C (°F) / AH, g/kg	27.2 (81.0) / 10.5	27.8 (82.0) / 10.3	27.8 (82.0) / 10.3	27.8 (82.0) / 9.6
Engine Air Dew Pt., °C (°F)	15.7 (60.2)	15.4 (59.8)	15.3 (59.6)	15.2 (59.3)
Engine Air Temp, °C (°F)	25.0 (77.0)	25.0 (77.0)	25.6 (78.0)	25.0 (77.0)
Engine Air: RH,% / AH, g/kg	56 / 11.5	55 / 11.3	53 / 11.3	54 / 11.1
NOx Humidity C.F.	1.015	1.012	1.010	1.008
Dry-to-Wet C.F.	.975	.977	.979	.984
Time, seconds	299.9	299.9	299.7	299.9
Tot. Blower Rate, scmm (scfm)*	57.05 (2,161.8)	56.94 (2,157.7)	57.13 (2,164.9)	57.38 (2,174.2)
90mm Sample Rate, scmm (scfm)*	0.0504 (1.91)	0.0603 (2.28)	0.0624 (2.37)	0.0637 (2.41)
Total Volume, scm (scf)*	285.4 (10,815)	284.9 (10,796)	285.7 (10,826)	287.1 (10,879)
HC Sample Meter/Range/ppm	0.0/0/15.2	0.0/0/18.4	0.0/0/16.7	0.0/0/11.6
HC Bckgrd Meter/Range/ppm	3.8/100/3.9	6.3/100/6.4	4.2/100/4.3	3.9/100/4.0
CO Sample Meter/Range/ppm (Dry)	66.9/100/65.8	8.4/100/8.0	9.2/100/8.7	10.9/100/10.4
CO Bckgrd Meter/Range/ppm	1.1/100/1.0	1.8/100/1.7	2.5/100/2.4	3.1/100/2.9
CO2 Sample Meter/Range/% (Wet)	92.7/1/0.9214	76.8/1/0.6863	60.6/1/0.4874	14.0/1/0.0905
CO2 Bckgrd Meter/Range/%	6.9/1/0.0438	6.9/1/0.0438	7.1/1/0.0451	7.1/1/0.0451
NOx Sample Meter/Range/ppm (Dry)	0.0/0/175.0	0.0/0/138.5	0.0/0/77.0	0.0/0/6.6
NOx Bckgrd Meter/Range/ppm	0.6/25/0.2	0.9/25/0.2	0.5/25/0.1	0.4/25/0.1
Dilution Factor	14.65	19.76	27.78	146.87
HC Concentration, ppm	11.59	12.31	12.60	7.64
CO Concentration, ppm	62.71	6.16	6.28	7.36
CO2 Concentration, %	0.88	0.64	0.44	0.05
NOx Concentration, ppm	170.45	135.19	75.24	6.38
HC Mass, grams	2.04	2.16	2.22	1.35
CO Mass, grams	22.36	2.19	2.24	2.64
CO2 Mass, grams	4,934.24	3,606.29	2,489.86	257.63
NOx Mass, grams	101.32	79.98	44.57	3.79
Part. Mass, grams	6.399	1.154	0.788	0.254
Fuel, kg (lb)	1.563 (3.45)	1.136 (2.50)	0.785 (1.73)	0.084 (0.18)
KW-HR (hp-hr)	7.56 (10.14)	5.67 (7.60)	3.80 (5.09)	0.01 (0.02)
Filter Number	1295.0-311	1296.0-312	1297.0-313	1298.0-314
Weight Gain, mg	5.645	1.221	0.860	0.282
Sample Multiplier	1.134	0.945	0.916	0.901
Blower 1, scf	10,805.6	10,785.0	10,813.8	10,867.3
Blower 2, scf	0.0	0.0	0.0	0.0
Gas Meter 1, scf	9.498	9.490	9.495	9.504
Gas Meter 2, scf	19.038	20.909	21.308	21.573

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DU8B-1	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/25/2002 Time: 01:02	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R100

Ambient/Test Cell Conditions

Barometer:	29.10	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	57.9	°F	14.4 °C
Abs. Humidity:	73.9	gr/lb	10.6 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.5	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.89	ppm	
HC Bckgrd	6.0	2	6.07	ppm	
CO	26.2	2	25.27	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		293.72	ppm	(Dry)
NOx Bckgrd	2.1	1	0.53	ppm	
CO2 Sample	60.7	3	1.1378	%	(Wet)
CO2 Bckgrd	2.9	3	0.0477	%	
CH4 Sample	n/a	n/a	1.91	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.99	ppm	

Corrected Concentrations

HC	12.33	ppm	
CO	24.10	ppm	
NOx	285.35	ppm	
CO2	1.0941	%	
CH4	0.08	ppm	(1.00)

Mass Emissions

HC	2.222	grams
CO	8.804	grams
NOx	170.732	grams
Particulate	1.788	grams
CO2	6.280	kg
CH4	0.017	grams
Fuel	4.36 lb	1.98 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,158.8	61.14
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.87	0.05
Gas Meter 2:	4.16	0.12
Sample Rate:	2.29	0.06
20X20 Sample Rate:	3.20	0.09
47 mm Sample Rate:	52.15	1.48
Total Flow Rate:	2,216.39	62.77

Particulate Data

Filter Number:	1425.0-328 (pair)	
Weight Gain:	1.847	mg
Sample Multiplier:	0.968	

Correction Factors

NOx Humidity CF:	0.997
Dry-to-Wet CF, Sample:	0.973
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	11.92

Test Cycle Data

Sample Time:	299.90	sec		
Work:	13.19	hp-hr	9.84	kW-hr
Reference Work:	13.19	hp-hr	9.84	kW-hr
Total Volume (Vmix):	11,078.3	scf	313.74	scm

Brake-Specific Emission Results

BSHC (Cell)	0.168	g/hp-hr	0.226	g/kW-hr
CO	0.667	g/hp-hr	0.895	g/kW-hr
NOx (Cell)	12.944	g/hp-hr	17.358	g/kW-hr
Particulate	0.136	g/hp-hr	0.182	g/kW-hr
CO2	476.1	g/hp-hr	638.46	g/kW-hr
BSFC	0.331	lb/hp-hr	0.201	kg/kW-hr
NMHC	0.146	g/hp-hr	0.196	g/kW-hr
CH4	0.001	g/hp-hr	0.002	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DU8B-2	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/25/2002 Time: 01:17	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R075

Ambient/Test Cell Conditions

Barometer:	29.10	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	57.4	°F	14.1 °C
Abs. Humidity:	72.6	gr/lb	10.4 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.5	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		19.25	ppm	
HC Bckgrd	6.7	2	6.77	ppm	
CO	11.4	2	10.84	ppm	(Dry)
CO Bckgrd	1.0	2	0.94	ppm	
NOx Sample	n/a		162.66	ppm	(Dry)
NOx Bckgrd	2.4	1	0.60	ppm	
CO2 Sample	92.6	1	0.9198	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	
CH4 Sample	n/a	n/a	1.97	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.06	ppm	

Corrected Concentrations

HC	12.94	ppm	
CO	9.63	ppm	
NOx	158.06	ppm	
CO2	0.8783	%	
CH4	0.06	ppm	(1.00)

Mass Emissions

HC	2.342	grams	
CO	3.532	grams	
NOx	94.646	grams	
Particulate	1.275	grams	
CO2	5.063	kg	
CH4	0.012	grams	
Fuel	3.52 lb	1.59	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,168.6	61.42
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.87	0.05
Gas Meter 2:	4.24	0.12
Sample Rate:	2.37	0.07
20X20 Sample Rate:	2.80	0.08
47 mm Sample Rate:	52.15	1.48
Total Flow Rate:	2,225.95	63.04

Particulate Data

Filter Number:	1426.0-329 (pair)	
Weight Gain:	1.359	mg
Sample Multiplier:	0.938	

Correction Factors

NOx Humidity CF:	0.994
Dry-to-Wet CF, Sample:	0.975
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	14.75

Test Cycle Data

Sample Time:	299.90	sec		
Work:	9.90	hp-hr	7.38	kW-hr
Reference Work:	9.90	hp-hr	7.38	kW-hr
Total Volume (Vmix):	11,126.0	scf	315.10	scm

Brake-Specific Emission Results

BSHC (Cell)	0.237	g/hp-hr	0.317	g/kW-hr
CO	0.357	g/hp-hr	0.478	g/kW-hr
NOx (Cell)	9.560	g/hp-hr	12.820	g/kW-hr
Particulate	0.129	g/hp-hr	0.173	g/kW-hr
CO2	511.4	g/hp-hr	685.81	g/kW-hr
BSFC	0.355	lb/hp-hr	0.216	kg/kW-hr
NMHC	0.206	g/hp-hr	0.276	g/kW-hr
CH4	0.001	g/hp-hr	0.002	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DU8B-3	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/25/2002 Time: 01:32	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R050

Ambient/Test Cell Conditions

Barometer:	29.09	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	72.1	gr/lb	10.3 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	71.9	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		25.48	ppm	
HC Bckgrd	7.0	2	7.08	ppm	
CO	14.8	2	14.13	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		76.47	ppm	(Dry)
NOx Bckgrd	1.4	1	0.35	ppm	
CO2 Sample	76.5	1	0.6822	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	
CH4 Sample	n/a	n/a	2.03	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.00	ppm	

Corrected Concentrations

HC	18.76	ppm	
CO	13.49	ppm	
NOx	74.43	ppm	
CO2	0.6406	%	
CH4	0.13	ppm	(1.00)

Mass Emissions

HC	3.388	grams
CO	4.938	grams
NOx	44.414	grams
Particulate	1.633	grams
CO2	3.685	kg
CH4	0.027	grams
Fuel	2.56 lb	1.16 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,164.2	61.29
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.86	0.05
Gas Meter 2:	4.19	0.12
Sample Rate:	2.33	0.07
20X20 Sample Rate:	2.80	0.08
47 mm Sample Rate:	52.53	1.49
Total Flow Rate:	2,221.90	62.93

Particulate Data

Filter Number:	1427.0-330 (pair)	
Weight Gain:	1.711	mg
Sample Multiplier:	0.954	

Correction Factors

NOx Humidity CF:	0.992
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	19.84

Test Cycle Data

Sample Time:	299.80	sec		
Work:	6.69	hp-hr	4.99	kW-hr
Reference Work:	6.69	hp-hr	4.99	kW-hr
Total Volume (Vmix):	11,102.1	scf	314.42	scm

Brake-Specific Emission Results

BSHC (Cell)	0.506	g/hp-hr	0.679	g/kW-hr
CO	0.738	g/hp-hr	0.990	g/kW-hr
NOx (Cell)	6.639	g/hp-hr	8.903	g/kW-hr
Particulate	0.244	g/hp-hr	0.327	g/kW-hr
CO2	550.8	g/hp-hr	738.62	g/kW-hr
BSFC	0.383	lb/hp-hr	0.233	kg/kW-hr
NMHC	0.440	g/hp-hr	0.590	g/kW-hr
CH4	0.004	g/hp-hr	0.005	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DU8B-4	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/25/2002 Time: 01:47	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R010

Ambient/Test Cell Conditions

Barometer:	29.09	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	72.1	gr/lb	10.3 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	71.9	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		37.94	ppm	
HC Bckgrd	7.0	2	7.08	ppm	
CO	28.3	2	27.33	ppm	(Dry)
CO Bckgrd	0.6	2	0.56	ppm	
NOx Sample	n/a		18.40	ppm	(Dry)
NOx Bckgrd	1.3	1	0.33	ppm	
CO2 Sample	43.7	1	0.3189	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	
CH4 Sample	n/a	n/a	2.08	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.04	ppm	

Corrected Concentrations

HC	31.03	ppm
CO	26.25	ppm
NOx	17.73	ppm
CO2	0.2761	%
CH4	0.09	ppm (1.00)

Mass Emissions

HC	5.648	grams
CO	9.683	grams
NOx	10.661	grams
Particulate	0.791	grams
CO2	1.601	kg
CH4	0.019	grams
Fuel	1.13 lb	0.51 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,177.9	61.68
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.86	0.05
Gas Meter 2:	4.31	0.12
Sample Rate:	2.46	0.07
20X20 Sample Rate:	2.60	0.07
47 mm Sample Rate:	53.29	1.51
Total Flow Rate:	2,236.28	63.33

Particulate Data

Filter Number:	1430.0-355 (pair)	
Weight Gain:	0.869	mg
Sample Multiplier:	0.911	

Correction Factors

NOx Humidity CF:	0.992
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	41.83

Test Cycle Data

Sample Time:	300.20	sec		
Work:	1.40	hp-hr	1.04	kW-hr
Reference Work:	1.40	hp-hr	1.04	kW-hr
Total Volume (Vmix):	11,188.9	scf	316.88	scm

Brake-Specific Emission Results

BSHC (Cell)	4.034	g/hp-hr	5.410	g/kW-hr
CO	6.916	g/hp-hr	9.275	g/kW-hr
NOx (Cell)	7.615	g/hp-hr	10.212	g/kW-hr
Particulate	0.565	g/hp-hr	0.758	g/kW-hr
CO2	1,143.4	g/hp-hr	1,533.37	g/kW-hr
BSFC	0.808	lb/hp-hr	0.492	kg/kW-hr
NMHC	3.506	g/hp-hr	4.701	g/kW-hr
CH4	0.014	g/hp-hr	0.018	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DU8B-5	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/26/2002 Time: 09:55	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	29.10	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	57.0	°F	13.9 °C
Dew Point:	55.8	°F	13.2 °C
Abs. Humidity:	68.4	gr/lb	9.8 g/kg
Rel. Humidity:	96	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.5	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		16.46	ppm	
HC Bckgrd	7.1	2	7.18	ppm	
CO	63.9	2	62.74	ppm	(Dry)
CO Bckgrd	1.4	2	1.31	ppm	
NOx Sample	n/a		183.37	ppm	(Dry)
NOx Bckgrd	1.8	1	0.45	ppm	
CO2 Sample	91.3	1	0.8992	%	(Wet)
CO2 Bckgrd	7.6	1	0.0484	%	
CH4 Sample	n/a	n/a	1.97	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.07	ppm	

Corrected Concentrations

HC	9.76	ppm	
CO	59.55	ppm	
NOx	178.42	ppm	
CO2	0.8540	%	
CH4	0.04	ppm	(1.00)

Mass Emissions

HC	1.763	grams
CO	21.805	grams
NOx	105.520	grams
Particulate	5.416	grams
CO2	4.914	kg
CH4	0.008	grams
Fuel	3.43 lb	1.56 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,164.6	61.30
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.85	0.05
Gas Meter 2:	3.88	0.11
Sample Rate:	2.04	0.06
20X20 Sample Rate:	3.80	0.11
47 mm Sample Rate:	52.20	1.48
Total Flow Rate:	2,222.69	62.95

Particulate Data

Filter Number:	1431.0-356 (pair)	
Weight Gain:	4.966	mg
Sample Multiplier:	1.091	

Correction Factors

NOx Humidity CF:	0.983
Dry-to-Wet CF, Sample:	0.975
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	15.01

Test Cycle Data

Sample Time:	299.80	sec		
Work:	10.29	hp-hr	7.67	kW-hr
Reference Work:	10.29	hp-hr	7.67	kW-hr
Total Volume (Vmix):	11,106.0	scf	314.53	scm

Brake-Specific Emission Results

BSHC (Cell)	0.171	g/hp-hr	0.230	g/kW-hr
CO	2.119	g/hp-hr	2.842	g/kW-hr
NOx (Cell)	10.255	g/hp-hr	13.752	g/kW-hr
Particulate	0.526	g/hp-hr	0.706	g/kW-hr
CO2	477.6	g/hp-hr	640.42	g/kW-hr
BSFC	0.333	lb/hp-hr	0.203	kg/kW-hr
NMHC	0.149	g/hp-hr	0.200	g/kW-hr
CH4	0.001	g/hp-hr	0.001	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DU8B-6	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/26/2002 Time: 10:10	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R075

Ambient/Test Cell Conditions

Barometer:	29.09	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	56.7	°F	13.7 °C
Abs. Humidity:	70.8	gr/lb	10.1 g/kg
Rel. Humidity:	53	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.2	gr/lb	10.7 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		18.92	ppm	
HC Bckgrd	7.2	2	7.28	ppm	
CO	9.1	2	8.63	ppm	(Dry)
CO Bckgrd	1.4	2	1.31	ppm	
NOx Sample	n/a		141.20	ppm	(Dry)
NOx Bckgrd	1.7	1	0.43	ppm	
CO2 Sample	76.6	1	0.6836	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	
CH4 Sample	n/a	n/a	2.17	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.25	ppm	

Corrected Concentrations

HC	12.01	ppm	
CO	7.16	ppm	
NOx	137.53	ppm	
CO2	0.6395	%	
CH4	0.03	ppm	(1.00)

Mass Emissions

HC	2.173	grams	
CO	2.626	grams	
NOx	81.957	grams	
Particulate	1.409	grams	
CO2	3.686	kg	
CH4	0.006	grams	
Fuel	2.56 lb	1.16 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,167.6	61.39
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.85	0.05
Gas Meter 2:	4.19	0.12
Sample Rate:	2.34	0.07
20X20 Sample Rate:	3.20	0.09
47 mm Sample Rate:	52.48	1.49
Total Flow Rate:	2,225.67	63.03

Particulate Data

Filter Number:	1432.0-357 (pair)	
Weight Gain:	1.482	mg
Sample Multiplier:	0.951	

Correction Factors

NOx Humidity CF:	0.989
Dry-to-Wet CF, Sample:	0.977
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	19.83

Test Cycle Data

Sample Time:	299.90	sec		
Work:	7.81	hp-hr	5.82	kW-hr
Reference Work:	7.81	hp-hr	5.82	kW-hr
Total Volume (Vmix):	11,124.7	scf	315.06	scm

Brake-Specific Emission Results

BSHC (Cell)	0.278	g/hp-hr	0.373	g/kW-hr
CO	0.336	g/hp-hr	0.451	g/kW-hr
NOx (Cell)	10.494	g/hp-hr	14.073	g/kW-hr
Particulate	0.180	g/hp-hr	0.242	g/kW-hr
CO2	472.0	g/hp-hr	632.92	g/kW-hr
BSFC	0.328	lb/hp-hr	0.199	kg/kW-hr
NMHC	0.242	g/hp-hr	0.324	g/kW-hr
CH4	0.001	g/hp-hr	0.001	g/kW-hr

Analyzed: 09/26/2002 14:28

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 6.8 L (413 CID) 6
Engine Cycle: Diesel
Engine S/N: 553496

Test No.: J12DU8B-7
Date: 06/26/2002 Time: 10:23
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1
Steady-State

DIESEL 2D, 2D=EM4619F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40
060R050

Ambient/Test Cell Conditions

Barometer:	29.09	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	57.4	°F	14.1 °C
Abs. Humidity:	72.6	gr/lb	10.4 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.6	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		21.65	ppm	
HC Bckgrd	9.6	2	9.69	ppm	
CO	8.1	2	7.67	ppm	(Dry)
CO Bckgrd	1.4	2	1.31	ppm	
NOx Sample	n/a		80.99	ppm	(Dry)
NOx Bckgrd	1.6	1	0.40	ppm	
CO2 Sample	60.7	1	0.4885	%	(Wet)
CO2 Bckgrd	7.4	1	0.0471	%	
CH4 Sample	n/a	n/a	4.07	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	4.28	ppm	

Corrected Concentrations

HC	12.31	ppm	
CO	6.24	ppm	
NOx	78.90	ppm	
CO2	0.4431	%	
CH4	-0.05	ppm	(1.00)

Mass Emissions

HC	2.204	grams	
CO	2.265	grams	
NOx	46.732	grams	
Particulate	0.778	grams	
CO2	2.526	kg	
CH4	0.000	grams	
Fuel	1.76 lb	0.80	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,144.1	60.72
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.84	0.05
Gas Meter 2:	4.29	0.12
Sample Rate:	2.45	0.07
20X20 Sample Rate:	3.00	0.08
47 mm Sample Rate:	51.91	1.47
Total Flow Rate:	2,201.49	62.35

Particulate Data

Filter Number:	1433.0-358 (pair)	
Weight Gain:	0.866	mg
Sample Multiplier:	0.899	

Correction Factors

NOx Humidity CF:	0.994
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	27.70

Test Cycle Data

Sample Time:	299.90	sec		
Work:	5.31	hp-hr	3.96	kW-hr
Reference Work:	5.31	hp-hr	3.96	kW-hr
Total Volume (Vmix):	11,003.8	scf	311.63	scm

Brake-Specific Emission Results

BSHC (Cell)	0.415	g/hp-hr	0.557	g/kW-hr
CO	0.427	g/hp-hr	0.572	g/kW-hr
NOx (Cell)	8.801	g/hp-hr	11.802	g/kW-hr
Particulate	0.147	g/hp-hr	0.197	g/kW-hr
CO2	475.7	g/hp-hr	637.97	g/kW-hr
BSFC	0.331	lb/hp-hr	0.201	kg/kW-hr
NMHC	0.361	g/hp-hr	0.484	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J12DU8B-8	DIESEL 2D, 2D=EM4619F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/26/2002 Time: 10:37	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100l000

Ambient/Test Cell Conditions

Barometer:	29.09	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	74.8	gr/lb	10.7 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	71.9	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		15.57	ppm	
HC Bckgrd	8.2	2	8.28	ppm	
CO	8.8	2	8.34	ppm	(Dry)
CO Bckgrd	1.3	2	1.22	ppm	
NOx Sample	n/a		6.67	ppm	(Dry)
NOx Bckgrd	0.9	1	0.23	ppm	
CO2 Sample	14.0	1	0.0905	%	(Wet)
CO2 Bckgrd	4.9	1	0.0310	%	
CH4 Sample	n/a	n/a	2.62	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.54	ppm	

Corrected Concentrations

HC	7.35	ppm
CO	7.02	ppm
NOx	6.33	ppm
CO2	0.0597	%
CH4	0.10	ppm (1.00)

Mass Emissions

HC	2.654	grams
CO	5.137	grams
NOx	7.606	grams
Particulate	0.497	grams
CO2	0.687	kg
CH4	0.040	grams
Fuel	0.49 lb	0.22 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,164.6	61.30
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.84	0.05
Gas Meter 2:	4.33	0.12
Sample Rate:	2.48	0.07
20X20 Sample Rate:	3.00	0.08
47 mm Sample Rate:	51.42	1.46
Total Flow Rate:	2,221.46	62.91

Particulate Data

Filter Number:	1987.0-393 (pair)	
Weight Gain:	0.555	mg
Sample Multiplier:	0.895	

Correction Factors

NOx Humidity CF:	0.999
Dry-to-Wet CF, Sample:	0.983
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	146.55

Test Cycle Data

Sample Time:	599.80	sec		
Work:	0.06	hp-hr	0.04	kW-hr
Reference Work:	0.06	hp-hr	0.04	kW-hr
Total Volume (Vmix):	22,207.2	scf	628.92	scm

Brake-Specific Emission Results

BSHC (Cell)	44.234	g/hp-hr	59.319	g/kW-hr
CO	85.612	g/hp-hr	114.807	g/kW-hr
NOx (Cell)	126.766	g/hp-hr	169.995	g/kW-hr
Particulate	8.279	g/hp-hr	11.102	g/kW-hr
CO2	11,450.2	g/hp-hr	15,355.02	g/kW-hr
BSFC	8.121	lb/hp-hr	4.939	kg/kW-hr
NMHC	38.440	g/hp-hr	51.548	g/kW-hr
CH4	0.668	g/hp-hr	0.896	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRU8E-1	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/27/2002 Time: 10:02	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R100

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	58.6	°F	14.8 °C
Abs. Humidity:	75.9	gr/lb	10.8 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	71.9	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.00	ppm	
HC Bckgrd	7.8	2	7.88	ppm	
CO	27.0	2	26.05	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		298.36	ppm	(Dry)
NOx Bckgrd	2.1	1	0.53	ppm	
CO2 Sample	61.6	3	1.1573	%	(Wet)
CO2 Bckgrd	3.2	3	0.0526	%	
CH4 Sample	n/a	n/a	1.79	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.99	ppm	

Corrected Concentrations

HC	9.79	ppm	
CO	24.52	ppm	
NOx	289.92	ppm	
CO2	1.1092	%	
CH4	-0.04	ppm	(1.00)

Mass Emissions

HC	1.762	grams		
CO	8.944	grams		
NOx	174.119	grams		
Particulate	2.295	grams		
CO2	6.357	kg		
CH4	0.000	grams		
Fuel	4.42	lb	2.00	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,154.8	61.03
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.85	0.05
Gas Meter 2:	4.19	0.12
Sample Rate:	2.34	0.07
20X20 Sample Rate:	3.40	0.10
47 mm Sample Rate:	51.94	1.47
Total Flow Rate:	2,212.50	62.66

Particulate Data

Filter Number:	1988.0 (pair)	
Weight Gain:	2.432	mg
Sample Multiplier:	0.944	

Correction Factors

NOx Humidity CF:	1.002
Dry-to-Wet CF, Sample:	0.973
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	11.72

Test Cycle Data

Sample Time:	300.00	sec		
Work:	13.36	hp-hr	9.96	kW-hr
Reference Work:	13.36	hp-hr	9.96	kW-hr
Total Volume (Vmix):	11,062.5	scf	313.30	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.132 g/hp-hr	0.177	g/kW-hr
CO		0.669 g/hp-hr	0.898	g/kW-hr
NOx	(Cell)	13.033 g/hp-hr	17.477	g/kW-hr
Particulate		0.172 g/hp-hr	0.230	g/kW-hr
CO2		475.8 g/hp-hr	638.12	g/kW-hr
BSFC		0.331 lb/hp-hr	0.201	kg/kW-hr
NMHC		0.115 g/hp-hr	0.154	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model: 1996 Deere 6068T
Engine Desc.: 6.8 L (413 CID) 6
Engine Cycle: Diesel
Engine S/N: 553496

Test No.: J2NRU8E-2
Date: 06/27/2002 Time: 10:16
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1
Steady-State

DIESEL 2D, NR=EM2831F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40
100R075

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	59.2	°F	15.1 °C
Abs. Humidity:	77.6	gr/lb	11.1 g/kg
Rel. Humidity:	64	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.1	gr/lb	11.0 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		18.90	ppm	
HC Bckgrd	8.0	2	8.08	ppm	
CO	10.4	2	9.88	ppm	(Dry)
CO Bckgrd	1.4	2	1.31	ppm	
NOx Sample	n/a		171.14	ppm	(Dry)
NOx Bckgrd	2.3	1	0.58	ppm	
CO2 Sample	93.6	1	0.9358	%	(Wet)
CO2 Bckgrd	7.8	1	0.0496	%	
CH4 Sample	n/a	n/a	2.14	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.22	ppm	

Corrected Concentrations

HC	11.38	ppm	
CO	8.36	ppm	
NOx	166.18	ppm	
CO2	0.8896	%	
CH4	0.07	ppm	(1.00)

Mass Emissions

HC	2.062	grams	
CO	3.069	grams	
NOx	100.939	grams	
Particulate	1.587	grams	
CO2	5.135	kg	
CH4	0.015	grams	
Fuel	3.56 lb	1.62	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,169.7	61.45
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.84	0.05
Gas Meter 2:	4.29	0.12
Sample Rate:	2.45	0.07
20X20 Sample Rate:	3.00	0.08
47 mm Sample Rate:	52.92	1.50
Total Flow Rate:	2,228.04	63.10

Particulate Data

Filter Number:	1989.0 (pair)	
Weight Gain:	1.743	mg
Sample Multiplier:	0.911	

Correction Factors

NOx Humidity CF:	1.007
Dry-to-Wet CF, Sample:	0.974
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	14.50

Test Cycle Data

Sample Time:	300.00	sec		
Work:	10.14	hp-hr	7.56	kW-hr
Reference Work:	10.14	hp-hr	7.56	kW-hr
Total Volume (Vmix):	11,140.2	scf	315.50	scm

Brake-Specific Emission Results

BSHC (Cell)	0.203	g/hp-hr	0.273	g/kW-hr
CO	0.303	g/hp-hr	0.406	g/kW-hr
NOx (Cell)	9.955	g/hp-hr	13.349	g/kW-hr
Particulate	0.157	g/hp-hr	0.210	g/kW-hr
CO2	506.4	g/hp-hr	679.06	g/kW-hr
BSFC	0.351	lb/hp-hr	0.214	kg/kW-hr
NMHC	0.177	g/hp-hr	0.237	g/kW-hr
CH4	0.002	g/hp-hr	0.002	g/kW-hr

Analyzed: 09/26/2002 14:29

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRU8E-3	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/27/2002 Time: 10:30	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R050

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	59.3	°F	15.2 °C
Abs. Humidity:	77.9	gr/lb	11.1 g/kg
Rel. Humidity:	62	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.1	gr/lb	11.0 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		26.66	ppm	
HC Bckgrd	8.2	2	8.28	ppm	
CO	15.5	2	14.81	ppm	(Dry)
CO Bckgrd	0.8	2	0.75	ppm	
NOx Sample	n/a		77.89	ppm	(Dry)
NOx Bckgrd	2.3	1	0.58	ppm	
CO2 Sample	78.1	1	0.7040	%	(Wet)
CO2 Bckgrd	7.9	1	0.0503	%	
CH4 Sample	n/a	n/a	2.11	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.19	ppm	

Corrected Concentrations

HC	18.81	ppm	
CO	13.69	ppm	
NOx	75.49	ppm	
CO2	0.6563	%	
CH4	0.03	ppm	(1.00)

Mass Emissions

HC	3.390	grams	
CO	5.000	grams	
NOx	45.628	grams	
Particulate	1.968	grams	
CO2	3.766	kg	
CH4	0.007	grams	
Fuel	2.62 lb	1.19 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,158.3	61.12
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.84	0.05
Gas Meter 2:	4.24	0.12
Sample Rate:	2.40	0.07
20X20 Sample Rate:	3.00	0.08
47 mm Sample Rate:	52.35	1.48
Total Flow Rate:	2,216.01	62.76

Particulate Data

Filter Number:	1990.0 (pair)	
Weight Gain:	2.131	mg
Sample Multiplier:	0.923	

Correction Factors

NOx Humidity CF:	1.008
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	19.22

Test Cycle Data

Sample Time:	299.90	sec		
Work:	6.85	hp-hr	5.11	kW-hr
Reference Work:	6.85	hp-hr	5.11	kW-hr
Total Volume (Vmix):	11,076.4	scf	313.69	scm

Brake-Specific Emission Results

BSHC (Cell)	0.495	g/hp-hr	0.664	g/kW-hr
CO	0.730	g/hp-hr	0.979	g/kW-hr
NOx (Cell)	6.661	g/hp-hr	8.932	g/kW-hr
Particulate	0.287	g/hp-hr	0.385	g/kW-hr
CO2	549.8	g/hp-hr	737.34	g/kW-hr
BSFC	0.383	lb/hp-hr	0.233	kg/kW-hr
NMHC	0.430	g/hp-hr	0.577	g/kW-hr
CH4	0.001	g/hp-hr	0.001	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRU8E-4	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/27/2002 Time: 10:44	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R010

Ambient/Test Cell Conditions

Barometer:	29.06	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	60.2	°F	15.7 °C
Abs. Humidity:	80.5	gr/lb	11.5 g/kg
Rel. Humidity:	66	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	80.8	gr/lb	11.5 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		37.23	ppm	
HC Bckgrd	7.6	2	7.68	ppm	
CO	28.5	2	27.53	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		19.53	ppm	(Dry)
NOx Bckgrd	2.0	1	0.50	ppm	
CO2 Sample	45.9	1	0.3389	%	(Wet)
CO2 Bckgrd	8.0	1	0.0509	%	
CH4 Sample	n/a	n/a	2.10	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.05	ppm	

Corrected Concentrations

HC	29.74	ppm	
CO	26.31	ppm	
NOx	18.63	ppm	
CO2	0.2893	%	
CH4	0.10	ppm	(1.00)

Mass Emissions

HC	5.334	grams	
CO	9.561	grams	
NOx	11.281	grams	
Particulate	0.957	grams	
CO2	1.652	kg	
CH4	0.022	grams	
Fuel	1.17 lb	0.53 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,147.3	60.81
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.84	0.05
Gas Meter 2:	4.31	0.12
Sample Rate:	2.47	0.07
20X20 Sample Rate:	3.00	0.08
47 mm Sample Rate:	52.54	1.49
Total Flow Rate:	2,205.31	62.46

Particulate Data

Filter Number:	1991.0 (pair)	
Weight Gain:	1.071	mg
Sample Multiplier:	0.893	

Correction Factors

NOx Humidity CF:	1.014
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.982
Dilution Factor:	39.42

Test Cycle Data

Sample Time:	299.90	sec		
Work:	1.62	hp-hr	1.21	kW-hr
Reference Work:	1.62	hp-hr	1.21	kW-hr
Total Volume (Vmix):	11,022.9	scf	312.17	scm

Brake-Specific Emission Results

BSHC (Cell)	3.293	g/hp-hr	4.415	g/kW-hr
CO	5.902	g/hp-hr	7.914	g/kW-hr
NOx (Cell)	6.964	g/hp-hr	9.339	g/kW-hr
Particulate	0.591	g/hp-hr	0.792	g/kW-hr
CO2	1,019.8	g/hp-hr	1,367.62	g/kW-hr
BSFC	0.720	lb/hp-hr	0.438	kg/kW-hr
NMHC	2.861	g/hp-hr	3.837	g/kW-hr
CH4	0.013	g/hp-hr	0.018	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRU8E-5	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/27/2002 Time: 12:57	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	29.01	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	78.0	°F	25.6 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	71.2	gr/lb	10.2 g/kg
Rel. Humidity:	48	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.4	gr/lb	11.1 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		15.59	ppm	
HC Bckgrd	7.1	2	7.18	ppm	
CO	74.1	2	73.12	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		180.49	ppm	(Dry)
NOx Bckgrd	0.7	1	0.18	ppm	
CO2 Sample	92.0	1	0.9103	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	
CH4 Sample	n/a	n/a	1.90	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.03	ppm	

Corrected Concentrations

HC	8.89	ppm	
CO	70.60	ppm	
NOx	175.70	ppm	
CO2	0.8670	%	
CH4	0.01	ppm	(1.00)

Mass Emissions

HC	1.602	grams	
CO	25.776	grams	
NOx	104.347	grams	
Particulate	5.688	grams	
CO2	4.974	kg	
CH4	0.002	grams	
Fuel	3.48 lb	1.58 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,161.5	61.21
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.86	0.05
Gas Meter 2:	3.84	0.11
Sample Rate:	1.99	0.06
20X20 Sample Rate:	3.00	0.09
47 mm Sample Rate:	50.46	1.43
Total Flow Rate:	2,216.94	62.79

Particulate Data

Filter Number:	1992.0 (pair)	
Weight Gain:	5.103	mg
Sample Multiplier:	1.115	

Correction Factors

NOx Humidity CF:	0.990
Dry-to-Wet CF, Sample:	0.974
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	14.81

Test Cycle Data

Sample Time:	299.70	sec		
Work:	10.20	hp-hr	7.61	kW-hr
Reference Work:	10.20	hp-hr	7.61	kW-hr
Total Volume (Vmix):	11,073.6	scf	313.61	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.157 g/hp-hr	0.211	g/kW-hr
CO		2.527 g/hp-hr	3.389	g/kW-hr
NOx	(Cell)	10.230 g/hp-hr	13.719	g/kW-hr
Particulate		0.558 g/hp-hr	0.748	g/kW-hr
CO2		487.7 g/hp-hr	654.00	g/kW-hr
BSFC		0.341 lb/hp-hr	0.207	kg/kW-hr
NMHC		0.137 g/hp-hr	0.183	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRU8E-6	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/27/2002 Time: 01:10	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R075

Ambient/Test Cell Conditions

Barometer:	29.00	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	78.0	°F	25.6 °C
Dew Point:	56.4	°F	13.6 °C
Abs. Humidity:	70.2	gr/lb	10.0 g/kg
Rel. Humidity:	47	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.4	gr/lb	11.1 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		18.78	ppm	
HC Bckgrd	6.8	2	6.87	ppm	
CO	7.8	2	7.38	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		145.09	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	76.6	1	0.6836	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	
CH4 Sample	n/a	n/a	1.83	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.87	ppm	

Corrected Concentrations

HC	12.26	ppm	
CO	6.56	ppm	
NOx	141.47	ppm	
CO2	0.6395	%	
CH4	0.05	ppm	(1.00)

Mass Emissions

HC	2.201	grams	
CO	2.387	grams	
NOx	83.558	grams	
Particulate	1.710	grams	
CO2	3.658	kg	
CH4	0.011	grams	
Fuel	2.54 lb	1.15 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,151.2	60.92
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.86	0.05
Gas Meter 2:	4.19	0.12
Sample Rate:	2.33	0.07
20X20 Sample Rate:	3.00	0.09
47 mm Sample Rate:	53.17	1.51
Total Flow Rate:	2,209.68	62.58

Particulate Data

Filter Number:	2003.0 (pair)	
Weight Gain:	1.803	mg
Sample Multiplier:	0.948	

Correction Factors

NOx Humidity CF:	0.988
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	19.84

Test Cycle Data

Sample Time:	299.80	sec		
Work:	7.69	hp-hr	5.73	kW-hr
Reference Work:	7.69	hp-hr	5.73	kW-hr
Total Volume (Vmix):	11,041.0	scf	312.69	scm

Brake-Specific Emission Results

BSHC (Cell)	0.286	g/hp-hr	0.384	g/kW-hr
CO	0.310	g/hp-hr	0.416	g/kW-hr
NOx (Cell)	10.866	g/hp-hr	14.571	g/kW-hr
Particulate	0.222	g/hp-hr	0.298	g/kW-hr
CO2	475.7	g/hp-hr	637.97	g/kW-hr
BSFC	0.330	lb/hp-hr	0.201	kg/kW-hr
NMHC	0.249	g/hp-hr	0.334	g/kW-hr
CH4	0.001	g/hp-hr	0.002	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRU8E-7	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/27/2002 Time: 01:23	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R050

Ambient/Test Cell Conditions

Barometer:	29.00	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	56.4	°F	13.6 °C
Abs. Humidity:	70.2	gr/lb	10.0 g/kg
Rel. Humidity:	51	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.4	gr/lb	11.1 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		18.87	ppm	
HC Bckgrd	7.1	2	7.18	ppm	
CO	6.7	2	6.33	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		84.73	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	60.0	1	0.4808	%	(Wet)
CO2 Bckgrd	7.2	1	0.0458	%	
CH4 Sample	n/a	n/a	1.69	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.91	ppm	

Corrected Concentrations

HC	11.94	ppm	
CO	5.91	ppm	
NOx	82.69	ppm	
CO2	0.4366	%	
CH4	-0.15	ppm	(1.00)

Mass Emissions

HC	2.157	grams	
CO	2.164	grams	
NOx	49.095	grams	
Particulate	3.662	grams	
CO2	2.511	kg	
CH4	0.000	grams	
Fuel	1.75 lb	0.79 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,164.2	61.29
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	3.72	0.11
Gas Meter 2:	4.29	0.12
Sample Rate:	0.57	0.02
20X20 Sample Rate:	2.60	0.07
47 mm Sample Rate:	53.20	1.51
Total Flow Rate:	2,220.52	62.89

Particulate Data

Filter Number:	2004.0 (pair)	
Weight Gain:	0.942	mg
Sample Multiplier:	3.887	

Correction Factors

NOx Humidity CF:	0.988
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	28.16

Test Cycle Data

Sample Time:	299.90	sec		
Work:	5.14	hp-hr	3.83	kW-hr
Reference Work:	5.14	hp-hr	3.83	kW-hr
Total Volume (Vmix):	11,098.9	scf	314.33	scm

Brake-Specific Emission Results

BSHC (Cell)	0.420	g/hp-hr	0.563	g/kW-hr
CO	0.421	g/hp-hr	0.564	g/kW-hr
NOx (Cell)	9.552	g/hp-hr	12.809	g/kW-hr
Particulate	0.712	g/hp-hr	0.955	g/kW-hr
CO2	488.5	g/hp-hr	655.05	g/kW-hr
BSFC	0.340	lb/hp-hr	0.207	kg/kW-hr
NMHC	0.365	g/hp-hr	0.489	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.802

Engine Model:	1996 Deere 6068T	Test No.: J2NRU8E-8	DIESEL 2D, NR=EM2831F
Engine Desc.:	6.8 L (413 CID) 6	Date: 06/27/2002 Time: 01:37	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	553496	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100I000

Ambient/Test Cell Conditions

Barometer:	29.00	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	78.0	°F	25.6 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	69.2	gr/lb	9.9 g/kg
Rel. Humidity:	47	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.4	gr/lb	11.1 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		14.39	ppm	
HC Bckgrd	7.0	2	7.08	ppm	
CO	9.4	2	8.92	ppm	(Dry)
CO Bckgrd	0.5	2	0.47	ppm	
NOx Sample	n/a		7.48	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	14.0	1	0.0905	%	(Wet)
CO2 Bckgrd	7.1	1	0.0451	%	
CH4 Sample	n/a	n/a	1.83	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.97	ppm	

Corrected Concentrations

HC	7.36	ppm	
CO	8.31	ppm	
NOx	7.24	ppm	
CO2	0.0457	%	
CH4	-0.12	ppm	(1.00)

Mass Emissions

HC	2.646	grams	
CO	6.059	grams	
NOx	8.544	grams	
Particulate	0.583	grams	
CO2	0.524	kg	
CH4	0.000	grams	
Fuel	0.38 lb	0.17 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,155.3	61.04
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.86	0.05
Gas Meter 2:	4.31	0.12
Sample Rate:	2.45	0.07
20X20 Sample Rate:	2.90	0.08
47 mm Sample Rate:	51.21	1.45
Total Flow Rate:	2,211.90	62.64

Particulate Data

Filter Number:	2005.0 (pair)	
Weight Gain:	0.646	mg
Sample Multiplier:	0.903	

Correction Factors

NOx Humidity CF:	0.985
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	146.65

Test Cycle Data

Sample Time:	599.70	sec		
Work:	0.07	hp-hr	0.05	kW-hr
Reference Work:	0.07	hp-hr	0.05	kW-hr
Total Volume (Vmix):	22,107.9	scf	626.11	scm

Brake-Specific Emission Results

BSHC	(Cell)	37.806 g/hp-hr	50.699	g/kW-hr
CO		86.561 g/hp-hr	116.080	g/kW-hr
NOx	(Cell)	122.062 g/hp-hr	163.687	g/kW-hr
Particulate		8.334 g/hp-hr	11.177	g/kW-hr
CO2		7,479.1 g/hp-hr	10,029.67	g/kW-hr
BSFC		5.357 lb/hp-hr	3.258	kg/kW-hr
NMHC		32.853 g/hp-hr	44.057	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Analyzed: 09/26/2002 14:31

APPENDIX J

DETAILED COMPUTER PRINTOUTS FOR TYPE-C1 STEADY-STATE EMISSION TESTS ON A CUMMINS M11C USING TWO FUELS

Test Name	Cycle or Mode	Fuel	Toxics Information	Description	Page
M02DXS08A	C1 Test	2D	Without	Steady-State Emissions Summary	J-1
M12DU8B-1	C1-1	2D	Yes	Steady-State Emissions Summary	J-4
M12DU8B-2	C1-2	2D	Yes	Steady-State Emissions Summary	J-5
M12DU8B-3	C1-3	2D	Yes	Steady-State Emissions Summary	J-6
M12DU8B-4	C1-4	2D	Yes	Steady-State Emissions Summary	J-7
M12DU8B-5	C1-5	2D	Yes	Steady-State Emissions Summary	J-8
M12DU8B-6	C1-6	2D	Yes	Steady-State Emissions Summary	J-9
M12DU8B-7	C1-7	2D	Yes	Steady-State Emissions Summary	J-10
M12DU8B-8	C1-8	2D	Yes	Steady-State Emissions Summary	J-11
M2NRV8E-1	C1-1	NR	Yes	Steady-State Emissions Summary	J-12
M2NRV8E-2	C1-2	NR	Yes	Steady-State Emissions Summary	J-13
M2NRV8E-3	C1-3	NR	Yes	Steady-State Emissions Summary	J-14
M2NRV8E-4	C1-4	NR	Yes	Steady-State Emissions Summary	J-15
M2NRV8E-5	C1-5	NR	Yes	Steady-State Emissions Summary	J-16
M2NRV8E-6	C1-6	NR	Yes	Steady-State Emissions Summary	J-17
M2NRV8E-7	C1-7	NR	Yes	Steady-State Emissions Summary	J-18
M2NRV8E-8	C1-8	NR	Yes	Steady-State Emissions Summary	J-19

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.801

Engine Model: 1998 Cummins M11C
Engine Desc.: 0.0 L (0 CID) 6
Engine Cycle: Diesel
Engine S/N: 34872033

Test No.: M02DXS08A
Date: 05/28/2002 Time:
Program SSDIL: 2.28-R
Cell: 16 Bag Cart: 1

DIESEL 2D, 2D=Tank 19
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40

	Target			Measured		C - B	Intake Air			Factors			
	Speed	Load	Torque	Time	Speed	Torque	Fuel	Temp	Humid	Baro.	NOx	Part.	Dry	F
Mode	rpm	pct	lb-ft	sec	rpm	lb-ft	lb/hr	°F	g/kg	in-Hg	Hum.	Hum.	Wet	(TC)
1	1,700	100.0	840.0	300	1,700	840.0	88.5	73.0	10.9	29.03	1.004	0.997	0.970	1.007
2	1,700	75.0	630.0	300	1,701	635.0	71.1	73.0	10.9	29.03	1.003	0.998	0.973	1.007
3	1,700	50.0	420.0	300	1,702	425.0	50.8	74.0	10.9	29.02	1.004	0.997	0.975	1.010
4	1,700	10.0	84.0	300	1,700	90.0	17.7	74.0	10.9	29.02	1.004	0.997	0.981	1.010
5	1,300	100.0	954.0	300	1,305	954.0	76.6	74.0	10.9	29.01	1.003	0.998	0.972	1.010
6	1,300	75.0	715.5	300	1,293	711.0	59.4	74.0	11.3	29.01	1.010	0.993	0.974	1.011
7	1,300	50.0	477.0	300	1,305	475.0	42.1	74.0	11.1	29.01	1.008	0.994	0.977	1.010
8	830	0.0	0.0	600	865	5.0	4.1	76.0	10.9	29.01	1.003	0.998	0.982	1.016

	BHP								Weighted Results				
	from	Grams/Hour					Mode	Power	Grams/Hour				
Mode	Work	HC	CO	NOx	Part.	CO2	wf	bhp	HC	CO	NOx	Part.	CO2
1	270.5	39.88	69.7	1,838.3	16.74	127,611	.150	40.6	5.98	10.45	275.75	2.51	19,142
2	205.5	39.11	67.1	1,102.0	19.59	102,407	.150	30.8	5.87	10.07	165.31	2.94	15,361
3	137.9	42.79	68.0	600.0	25.88	73,065	.150	20.7	6.42	10.21	90.01	3.88	10,960
4	28.9	56.30	100.8	394.0	24.58	25,230	.100	2.9	5.63	10.08	39.40	2.46	2,523
5	235.9	31.28	180.0	1,695.2	17.45	110,283	.100	23.6	3.13	18.00	169.52	1.75	11,028
6	177.1	25.02	119.6	1,024.3	18.85	85,563	.100	17.7	2.50	11.96	102.43	1.88	8,556
7	118.3	27.72	94.8	547.7	27.41	60,493	.100	11.8	2.77	9.48	54.77	2.74	6,049
8	0.9	25.59	36.7	130.5	7.16	5,845	.150	0.1	3.84	5.51	19.57	1.07	877
							Total	148.1	36.14	85.76	916.75	19.23	74,496

	Weighted Modal Contribution				
	g/hp-hr				
Mode	HC	CO	NOx	Part.	CO2
1	0.04	0.07	1.86	0.017	129
2	0.04	0.07	1.12	0.020	104
3	0.04	0.07	0.61	0.026	74
4	0.04	0.07	0.27	0.017	17
5	0.02	0.12	1.14	0.012	74
6	0.02	0.08	0.69	0.013	58
7	0.02	0.06	0.37	0.019	41
8	0.03	0.04	0.13	0.007	6

Composite Results

BSHC	=	0.24	g/hp-hr	=	0.33 g/kW-hr
BSCO	=	0.58	g/hp-hr	=	0.78 g/kW-hr
BSNOx	=	6.19	g/hp-hr	=	8.30 g/kW-hr
Particulate	=	0.130	g/hp-hr	=	0.174 g/kW-hr
BSCO2	=	503	g/hp-hr	=	675 g/kW-hr
BSFC	=	0.350	lb/hp-hr	=	0.213 kg/kW-hr

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M02DXS08A	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	0.0 L (0 CID) 6	Date:	05/28/2002 Time:	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program SSDIL:	2.28-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

Mode Number	1	2	3	4
Barometer, kPa (in Hg)	98.3 (29.03)	98.3 (29.03)	98.3 (29.02)	98.3 (29.02)
Dil. Air: Temp, °C (°F) / AH, g/kg	27.2 (81.0) / 10.5	27.8 (82.0) / 10.3	27.8 (82.0) / 11.0	27.8 (82.0) / 10.3
Engine Air Dew Pt., °C (°F)	14.9 (58.8)	14.8 (58.6)	14.9 (58.8)	14.9 (58.8)
Engine Air Temp, °C (°F)	22.8 (73.0)	22.8 (73.0)	23.3 (74.0)	23.3 (74.0)
Engine Air: RH,% / AH, g/kg	61 / 10.9	61 / 10.9	59 / 10.9	59 / 10.9
NOx Humidity C.F.	1.004	1.003	1.004	1.004
Dry-to-Wet C.F.	.970	.973	.975	.981
Time, seconds	299.7	299.9	300.0	299.8
Tot. Blower Rate, scmm (scfm)*	77.21 (2,925.7)	77.65 (2,942.3)	78.29 (2,966.6)	78.43 (2,972.0)
90mm Sample Rate, scmm (scfm)*	0.0541 (2.05)	0.0500 (1.90)	0.0499 (1.89)	0.0507 (1.92)
Total Volume, scm (scf)*	385.9 (14,624)	388.4 (14,716)	391.7 (14,843)	392.1 (14,860)
HC Sample Meter/Range/ppm	0.0/0/16.9	0.0/0/16.6	0.0/0/17.9	0.0/0/22.6
HC Bckgrd Meter/Range/ppm	3.3/100/3.3	3.2/100/3.2	3.3/100/3.3	3.2/100/3.2
CO Sample Meter/Range/ppm (Dry)	13.9/100/13.3	13.1/100/12.5	13.3/100/12.7	19.1/100/18.3
CO Bckgrd Meter/Range/ppm	0.8/100/0.8	0.6/100/0.6	0.8/100/0.8	0.9/100/0.8
CO2 Sample Meter/Range/% (Wet)	74.4/2/1.4460	61.5/2/1.1638	87.3/1/0.8372	43.7/1/0.3189
CO2 Bckgrd Meter/Range/%	2.9/2/0.0491	2.9/2/0.0491	7.6/1/0.0484	7.4/1/0.0471
NOx Sample Meter/Range/ppm (Dry)	0.0/0/198.6	0.0/0/118.4	0.0/0/63.9	0.0/0/41.8
NOx Bckgrd Meter/Range/ppm	1.1/25/0.3	1.6/25/0.4	1.7/25/0.4	1.8/25/0.5
Dilution Factor	9.39	11.67	16.20	42.15
HC Concentration, ppm	13.96	13.61	14.77	19.40
CO Concentration, ppm	12.03	11.53	11.59	17.14
CO2 Concentration, %	1.40	1.12	0.79	0.27
NOx Concentration, ppm	192.42	114.87	61.94	40.60
HC Mass, grams	3.32	3.26	3.57	4.69
CO Mass, grams	5.80	5.59	5.67	8.40
CO2 Mass, grams	10,623.58	8,531.05	6,088.77	2,101.13
NOx Mass, grams	153.04	91.81	50.00	32.82
Part. Mass, grams	1.398	1.635	2.163	2.053
Fuel, kg (lb)	3.343 (7.37)	2.686 (5.92)	1.919 (4.23)	0.669 (1.47)
KW-HR (hp-hr)	16.79 (22.52)	12.77 (17.12)	8.57 (11.49)	1.80 (2.41)
Filter Number	8788	8789	8790	8791
Weight Gain, mg	0.978	1.053	1.378	1.326
Sample Multiplier	1.429	1.553	1.570	1.549
Blower 1, scf	14,613.9	14,706.7	14,833.0	14,850.0
Blower 2, scf	0.0	0.0	0.0	0.0
Gas Meter 1, scf	11.005	11.701	11.690	11.690
Gas Meter 2, scf	21.238	21.180	21.145	21.286

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M02DXS08A	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	0.0 L (0 CID) 6	Date:	05/28/2002 Time:	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program SSDIL:	2.28-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	

Mode Number	5	6	7	8
Barometer, kPa (in Hg)	98.2 (29.01)	98.2 (29.01)	98.2 (29.01)	98.2 (29.01)
Dil. Air: Temp, °C (°F) / AH, g/kg	28.3 (83.0) / 10.8	28.3 (83.0) / 10.8	28.3 (83.0) / 10.8	28.9 (84.0) / 10.6
Engine Air Dew Pt., °C (°F)	14.8 (58.6)	15.3 (59.6)	15.2 (59.3)	14.8 (58.6)
Engine Air Temp, °C (°F)	23.3 (74.0)	23.3 (74.0)	23.3 (74.0)	24.4 (76.0)
Engine Air: RH,% / AH, g/kg	59 / 10.9	61 / 11.3	60 / 11.1	55 / 10.9
NOx Humidity C.F.	1.003	1.010	1.008	1.003
Dry-to-Wet C.F.	.972	.974	.977	.982
Time, seconds	299.9	299.9	299.8	599.8
Tot. Blower Rate, scmm (scfm)*	77.77 (2,947.0)	78.09 (2,959.3)	78.74 (2,983.8)	79.13 (2,998.7)
90mm Sample Rate, scmm (scfm)*	0.0491 (1.86)	0.0493 (1.87)	0.0491 (1.86)	0.0511 (1.94)
Total Volume, scm (scf)*	389.0 (14,739)	390.6 (14,801)	393.7 (14,918)	791.6 (29,996)
HC Sample Meter/Range/ppm	0.0/0/14.0	0.0/0/12.0	0.0/0/12.9	0.0/0/12.3
HC Bckgrd Meter/Range/ppm	3.4/100/3.5	3.5/100/3.6	3.5/100/3.6	3.5/100/3.6
CO Sample Meter/Range/ppm (Dry)	33.8/100/32.8	23.5/100/22.6	18.9/100/18.1	8.5/100/8.1
CO Bckgrd Meter/Range/ppm	0.8/100/0.8	1.7/100/1.6	1.8/100/1.7	1.9/100/1.8
CO2 Sample Meter/Range/% (Wet)	65.5/2/1.2492	52.4/2/0.9751	77.5/1/0.6958	16.5/1/0.1074
CO2 Bckgrd Meter/Range/%	3.0/2/0.0508	2.9/2/0.0491	7.3/1/0.0464	7.1/1/0.0451
NOx Sample Meter/Range/ppm (Dry)	0.0/0/181.9	0.0/0/108.5	0.0/0/57.6	0.0/0/13.8
NOx Bckgrd Meter/Range/ppm	1.4/25/0.4	1.2/25/0.3	1.2/25/0.3	0.9/25/0.2
Dilution Factor	10.86	13.91	19.48	124.40
HC Concentration, ppm	10.87	8.66	9.51	8.74
CO Concentration, ppm	30.85	20.42	16.05	6.18
CO2 Concentration, %	1.20	0.93	0.65	0.06
NOx Concentration, ppm	176.40	105.36	56.00	13.34
HC Mass, grams	2.61	2.08	2.31	4.26
CO Mass, grams	14.99	9.96	7.89	6.12
CO2 Mass, grams	9,187.20	7,127.89	5,037.70	973.84
NOx Mass, grams	141.22	85.33	45.61	21.73
Part. Mass, grams	1.457	1.582	2.296	1.195
Fuel, kg (lb)	2.896 (6.38)	2.246 (4.95)	1.589 (3.50)	0.313 (0.69)
KW-HR (hp-hr)	14.65 (19.65)	11.00 (14.75)	7.35 (9.85)	0.11 (0.15)
Filter Number	8792	8793	8794	8795
Weight Gain, mg	0.920	0.998	1.431	0.771
Sample Multiplier	1.583	1.585	1.604	1.550
Blower 1, scf	14,729.9	14,791.4	14,908.9	29,976.8
Blower 2, scf	0.0	0.0	0.0	0.0
Gas Meter 1, scf	11.659	11.668	11.677	23.318
Gas Meter 2, scf	20.967	21.006	20.977	42.671

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.:	M12DU8B-1	DIESEL 2D, 2D=Tank 19	
Engine Desc.:	10.7 L (655 CID) 661	Date:	06/04/2002 Time: 11:12	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	34872033	Cell: 16	Bag Cart: 1	Oil Code: 15w40	
		Steady-State		100R100	

Ambient/Test Cell Conditions

Barometer:	28.98	in Hg	98.1 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	57.4	°F	14.1 °C
Abs. Humidity:	72.9	gr/lb	10.4 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	78.0	°F	25.6 °C
Abs. Humidity	68.9	gr/lb	9.8 g/kg
Rel. Humidity:	47	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		20.90	ppm	
HC Bckgrd	6.5	2	6.57	ppm	
CO	13.5	2	12.87	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		198.78	ppm	(Dry)
NOx Bckgrd	1.0	1	0.25	ppm	
CO2 Sample	74.4	3	1.4460	%	(Wet)
CO2 Bckgrd	3.1	3	0.0525	%	
CH4 Sample	n/a	n/a	1.79	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.93	ppm	

Corrected Concentrations

HC	15.03	ppm	
CO	11.58	ppm	
NOx	192.88	ppm	
CO2	1.3991	%	
CH4	0.06	ppm	(1.00)

Mass Emissions

HC	7.239	grams	
CO	11.307	grams	
NOx	307.576	grams	
Particulate	3.231	grams	
CO2	21.460	kg	
CH4	0.036	grams	
Fuel	14.89 lb	6.75 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,905.5	82.28
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.56	0.07
Gas Meter 2:	4.24	0.12
Sample Rate:	1.68	0.05
20X20 Sample Rate:	2.30	0.07
47 mm Sample Rate:	52.11	1.48
Total Flow Rate:	2,961.56	83.87

Particulate Data

Filter Number:	8811.0-183 (pair)	
Weight Gain:	1.835	mg
Sample Multiplier:	1.761	

Correction Factors

NOx Humidity CF:	0.995
Dry-to-Wet CF, Sample:	0.971
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	9.39

Test Cycle Data

Sample Time:	599.80	sec		
Work:	45.89	hp-hr	34.22	kW-hr
Reference Work:	45.89	hp-hr	34.22	kW-hr
Total Volume (Vmix):	29,605.7	scf	838.45	scm

Brake-Specific Emission Results

BSHC (Cell)	0.158	g/hp-hr	0.212	g/kW-hr
CO	0.246	g/hp-hr	0.330	g/kW-hr
NOx (Cell)	6.702	g/hp-hr	8.988	g/kW-hr
Particulate	0.070	g/hp-hr	0.094	g/kW-hr
CO2	467.6	g/hp-hr	627.12	g/kW-hr
BSFC	0.324	lb/hp-hr	0.197	kg/kW-hr
NMHC	0.137	g/hp-hr	0.184	g/kW-hr
CH4	0.001	g/hp-hr	0.001	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M12DU8B-2	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/04/2002 Time: 11:33	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R075

Ambient/Test Cell Conditions

Barometer:	28.98	in Hg	98.1 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	57.9	°F	14.4 °C
Abs. Humidity:	74.2	gr/lb	10.6 g/kg
Rel. Humidity:	57	%	
Dilution Air:			
Temperature:	79.0	°F	26.1 °C
Abs. Humidity	67.2	gr/lb	9.6 g/kg
Rel. Humidity:	44	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		19.96	ppm	
HC Bckgrd	7.3	2	7.38	ppm	
CO	12.5	2	11.90	ppm	(Dry)
CO Bckgrd	0.8	2	0.75	ppm	
NOx Sample	n/a		117.99	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	61.4	3	1.1617	%	(Wet)
CO2 Bckgrd	3.4	3	0.0576	%	
CH4 Sample	n/a	n/a	1.82	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.96	ppm	

Corrected Concentrations

HC	13.21	ppm	
CO	10.79	ppm	
NOx	114.78	ppm	
CO2	1.1090	%	
CH4	0.03	ppm	(1.00)

Mass Emissions

HC	6.393	grams	
CO	10.585	grams	
NOx	184.552	grams	
Particulate	3.170	grams	
CO2	17.092	kg	
CH4	0.017	grams	
Fuel	11.86 lb	5.38 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,921.9	82.75
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.56	0.07
Gas Meter 2:	4.22	0.12
Sample Rate:	1.66	0.05
20X20 Sample Rate:	1.00	0.03
47 mm Sample Rate:	51.60	1.46
Total Flow Rate:	2,976.14	84.29

Particulate Data

Filter Number:	8812.0-184 (pair)	
Weight Gain:	1.773	mg
Sample Multiplier:	1.788	

Correction Factors

NOx Humidity CF:	0.998
Dry-to-Wet CF, Sample:	0.974
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	11.69

Test Cycle Data

Sample Time:	599.70	sec		
Work:	34.81	hp-hr	25.96	kW-hr
Reference Work:	34.81	hp-hr	25.96	kW-hr
Total Volume (Vmix):	29,746.5	scf	842.44	scm

Brake-Specific Emission Results

BSHC (Cell)	0.184	g/hp-hr	0.246	g/kW-hr
CO	0.304	g/hp-hr	0.408	g/kW-hr
NOx (Cell)	5.302	g/hp-hr	7.110	g/kW-hr
Particulate	0.091	g/hp-hr	0.122	g/kW-hr
CO2	491.0	g/hp-hr	658.45	g/kW-hr
BSFC	0.341	lb/hp-hr	0.207	kg/kW-hr
NMHC	0.160	g/hp-hr	0.214	g/kW-hr
CH4	0.000	g/hp-hr	0.001	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M12DU8B-3	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/04/2002 Time: 11:53	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R050

Ambient/Test Cell Conditions

Barometer:	28.97	in Hg	98.1 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	75.1	gr/lb	10.7 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	70.5	gr/lb	10.1 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		21.61	ppm	
HC Bckgrd	7.3	2	7.38	ppm	
CO	13.2	2	12.58	ppm	(Dry)
CO Bckgrd	0.6	2	0.56	ppm	
NOx Sample	n/a		62.27	ppm	(Dry)
NOx Bckgrd	0.2	1	0.05	ppm	
CO2 Sample	85.9	1	0.8161	%	(Wet)
CO2 Bckgrd	7.2	1	0.0458	%	
CH4 Sample	n/a	n/a	1.84	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.05	ppm	

Corrected Concentrations

HC	14.67	ppm	
CO	11.69	ppm	
NOx	60.77	ppm	
CO2	0.7731	%	
CH4	-0.09	ppm	(1.00)

Mass Emissions

HC	7.171	grams	
CO	11.573	grams	
NOx	98.895	grams	
Particulate	4.288	grams	
CO2	12.032	kg	
CH4	0.000	grams	
Fuel	8.36 lb	3.79 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,950.0	83.55
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.54	0.07
Gas Meter 2:	4.24	0.12
Sample Rate:	1.70	0.05
20X20 Sample Rate:	1.60	0.05
47 mm Sample Rate:	51.70	1.46
Total Flow Rate:	3,005.00	85.10

Particulate Data

Filter Number:	8894.0-185 (pair)	
Weight Gain:	2.421	mg
Sample Multiplier:	1.771	

Correction Factors

NOx Humidity CF:	1.000
Dry-to-Wet CF, Sample:	0.977
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	16.61

Test Cycle Data

Sample Time:	599.80	sec		
Work:	23.23	hp-hr	17.32	kW-hr
Reference Work:	23.23	hp-hr	17.32	kW-hr
Total Volume (Vmix):	30,040.0	scf	850.75	scm

Brake-Specific Emission Results

BSHC (Cell)	0.309	g/hp-hr	0.414	g/kW-hr
CO	0.498	g/hp-hr	0.668	g/kW-hr
NOx (Cell)	4.257	g/hp-hr	5.709	g/kW-hr
Particulate	0.185	g/hp-hr	0.248	g/kW-hr
CO2	517.9	g/hp-hr	694.56	g/kW-hr
BSFC	0.360	lb/hp-hr	0.219	kg/kW-hr
NMHC	0.268	g/hp-hr	0.360	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M12DU8B-4	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/04/2002 Time: 12:14	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R010

Ambient/Test Cell Conditions

Barometer:	28.97	in Hg	98.1 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	57.9	°F	14.4 °C
Abs. Humidity:	74.3	gr/lb	10.6 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.9	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		28.79	ppm	
HC Bckgrd	7.1	2	7.18	ppm	
CO	21.5	2	20.66	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		38.92	ppm	(Dry)
NOx Bckgrd	0.2	1	0.05	ppm	
CO2 Sample	41.6	1	0.3003	%	(Wet)
CO2 Bckgrd	7.0	1	0.0445	%	
CH4 Sample	n/a	n/a	1.98	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.00	ppm	

Corrected Concentrations

HC	21.77	ppm	
CO	19.99	ppm	
NOx	38.16	ppm	
CO2	0.2568	%	
CH4	0.02	ppm	(1.00)

Mass Emissions

HC	10.698	grams	
CO	19.909	grams	
NOx	62.307	grams	
Particulate	4.724	grams	
CO2	4.019	kg	
CH4	0.013	grams	
Fuel	2.83 lb	1.28 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,966.6	84.01
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.53	0.07
Gas Meter 2:	4.26	0.12
Sample Rate:	1.73	0.05
20X20 Sample Rate:	0.90	0.03
47 mm Sample Rate:	51.91	1.47
Total Flow Rate:	3,021.10	85.56

Particulate Data

Filter Number:	8895.0-186 (pair)	
Weight Gain:	2.707	mg
Sample Multiplier:	1.745	

Correction Factors

NOx Humidity CF:	0.998
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	44.60

Test Cycle Data

Sample Time:	599.90	sec		
Work:	4.83	hp-hr	3.60	kW-hr
Reference Work:	4.83	hp-hr	3.60	kW-hr
Total Volume (Vmix):	30,206.0	scf	855.45	scm

Brake-Specific Emission Results

BSHC (Cell)	2.215	g/hp-hr	2.970	g/kW-hr
CO	4.122	g/hp-hr	5.528	g/kW-hr
NOx (Cell)	12.900	g/hp-hr	17.299	g/kW-hr
Particulate	0.978	g/hp-hr	1.312	g/kW-hr
CO2	832.1	g/hp-hr	1,115.80	g/kW-hr
BSFC	0.586	lb/hp-hr	0.356	kg/kW-hr
NMHC	1.925	g/hp-hr	2.581	g/kW-hr
CH4	0.003	g/hp-hr	0.004	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M12DU8B-5	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/05/2002 Time: 09:15	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	29.06	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	58.6	°F	14.8 °C
Abs. Humidity:	75.9	gr/lb	10.8 g/kg
Rel. Humidity:	57	%	
Dilution Air:			
Temperature:	77.0	°F	25.0 °C
Abs. Humidity	70.3	gr/lb	10.0 g/kg
Rel. Humidity:	49	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		16.58	ppm	
HC Bckgrd	7.8	2	7.88	ppm	
CO	30.0	2	29.01	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		179.16	ppm	(Dry)
NOx Bckgrd	1.4	1	0.35	ppm	
CO2 Sample	63.7	3	1.2106	%	(Wet)
CO2 Bckgrd	3.0	3	0.0508	%	
CH4 Sample	n/a	n/a	1.74	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.95	ppm	

Corrected Concentrations

HC	9.40	ppm	
CO	27.71	ppm	
NOx	174.05	ppm	
CO2	1.1643	%	
CH4	-0.04	ppm	(1.00)

Mass Emissions

HC	4.593	grams
CO	27.432	grams
NOx	283.706	grams
Particulate	2.864	grams
CO2	18.112	kg
CH4	0.000	grams
Fuel	12.58 lb	5.71 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,938.6	83.22
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.55	0.07
Gas Meter 2:	4.15	0.12
Sample Rate:	1.60	0.05
20X20 Sample Rate:	13.01	0.37
47 mm Sample Rate:	51.16	1.45
Total Flow Rate:	3,004.39	85.09

Particulate Data

Filter Number:	8922.0-224 (pair)	
Weight Gain:	1.528	mg
Sample Multiplier:	1.874	

Correction Factors

NOx Humidity CF:	1.002
Dry-to-Wet CF, Sample:	0.973
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	11.20

Test Cycle Data

Sample Time:	599.60	sec		
Work:	39.81	hp-hr	29.69	kW-hr
Reference Work:	39.81	hp-hr	29.69	kW-hr
Total Volume (Vmix):	30,023.9	scf	850.29	scm

Brake-Specific Emission Results

BSHC (Cell)	0.115	g/hp-hr	0.155	g/kW-hr
CO	0.689	g/hp-hr	0.924	g/kW-hr
NOx (Cell)	7.126	g/hp-hr	9.557	g/kW-hr
Particulate	0.072	g/hp-hr	0.096	g/kW-hr
CO2	455.0	g/hp-hr	610.10	g/kW-hr
BSFC	0.316	lb/hp-hr	0.192	kg/kW-hr
NMHC	0.100	g/hp-hr	0.134	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model: 1998 Cummins M11C
Engine Desc.: 10.7 L (655 CID) 661
Engine Cycle: Diesel
Engine S/N: 34872033

Test No.: M12DU8B-6
Date: 06/05/2002 Time: 09:36
Program HDT: 4.11-R
Cell: 16 Bag Cart: 1
Steady-State

DIESEL 2D, 2D=Tank 19
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: 15w40
060R075

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	59.3	°F	15.2 °C
Abs. Humidity:	77.9	gr/lb	11.1 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	68.5	gr/lb	9.8 g/kg
Rel. Humidity:	42	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		13.58	ppm	
HC Bckgrd	7.6	2	7.68	ppm	
CO	19.9	2	19.09	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		104.78	ppm	(Dry)
NOx Bckgrd	1.8	1	0.45	ppm	
CO2 Sample	93.8	1	0.9390	%	(Wet)
CO2 Bckgrd	6.7	1	0.0425	%	
CH4 Sample	n/a	n/a	1.77	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.97	ppm	

Corrected Concentrations

HC	6.43	ppm	
CO	18.23	ppm	
NOx	101.85	ppm	
CO2	0.8994	%	
CH4	-0.06	ppm	(1.00)

Mass Emissions

HC	3.151	grams	
CO	18.104	grams	
NOx	167.376	grams	
Particulate	2.913	grams	
CO2	14.034	kg	
CH4	0.000	grams	
Fuel	9.75 lb	4.42 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,948.1	83.49
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.56	0.07
Gas Meter 2:	4.14	0.12
Sample Rate:	1.58	0.04
20X20 Sample Rate:	12.60	0.36
47 mm Sample Rate:	50.23	1.42
Total Flow Rate:	3,012.52	85.32

Particulate Data

Filter Number:	8923.0-225 (pair)	
Weight Gain:	1.523	mg
Sample Multiplier:	1.912	

Correction Factors

NOx Humidity CF:	1.008
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	14.45

Test Cycle Data

Sample Time:	599.80	sec		
Work:	29.71	hp-hr	22.15	kW-hr
Reference Work:	29.71	hp-hr	22.15	kW-hr
Total Volume (Vmix):	30,115.2	scf	852.88	scm

Brake-Specific Emission Results

BSHC (Cell)	0.106	g/hp-hr	0.142	g/kW-hr
CO	0.609	g/hp-hr	0.817	g/kW-hr
NOx (Cell)	5.634	g/hp-hr	7.555	g/kW-hr
Particulate	0.098	g/hp-hr	0.131	g/kW-hr
CO2	472.4	g/hp-hr	633.44	g/kW-hr
BSFC	0.328	lb/hp-hr	0.200	kg/kW-hr
NMHC	0.092	g/hp-hr	0.124	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M12DU8B-7	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/05/2002 Time: 09:57	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R050

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	59.9	°F	15.5 °C
Abs. Humidity:	79.6	gr/lb	11.4 g/kg
Rel. Humidity:	57	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.6	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		17.55	ppm	
HC Bckgrd	7.5	2	7.58	ppm	
CO	10.8	2	10.26	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		37.65	ppm	(Dry)
NOx Bckgrd	1.4	1	0.35	ppm	
CO2 Sample	64.1	1	0.5270	%	(Wet)
CO2 Bckgrd	6.7	1	0.0425	%	
CH4 Sample	n/a	n/a	1.77	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.89	ppm	

Corrected Concentrations

HC	10.27	ppm	
CO	9.38	ppm	
NOx	36.51	ppm	
CO2	0.4862	%	
CH4	-0.06	ppm	(1.00)

Mass Emissions

HC	5.100	grams	
CO	9.448	grams	
NOx	61.118	grams	
Particulate	3.884	grams	
CO2	7.693	kg	
CH4	0.000	grams	
Fuel	5.35 lb	2.43	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,988.7	84.64
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.55	0.07
Gas Meter 2:	4.21	0.12
Sample Rate:	1.66	0.05
20X20 Sample Rate:	12.70	0.36
47 mm Sample Rate:	51.06	1.45
Total Flow Rate:	3,054.08	86.49

Particulate Data

Filter Number:	8924.0-226 (pair)	
Weight Gain:	2.107	mg
Sample Multiplier:	1.843	

Correction Factors

NOx Humidity CF:	1.012
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	25.69

Test Cycle Data

Sample Time:	600.00	sec		
Work:	14.91	hp-hr	11.12	kW-hr
Reference Work:	14.91	hp-hr	11.12	kW-hr
Total Volume (Vmix):	30,540.8	scf	864.93	scm

Brake-Specific Emission Results

BSHC (Cell)	0.342	g/hp-hr	0.459	g/kW-hr
CO	0.634	g/hp-hr	0.850	g/kW-hr
NOx (Cell)	4.099	g/hp-hr	5.497	g/kW-hr
Particulate	0.261	g/hp-hr	0.349	g/kW-hr
CO2	515.9	g/hp-hr	691.87	g/kW-hr
BSFC	0.359	lb/hp-hr	0.218	kg/kW-hr
NMHC	0.297	g/hp-hr	0.399	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M12DU8B-8	DIESEL 2D, 2D=Tank 19
Engine Desc.:	10.7 L (655 CID) 661	Date: 06/05/2002 Time: 10:17	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100I000

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	58.6	°F	14.8 °C
Abs. Humidity:	75.9	gr/lb	10.8 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	70.3	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		22.02	ppm	
HC Bckgrd	7.0	2	7.08	ppm	
CO	10.8	2	10.26	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		11.00	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	14.5	1	0.0939	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	
CH4 Sample	n/a	n/a	1.91	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.95	ppm	

Corrected Concentrations

HC	14.99	ppm	
CO	9.92	ppm	
NOx	10.67	ppm	
CO2	0.0510	%	
CH4	-0.03	ppm	(1.00)

Mass Emissions

HC	14.964	grams
CO	20.072	grams
NOx	35.535	grams
Particulate	3.147	grams
CO2	1.622	kg
CH4	0.000	grams
Fuel	1.18 lb	0.53 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,003.0	85.05
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.55	0.07
Gas Meter 2:	4.27	0.12
Sample Rate:	1.71	0.05
20X20 Sample Rate:	12.50	0.35
47 mm Sample Rate:	51.85	1.47
Total Flow Rate:	3,069.10	86.92

Particulate Data

Filter Number:	8925.0-227 (pair)	
Weight Gain:	1.758	mg
Sample Multiplier:	1.790	

Correction Factors

NOx Humidity CF:	1.002
Dry-to-Wet CF, Sample:	0.983
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	140.16

Test Cycle Data

Sample Time:	1,199.60	sec		
Work:	0.03	hp-hr	0.02	kW-hr
Reference Work:	0.03	hp-hr	0.02	kW-hr
Total Volume (Vmix):	61,361.5	scf	1,737.79	scm

Brake-Specific Emission Results

BSHC	(Cell) 498.800	g/hp-hr	668.902	g/kW-hr
CO	669.080	g/hp-hr	897.250	g/kW-hr
NOx	(Cell) 1,184.484	g/hp-hr	1,588.418	g/kW-hr
Particulate	104.892	g/hp-hr	140.662	g/kW-hr
CO2	54,054.1	g/hp-hr	72,487.66	g/kW-hr
BSFC	39.265	lb/hp-hr	23.880	kg/kW-hr
NMHC	433.458	g/hp-hr	581.276	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-1	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/07/2002 Time: 09:09	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R100

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	58.6	°F	14.8 °C
Abs. Humidity:	75.9	gr/lb	10.8 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.6	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		22.35	ppm	
HC Bckgrd	7.9	2	7.98	ppm	
CO	34.9	2	33.84	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		194.97	ppm	(Dry)
NOx Bckgrd	1.1	1	0.28	ppm	
CO2 Sample	64.5	3	1.2277	%	(Wet)
CO2 Bckgrd	3.0	3	0.0508	%	
CH4 Sample	n/a	n/a	1.90	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.18	ppm	

Corrected Concentrations

HC	15.09	ppm	
CO	32.31	ppm	
NOx	189.32	ppm	
CO2	1.1815	%	
CH4	-0.08	ppm	(1.00)

Mass Emissions

HC	7.299	grams	
CO	31.666	grams	
NOx	305.538	grams	
Particulate	3.381	grams	
CO2	18.198	kg	
CH4	0.000	grams	
Fuel	12.65 lb	5.74 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,916.6	82.60
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.58	0.07
Gas Meter 2:	4.27	0.12
Sample Rate:	1.69	0.05
20X20 Sample Rate:	2.80	0.08
47 mm Sample Rate:	52.32	1.48
Total Flow Rate:	2,973.40	84.21

Particulate Data

Filter Number:	8977.0 (pair)	
Weight Gain:	1.920	mg
Sample Multiplier:	1.761	

Correction Factors

NOx Humidity CF:	1.002
Dry-to-Wet CF, Sample:	0.972
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	11.04

Test Cycle Data

Sample Time:	599.90	sec		
Work:	45.97	hp-hr	34.28	kW-hr
Reference Work:	45.97	hp-hr	34.28	kW-hr
Total Volume (Vmix):	29,729.0	scf	841.94	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.159 g/hp-hr	0.213	g/kW-hr
CO		0.689 g/hp-hr	0.924	g/kW-hr
NOx	(Cell)	6.646 g/hp-hr	8.913	g/kW-hr
Particulate		0.074 g/hp-hr	0.099	g/kW-hr
CO2		395.9 g/hp-hr	530.87	g/kW-hr
BSFC		0.275 lb/hp-hr	0.167	kg/kW-hr
NMHC		0.138 g/hp-hr	0.185	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-2	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/07/2002 Time: 09:31	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R075

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	59.9	°F	15.5 °C
Abs. Humidity:	79.6	gr/lb	11.4 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	70.2	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		21.81	ppm	
HC Bckgrd	7.6	2	7.68	ppm	
CO	13.3	2	12.67	ppm	(Dry)
CO Bckgrd	0.6	2	0.56	ppm	
NOx Sample	n/a		113.81	ppm	(Dry)
NOx Bckgrd	1.2	1	0.30	ppm	
CO2 Sample	60.0	3	1.1322	%	(Wet)
CO2 Bckgrd	3.3	3	0.0559	%	
CH4 Sample	n/a	n/a	1.91	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.22	ppm	

Corrected Concentrations

HC	14.77	ppm	
CO	11.73	ppm	
NOx	110.57	ppm	
CO2	1.0810	%	
CH4	-0.13	ppm	(1.00)

Mass Emissions

HC	7.167	grams	
CO	11.531	grams	
NOx	180.756	grams	
Particulate	4.498	grams	
CO2	16.704	kg	
CH4	0.000	grams	
Fuel	11.60 lb	5.26 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,927.5	82.91
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.58	0.07
Gas Meter 2:	4.27	0.12
Sample Rate:	1.69	0.05
20X20 Sample Rate:	2.50	0.07
47 mm Sample Rate:	51.37	1.45
Total Flow Rate:	2,983.08	84.48

Particulate Data

Filter Number:	8978.0 (pair)	
Weight Gain:	2.547	mg
Sample Multiplier:	1.766	

Correction Factors

NOx Humidity CF:	1.012
Dry-to-Wet CF, Sample:	0.974
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	11.99

Test Cycle Data

Sample Time:	599.90	sec		
Work:	34.60	hp-hr	25.80	kW-hr
Reference Work:	34.60	hp-hr	25.80	kW-hr
Total Volume (Vmix):	29,825.8	scf	844.68	scm

Brake-Specific Emission Results

BSHC (Cell)	0.207	g/hp-hr	0.278	g/kW-hr
CO	0.333	g/hp-hr	0.447	g/kW-hr
NOx (Cell)	5.224	g/hp-hr	7.006	g/kW-hr
Particulate	0.130	g/hp-hr	0.174	g/kW-hr
CO2	482.8	g/hp-hr	647.41	g/kW-hr
BSFC	0.335	lb/hp-hr	0.204	kg/kW-hr
NMHC	0.180	g/hp-hr	0.241	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

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EPA Hot Transient Emission Test Results
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Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-3	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/07/2002 Time: 09:53	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R050

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	59.2	°F	15.1 °C
Abs. Humidity:	77.6	gr/lb	11.1 g/kg
Rel. Humidity:	60	%	
Dilution Air:			
Temperature:	85.0	°F	29.4 °C
Abs. Humidity	72.0	gr/lb	10.3 g/kg
Rel. Humidity:	39	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		23.59	ppm	
HC Bckgrd	7.6	2	7.68	ppm	
CO	12.9	2	12.29	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		61.72	ppm	(Dry)
NOx Bckgrd	0.7	1	0.18	ppm	
CO2 Sample	85.7	1	0.8131	%	(Wet)
CO2 Bckgrd	7.2	1	0.0458	%	
CH4 Sample	n/a	n/a	1.76	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.04	ppm	

Corrected Concentrations

HC	16.37	ppm	
CO	11.17	ppm	
NOx	60.10	ppm	
CO2	0.7700	%	
CH4	-0.16	ppm	(1.00)

Mass Emissions

HC	8.009	grams	
CO	11.071	grams	
NOx	98.530	grams	
Particulate	5.389	grams	
CO2	11.997	kg	
CH4	0.000	grams	
Fuel	8.34 lb	3.78 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,953.8	83.65
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.57	0.07
Gas Meter 2:	4.26	0.12
Sample Rate:	1.69	0.05
20X20 Sample Rate:	1.60	0.05
47 mm Sample Rate:	51.47	1.46
Total Flow Rate:	3,008.60	85.21

Particulate Data

Filter Number:	8979.0 (pair)	
Weight Gain:	3.025	mg
Sample Multiplier:	1.782	

Correction Factors

NOx Humidity CF:	1.007
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	16.67

Test Cycle Data

Sample Time:	599.70	sec		
Work:	23.22	hp-hr	17.32	kW-hr
Reference Work:	23.22	hp-hr	17.32	kW-hr
Total Volume (Vmix):	30,070.9	scf	851.63	scm

Brake-Specific Emission Results

BSHC (Cell)	0.345	g/hp-hr	0.463	g/kW-hr
CO	0.477	g/hp-hr	0.639	g/kW-hr
NOx (Cell)	4.243	g/hp-hr	5.690	g/kW-hr
Particulate	0.232	g/hp-hr	0.311	g/kW-hr
CO2	516.7	g/hp-hr	692.87	g/kW-hr
BSFC	0.359	lb/hp-hr	0.218	kg/kW-hr
NMHC	0.300	g/hp-hr	0.402	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

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Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-4	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/07/2002 Time: 10:16	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100R010

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	59.2	°F	15.1 °C
Abs. Humidity:	77.6	gr/lb	11.1 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	85.0	°F	29.4 °C
Abs. Humidity	72.0	gr/lb	10.3 g/kg
Rel. Humidity:	39	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		31.60	ppm	
HC Bckgrd	7.3	2	7.38	ppm	
CO	24.7	2	23.79	ppm	(Dry)
CO Bckgrd	2.7	2	2.54	ppm	
NOx Sample	n/a		36.53	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	41.0	1	0.2950	%	(Wet)
CO2 Bckgrd	7.2	1	0.0458	%	
CH4 Sample	n/a	n/a	2.08	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.03	ppm	

Corrected Concentrations

HC	24.38	ppm
CO	20.91	ppm
NOx	35.64	ppm
CO2	0.2502	%
CH4	0.09	ppm (1.00)

Mass Emissions

HC	12.047	grams
CO	20.933	grams
NOx	59.020	grams
Particulate	5.074	grams
CO2	3.937	kg
CH4	0.052	grams
Fuel	2.78 lb	1.26 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,983.1	84.48
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.54	0.07
Gas Meter 2:	4.29	0.12
Sample Rate:	1.74	0.05
20X20 Sample Rate:	1.60	0.05
47 mm Sample Rate:	52.11	1.48
Total Flow Rate:	3,038.53	86.05

Particulate Data

Filter Number:	8980.0 (pair)	
Weight Gain:	2.911	mg
Sample Multiplier:	1.743	

Correction Factors

NOx Humidity CF:	1.007
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	45.30

Test Cycle Data

Sample Time:	599.70	sec		
Work:	4.65	hp-hr	3.47	kW-hr
Reference Work:	4.65	hp-hr	3.47	kW-hr
Total Volume (Vmix):	30,370.1	scf	860.10	scm

Brake-Specific Emission Results

BSHC (Cell)	2.591	g/hp-hr	3.474	g/kW-hr
CO	4.502	g/hp-hr	6.037	g/kW-hr
NOx (Cell)	12.692	g/hp-hr	17.021	g/kW-hr
Particulate	1.091	g/hp-hr	1.463	g/kW-hr
CO2	846.7	g/hp-hr	1,135.40	g/kW-hr
BSFC	0.597	lb/hp-hr	0.363	kg/kW-hr
NMHC	2.251	g/hp-hr	3.019	g/kW-hr
CH4	0.011	g/hp-hr	0.015	g/kW-hr

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Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-5	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/10/2002 Time: 09:40	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	28.98	in Hg	98.1 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	72.3	gr/lb	10.3 g/kg
Rel. Humidity:	56	%	
Dilution Air:			
Temperature:	78.0	°F	25.6 °C
Abs. Humidity	73.9	gr/lb	10.6 g/kg
Rel. Humidity:	50	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		16.51	ppm	
HC Bckgrd	7.9	2	7.98	ppm	
CO	34.9	2	33.84	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		178.79	ppm	(Dry)
NOx Bckgrd	1.1	1	0.28	ppm	
CO2 Sample	64.5	3	1.2277	%	(Wet)
CO2 Bckgrd	3.0	3	0.0508	%	
CH4 Sample	n/a	n/a	1.77	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.97	ppm	

Corrected Concentrations

HC	9.25	ppm	
CO	32.26	ppm	
NOx	173.58	ppm	
CO2	1.1815	%	
CH4	-0.02	ppm	(1.00)

Mass Emissions

HC	4.510	grams	
CO	31.863	grams	
NOx	279.739	grams	
Particulate	3.598	grams	
CO2	18.340	kg	
CH4	0.000	grams	
Fuel	12.75 lb	5.78 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,940.1	83.26
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.55	0.07
Gas Meter 2:	4.19	0.12
Sample Rate:	1.64	0.05
20X20 Sample Rate:	5.00	0.14
47 mm Sample Rate:	50.89	1.44
Total Flow Rate:	2,997.60	84.89

Particulate Data

Filter Number:	8981.0-269 (pair)	
Weight Gain:	1.968	mg
Sample Multiplier:	1.828	

Correction Factors

NOx Humidity CF:	0.993
Dry-to-Wet CF, Sample:	0.972
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	11.04

Test Cycle Data

Sample Time:	599.70	sec		
Work:	39.65	hp-hr	29.57	kW-hr
Reference Work:	39.65	hp-hr	29.57	kW-hr
Total Volume (Vmix):	29,961.1	scf	848.51	scm

Brake-Specific Emission Results

BSHC (Cell)	0.114	g/hp-hr	0.153	g/kW-hr
CO	0.804	g/hp-hr	1.078	g/kW-hr
NOx (Cell)	7.055	g/hp-hr	9.461	g/kW-hr
Particulate	0.091	g/hp-hr	0.122	g/kW-hr
CO2	462.6	g/hp-hr	620.29	g/kW-hr
BSFC	0.321	lb/hp-hr	0.196	kg/kW-hr
NMHC	0.099	g/hp-hr	0.133	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

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Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-6	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/10/2002 Time: 10:02	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R075

Ambient/Test Cell Conditions

Barometer:	28.99	in Hg	98.2 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	57.8	°F	14.3 °C
Abs. Humidity:	73.9	gr/lb	10.6 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	72.2	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		14.60	ppm	
HC Bckgrd	8.0	2	8.08	ppm	
CO	23.7	2	22.81	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		106.43	ppm	(Dry)
NOx Bckgrd	1.5	1	0.38	ppm	
CO2 Sample	94.5	1	0.9504	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	
CH4 Sample	n/a	n/a	1.87	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.02	ppm	

Corrected Concentrations

HC	7.09	ppm	
CO	21.83	ppm	
NOx	103.43	ppm	
CO2	0.9097	%	
CH4	0.00	ppm	(1.00)

Mass Emissions

HC	3.451	grams	
CO	21.542	grams	
NOx	167.223	grams	
Particulate	4.045	grams	
CO2	14.108	kg	
CH4	0.000	grams	
Fuel	9.80 lb	4.45 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,941.1	83.29
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.55	0.07
Gas Meter 2:	4.20	0.12
Sample Rate:	1.65	0.05
20X20 Sample Rate:	2.30	0.07
47 mm Sample Rate:	49.84	1.41
Total Flow Rate:	2,994.93	84.82

Particulate Data

Filter Number:	8982.0-270 (pair)	
Weight Gain:	2.228	mg
Sample Multiplier:	1.816	

Correction Factors

NOx Humidity CF:	0.997
Dry-to-Wet CF, Sample:	0.975
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	14.27

Test Cycle Data

Sample Time:	599.70	sec		
Work:	29.73	hp-hr	22.17	kW-hr
Reference Work:	29.73	hp-hr	22.17	kW-hr
Total Volume (Vmix):	29,934.3	scf	847.76	scm

Brake-Specific Emission Results

BSHC (Cell)	0.116	g/hp-hr	0.156	g/kW-hr
CO	0.725	g/hp-hr	0.972	g/kW-hr
NOx (Cell)	5.625	g/hp-hr	7.543	g/kW-hr
Particulate	0.136	g/hp-hr	0.182	g/kW-hr
CO2	474.5	g/hp-hr	636.37	g/kW-hr
BSFC	0.330	lb/hp-hr	0.201	kg/kW-hr
NMHC	0.101	g/hp-hr	0.135	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

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Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-7	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/10/2002 Time: 10:23	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	060R050

Ambient/Test Cell Conditions

Barometer:	28.98	in Hg	98.1 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	57.4	°F	14.1 °C
Abs. Humidity:	72.9	gr/lb	10.4 g/kg
Rel. Humidity:	54	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	72.2	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		19.11	ppm	
HC Bckgrd	7.8	2	7.88	ppm	
CO	12.4	2	11.80	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		38.54	ppm	(Dry)
NOx Bckgrd	0.9	1	0.23	ppm	
CO2 Sample	65.6	1	0.5445	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	
CH4 Sample	n/a	n/a	1.91	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.93	ppm	

Corrected Concentrations

HC	11.55	ppm	
CO	10.89	ppm	
NOx	37.50	ppm	
CO2	0.5025	%	
CH4	0.06	ppm	(1.00)

Mass Emissions

HC	5.707	grams	
CO	10.909	grams	
NOx	61.372	grams	
Particulate	5.010	grams	
CO2	7.909	kg	
CH4	0.034	grams	
Fuel	5.50 lb	2.50 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,985.0	84.54
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.54	0.07
Gas Meter 2:	4.23	0.12
Sample Rate:	1.69	0.05
20X20 Sample Rate:	2.10	0.06
47 mm Sample Rate:	50.05	1.42
Total Flow Rate:	3,038.80	86.06

Particulate Data

Filter Number:	8983.0-271 (pair)	
Weight Gain:	2.787	mg
Sample Multiplier:	1.798	

Correction Factors

NOx Humidity CF:	0.995
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	24.86

Test Cycle Data

Sample Time:	599.90	sec		
Work:	15.09	hp-hr	11.25	kW-hr
Reference Work:	15.09	hp-hr	11.25	kW-hr
Total Volume (Vmix):	30,382.9	scf	860.46	scm

Brake-Specific Emission Results

BSHC (Cell)	0.378	g/hp-hr	0.507	g/kW-hr
CO	0.723	g/hp-hr	0.969	g/kW-hr
NOx (Cell)	4.067	g/hp-hr	5.454	g/kW-hr
Particulate	0.332	g/hp-hr	0.445	g/kW-hr
CO2	524.2	g/hp-hr	702.90	g/kW-hr
BSFC	0.365	lb/hp-hr	0.222	kg/kW-hr
NMHC	0.329	g/hp-hr	0.441	g/kW-hr
CH4	0.002	g/hp-hr	0.003	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.801

Engine Model:	1998 Cummins M11C	Test No.: M2NRV8E-8	DIESEL 2D, NR=EM2831F
Engine Desc.:	10.7 L (655 CID) 6	Date: 06/10/2002 Time: 10:43	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	34872033	Cell: 16 Bag Cart: 1	Oil Code: 15w40
		Steady-State	100l000

Ambient/Test Cell Conditions

Barometer:	28.98	in Hg	98.1 kPa
Engine Inlet Air			
Temperature:	77.0	°F	25.0 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	71.3	gr/lb	10.2 g/kg
Rel. Humidity:	50	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	67.2	gr/lb	9.6 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		24.89	ppm	
HC Bckgrd	7.8	2	7.88	ppm	
CO	13.1	2	12.48	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		11.21	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	15.1	1	0.0979	%	(Wet)
CO2 Bckgrd	6.9	1	0.0438	%	
CH4 Sample	n/a	n/a	2.07	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.99	ppm	

Corrected Concentrations

HC	17.07	ppm	
CO	11.65	ppm	
NOx	10.88	ppm	
CO2	0.0544	%	
CH4	0.10	ppm	(1.00)

Mass Emissions

HC	16.789	grams
CO	23.223	grams
NOx	35.291	grams
Particulate	3.757	grams
CO2	1.705	kg
CH4	0.116	grams
Fuel	1.24 lb	0.56 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,968.5	84.07
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.54	0.07
Gas Meter 2:	4.28	0.12
Sample Rate:	1.74	0.05
20X20 Sample Rate:	1.40	0.04
47 mm Sample Rate:	51.50	1.46
Total Flow Rate:	3,023.12	85.62

Particulate Data

Filter Number:	8984.0-272 (pair)	
Weight Gain:	2.157	mg
Sample Multiplier:	1.742	

Correction Factors

NOx Humidity CF:	0.990
Dry-to-Wet CF, Sample:	0.984
Dry-to-Wet CF, Bckgrd:	0.985
Dilution Factor:	133.95

Test Cycle Data

Sample Time:	1,200.00	sec		
Work:	0.21	hp-hr	0.16	kW-hr
Reference Work:	0.21	hp-hr	0.16	kW-hr
Total Volume (Vmix):	60,462.4	scf	1,712.33	scm

Brake-Specific Emission Results

BSHC	(Cell)	79.948 g/hp-hr	107.212	g/kW-hr
CO		110.587 g/hp-hr	148.299	g/kW-hr
NOx	(Cell)	168.054 g/hp-hr	225.364	g/kW-hr
Particulate		17.889 g/hp-hr	23.990	g/kW-hr
CO2		8,118.8 g/hp-hr	10,887.55	g/kW-hr
BSFC		5.920 lb/hp-hr	3.600	kg/kW-hr
NMHC		69.475 g/hp-hr	93.167	g/kW-hr
CH4		0.554 g/hp-hr	0.743	g/kW-hr

APPENDIX K

DETAILED COMPUTER PRINTOUTS FOR TYPE-C1 STEADY-STATE EMISSION TESTS ON A CATERPILLAR 3196 USING TWO FUELS

Test Name	Cycle or Mode	Fuel	Toxics Information	Description	Page
E02DXS8	C1 Test	2D	Without	Steady-State Emissions Summary	K-1
E12DU8B-1	C1-1	2D	Yes	Steady-State Emissions Summary	K-4
E12DU8B-2	C1-2	2D	Yes	Steady-State Emissions Summary	K-5
E12DU8B-3	C1-3	2D	Yes	Steady-State Emissions Summary	K-6
E12DU8B-4	C1-4	2D	Yes	Steady-State Emissions Summary	K-7
E12DU8B-5	C1-5	2D	Yes	Steady-State Emissions Summary	K-8
E12DU8B-6	C1-6	2D	Yes	Steady-State Emissions Summary	K-9
E12DU8B-7	C1-7	2D	Yes	Steady-State Emissions Summary	K-10
E12DU8B-8	C1-8	2D	Yes	Steady-State Emissions Summary	K-11
E2NRU8E-1	C1-1	NR	Yes	Steady-State Emissions Summary	K-12
E2NRU8E-2	C1-2	NR	Yes	Steady-State Emissions Summary	K-13
E2NRU8E-3	C1-3	NR	Yes	Steady-State Emissions Summary	K-14
E2NRU8E-4	C1-4	NR	Yes	Steady-State Emissions Summary	K-15
E2NRU8E-5	C1-5	NR	Yes	Steady-State Emissions Summary	K-16
E2NRU8E-6	C1-6	NR	Yes	Steady-State Emissions Summary	K-17
E2NRU8E-7	C1-7	NR	Yes	Steady-State Emissions Summary	K-18
E2NRU8E-8	C1-8	NR	Yes	Steady-State Emissions Summary	K-19

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.803

Engine Model: 2001 Cat 3196
Engine Desc.: 10.0 L (610 CID) 6
Engine Cycle: Diesel
Engine S/N: 6AR02540

Test No.: E02DXS8
Date: 07/30/2002 Time:
Program SSDIL: 2.28-R
Cell: 16 Bag Cart: 1

DIESEL 2D, 2D=EM????F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: EM????EO

	Target			Measured		C - B	Intake Air			Factors			
Mode	Speed rpm	Load pct	Torque lb-ft	Time sec	Speed rpm	Torque lb-ft	Fuel lb/hr	Temp °F	Humid g/kg	Baro. in-Hg	NOx Hum.	Part. Hum.	Dry Wet	F (TC)
1	2,100	100.0	1,045.0	300	2,098	1,045.0	126.8	72.0	12.7	29.18	1.038	0.974	0.972	1.002
2	2,100	75.0	783.8	300	2,101	788.0	99.3	72.0	12.6	29.18	1.035	0.976	0.974	1.002
3	2,100	50.0	522.5	300	2,099	520.0	69.1	72.0	12.9	29.18	1.042	0.971	0.977	1.003
4	2,100	10.0	104.5	300	2,098	107.0	22.8	73.0	12.7	29.17	1.038	0.974	0.981	1.006
5	1,400	100.0	1,370.0	300	1,401	1,370.0	112.7	73.0	12.8	29.17	1.039	0.973	0.973	1.006
6	1,400	75.0	1,027.5	300	1,400	1,025.0	85.0	73.0	12.9	29.17	1.042	0.971	0.975	1.006
7	1,400	50.0	685.0	300	1,400	688.0	58.8	73.0	13.0	29.16	1.044	0.970	0.977	1.006
8	880	0.0	0.0	600	880	9.0	3.5	74.0	12.7	29.16	1.038	0.974	0.982	1.009

	BHP from	Grams/Hour					Mode	Power	Weighted Results Grams/Hour				
Mode	Work	HC	CO	NOx	Part.	CO2	wf	bhp	HC	CO	NOx	Part.	CO2
1	415.0	14.11	76.8	2,989.3	17.34	182,857	.150	62.2	2.12	11.52	448.40	2.60	27,429
2	312.3	24.69	50.6	1,787.3	16.65	143,229	.150	46.9	3.70	7.59	268.09	2.50	21,484
3	208.7	27.11	61.0	967.9	21.73	99,527	.150	31.3	4.07	9.15	145.19	3.26	14,929
4	42.9	39.23	136.9	297.3	25.09	32,562	.100	4.3	3.92	13.69	29.73	2.51	3,256
5	363.2	3.68	1,228.5	1,977.3	45.52	160,821	.100	36.3	0.37	122.85	197.73	4.55	16,082
6	271.8	6.89	194.5	1,429.0	12.75	122,445	.100	27.2	0.69	19.45	142.90	1.27	12,245
7	183.8	5.03	89.4	1,015.3	10.77	84,749	.100	18.4	0.50	8.94	101.53	1.08	8,475
8	1.6	2.62	36.2	117.5	2.96	4,980	.150	0.2	0.39	5.43	17.62	0.44	747
							Total	226.6	15.76	198.63	1,351.20	18.21	104,647

	Weighted Modal Contribution g/hp-hr				
Mode	HC	CO	NOx	Part.	CO2
1	0.01	0.05	1.98	0.011	121
2	0.02	0.03	1.18	0.011	95
3	0.02	0.04	0.64	0.014	66
4	0.02	0.06	0.13	0.011	14
5	0.00	0.54	0.87	0.020	71
6	0.00	0.09	0.63	0.006	54
7	0.00	0.04	0.45	0.005	37
8	0.00	0.02	0.08	0.002	3

Composite Results

BSHC	=	0.07	g/hp-hr	=	0.09 g/kW-hr
BSCO	=	0.88	g/hp-hr	=	1.18 g/kW-hr
BSNOx	=	5.96	g/hp-hr	=	8.00 g/kW-hr
Particulate	=	0.080	g/hp-hr	=	0.108 g/kW-hr
BSCO2	=	462	g/hp-hr	=	619 g/kW-hr
BSFC	=	0.321	lb/hp-hr	=	0.195 kg/kW-hr

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.803

Engine Model:	2001 Cat 3196	Test No.:	E02DXS8		DIESEL 2D, 2D=EM????F
Engine Desc.:	10.0 L (610 CID) 6	Date:	07/30/2002	Time:	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program	SSDIL: 2.28-R		H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell:	16	Bag Cart: 1	Oil Code: EM????EO

Mode Number	1	2	3	4
Barometer, kPa (in Hg)	98.8 (29.18)	98.8 (29.18)	98.8 (29.18)	98.8 (29.17)
Dil. Air: Temp, °C (°F) / AH, g/kg	27.8 (82.0) / 11.0	28.3 (83.0) / 10.7	27.8 (82.0) / 11.0	27.8 (82.0) / 10.2
Engine Air Dew Pt., °C (°F)	17.3 (63.1)	17.1 (62.8)	17.6 (63.6)	17.3 (63.1)
Engine Air Temp, °C (°F)	22.2 (72.0)	22.2 (72.0)	22.2 (72.0)	22.8 (73.0)
Engine Air: RH,% / AH, g/kg	74 / 12.7	73 / 12.6	75 / 12.9	71 / 12.7
NOx Humidity C.F.	1.038	1.035	1.042	1.038
Dry-to-Wet C.F.	.972	.974	.977	.981
Time, seconds	299.9	299.9	300.0	299.9
Tot. Blower Rate, scmm (scfm)*	131.81 (4,994.9)	133.49 (5,058.4)	135.02 (5,116.4)	135.35 (5,129.1)
90mm Sample Rate, scmm (scfm)*	0.0594 (2.25)	0.0591 (2.24)	0.0590 (2.23)	0.0594 (2.25)
Total Volume, scm (scf)*	659.1 (24,977)	667.5 (25,295)	675.4 (25,593)	676.8 (25,648)
HC Sample Meter/Range/ppm	0.0/0/5.8	0.0/0/8.3	0.0/0/9.0	0.0/0/12.1
HC Bckgrd Meter/Range/ppm	3.2/100/3.2	3.5/100/3.6	3.7/100/3.8	4.3/100/4.4
CO Sample Meter/Range/ppm (Dry)	8.8/100/8.3	6.0/100/5.7	7.5/100/7.1	21.4/100/20.6
CO Bckgrd Meter/Range/ppm	0.3/100/0.3	0.5/100/0.5	1.0/100/0.9	7.3/100/6.9
CO2 Sample Meter/Range/% (Wet)	64.7/2/1.2250	94.7/1/0.9536	75.7/1/0.6715	36.0/1/0.2528
CO2 Bckgrd Meter/Range/%	3.2/2/0.0526	7.3/1/0.0464	7.6/1/0.0484	7.8/1/0.0496
NOx Sample Meter/Range/ppm (Dry)	0.0/0/182.8	0.0/0/108.4	0.0/0/57.8	0.0/0/17.9
NOx Bckgrd Meter/Range/ppm	1.1/25/0.3	2.6/25/0.7	2.6/25/0.7	1.4/25/0.4
Dilution Factor	11.10	14.25	20.22	53.16
HC Concentration, ppm	2.89	5.00	5.43	7.83
CO Concentration, ppm	7.77	5.06	6.02	13.49
CO2 Concentration, %	1.18	0.91	0.63	0.20
NOx Concentration, ppm	177.38	104.99	55.83	17.18
HC Mass, grams	1.18	2.06	2.26	3.27
CO Mass, grams	6.40	4.22	5.08	11.41
CO2 Mass, grams	15,233.03	11,931.79	8,293.96	2,712.58
NOx Mass, grams	249.03	148.89	80.66	24.77
Part. Mass, grams	1.483	1.422	1.864	2.146
Fuel, kg (lb)	4.789 (10.56)	3.752 (8.27)	2.610 (5.75)	0.861 (1.90)
KW-HR (hp-hr)	25.78 (34.57)	19.40 (26.02)	12.97 (17.39)	2.66 (3.57)
Filter Number	4207.0-442	4208.0-443	4209.0-444	4210.0-445
Weight Gain, mg	0.668	0.629	0.814	0.942
Sample Multiplier	2.220	2.260	2.290	2.278
Blower 1, scf	14,701.2	14,887.0	15,058.3	15,123.4
Blower 2, scf	10,264.8	10,396.7	10,523.8	10,513.4
Gas Meter 1, scf	10.372	10.286	10.311	10.296
Gas Meter 2, scf	21.621	21.476	21.485	21.554

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.803

Engine Model:	2001 Cat 3196	Test No.:	E02DXS8	DIESEL 2D, 2D=EM????F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	07/30/2002 Time:	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program SSDIL:	2.28-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code: EM????EO	

Mode Number	5	6	7	8
Barometer, kPa (in Hg)	98.8 (29.17)	98.8 (29.17)	98.7 (29.16)	98.7 (29.16)
Dil. Air: Temp, °C (°F) / AH, g/kg	27.8 (82.0) / 11.0	27.8 (82.0) / 11.0	27.8 (82.0) / 11.0	27.8 (82.0) / 11.0
Engine Air Dew Pt., °C (°F)	17.3 (63.2)	17.6 (63.6)	17.7 (63.8)	17.3 (63.1)
Engine Air Temp, °C (°F)	22.8 (73.0)	22.8 (73.0)	22.8 (73.0)	23.3 (74.0)
Engine Air: RH,% / AH, g/kg	71 / 12.8	72 / 12.9	73 / 13.0	69 / 12.7
NOx Humidity C.F.	1.039	1.042	1.044	1.038
Dry-to-Wet C.F.	.973	.975	.977	.982
Time, seconds	299.8	299.9	299.8	600.0
Tot. Blower Rate, scmm (scfm)*	132.45 (5,019.2)	133.82 (5,070.8)	135.65 (5,140.3)	136.57 (5,175.1)
90mm Sample Rate, scmm (scfm)*	0.0531 (2.01)	0.0585 (2.22)	0.0590 (2.24)	0.0594 (2.25)
Total Volume, scm (scf)*	662.1 (25,089)	669.2 (25,357)	678.1 (25,695)	1,366.3 (51,774)
HC Sample Meter/Range/ppm	0.0/0/4.8	0.0/0/11.5	0.0/0/6.0	0.0/0/5.6
HC Bckgrd Meter/Range/ppm	4.3/100/4.4	10.7/100/10.8	5.2/100/5.3	5.0/100/5.1
CO Sample Meter/Range/ppm (Dry)	54.9/250/128.4	21.0/100/20.2	9.7/100/9.2	4.2/100/4.0
CO Bckgrd Meter/Range/ppm	0.1/250/0.2	0.2/100/0.2	0.2/100/0.2	0.4/100/0.4
CO2 Sample Meter/Range/% (Wet)	58.3/2/1.0863	86.0/1/0.8176	67.9/1/0.5721	11.6/1/0.0745
CO2 Bckgrd Meter/Range/%	3.7/2/0.0609	6.9/1/0.0438	6.9/1/0.0438	6.9/1/0.0438
NOx Sample Meter/Range/ppm (Dry)	0.0/0/120.2	0.0/0/85.5	0.0/0/59.7	0.0/0/7.0
NOx Bckgrd Meter/Range/ppm	1.1/25/0.3	0.8/25/0.2	0.9/25/0.2	0.5/25/0.1
Dilution Factor	12.38	16.59	23.73	180.42
HC Concentration, ppm	0.75	1.39	1.00	0.52
CO Concentration, ppm	123.68	19.38	8.78	3.53
CO2 Concentration, %	1.03	0.78	0.53	0.03
NOx Concentration, ppm	116.66	83.16	58.17	6.73
HC Mass, grams	0.31	0.57	0.42	0.44
CO Mass, grams	102.31	16.20	7.44	6.03
CO2 Mass, grams	13,392.82	10,200.36	7,057.73	830.01
NOx Mass, grams	164.67	119.05	84.55	19.58
Part. Mass, grams	3.894	1.093	0.925	0.506
Fuel, kg (lb)	4.257 (9.39)	3.212 (7.08)	2.221 (4.90)	0.264 (0.58)
KW-HR (hp-hr)	22.56 (30.25)	16.88 (22.64)	11.42 (15.31)	0.19 (0.26)
Filter Number	4211.0-446	4212.0-447	4213.0-448	4214.0-449
Weight Gain, mg	1.561	0.478	0.402	0.220
Sample Multiplier	2.495	2.287	2.300	2.301
Blower 1, scf	14,751.8	14,910.0	15,108.5	30,477.2
Blower 2, scf	10,327.4	10,435.7	10,575.7	21,274.2
Gas Meter 1, scf	10.301	10.319	10.282	20.597
Gas Meter 2, scf	20.357	21.405	21.452	43.102

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DU8B-1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/05/2002 Time: 09:45	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R100

Ambient/Test Cell Conditions

Barometer:	29.18	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	71.8	gr/lb	10.3 g/kg
Rel. Humidity:	62	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.2	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.78	ppm	
HC Bckgrd	6.0	2	6.07	ppm	
CO	7.8	2	7.38	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		189.93	ppm	(Dry)
NOx Bckgrd	1.3	1	0.33	ppm	
CO2 Sample	63.1	3	1.1899	%	(Wet)
CO2 Bckgrd	3.0	3	0.0493	%	

Corrected Concentrations

HC	2.24	ppm
CO	6.35	ppm
NOx	184.46	ppm
CO2	1.1449	%

Mass Emissions

HC		1.856	grams	
CO		10.660	grams	
NOx		504.472	grams	
Particulate		2.622	grams	
CO2		30.199	kg	
Fuel	20.93 lb		9.49 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,949.4	83.53
Blower 2 Rate:	2,030.3	57.50
90 mm System:		
Gas Meter 1:	2.26	0.06
Gas Meter 2:	4.32	0.12
Sample Rate:	2.06	0.06
20X20 Sample Rate:	57.80	1.64
47 mm Sample Rate:	51.60	1.46
Total Flow Rate:	5,091.11	144.18

Particulate Data

Filter Number:	4332.0 (pair)	
Weight Gain:	1.063	mg
Sample Multiplier:	2.467	

Correction Factors

NOx Humidity CF:	0.992
Dry-to-Wet CF, Sample:	0.973
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	11.43

Test Cycle Data

Sample Time:	600.00	sec		
Work:	68.92	hp-hr	51.39	kW-hr
Reference Work:	68.92	hp-hr	51.39	kW-hr
Total Volume (Vmix):	50,911.1	scf	1,441.83	scm

Brake-Specific Emission Results

BSHC (Cell)	0.027	g/hp-hr	0.036	g/kW-hr
CO	0.155	g/hp-hr	0.207	g/kW-hr
NOx (Cell)	7.320	g/hp-hr	9.816	g/kW-hr
Particulate	0.038	g/hp-hr	0.051	g/kW-hr
CO2	438.2	g/hp-hr	587.61	g/kW-hr
BSFC	0.304	lb/hp-hr	0.185	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E12DU8B-2	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/05/2002 Time: 10:05	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Steady-State		100R075	

Ambient/Test Cell Conditions

Barometer:	29.18	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	57.2	°F	14.0 °C
Abs. Humidity:	71.8	gr/lb	10.3 g/kg
Rel. Humidity:	62	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	71.6	gr/lb	10.2 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.72	ppm	
HC Bckgrd	6.2	2	6.27	ppm	
CO	5.6	2	5.28	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		114.37	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	94.6	1	0.9520	%	(Wet)
CO2 Bckgrd	7.5	1	0.0477	%	

Corrected Concentrations

HC	3.89	ppm
CO	4.77	ppm
NOx	111.36	ppm
CO2	0.9076	%

Mass Emissions

HC		3.271	grams	
CO		8.135	grams	
NOx		309.260	grams	
Particulate		2.332	grams	
CO2		24.311	kg	
Fuel	16.85	lb	7.64	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,979.2	84.37
Blower 2 Rate:	2,079.5	58.89
90 mm System:		
Gas Meter 1:	2.25	0.06
Gas Meter 2:	4.30	0.12
Sample Rate:	2.05	0.06
20X20 Sample Rate:	57.60	1.63
47 mm Sample Rate:	51.52	1.46
Total Flow Rate:	5,169.85	146.41

Particulate Data

Filter Number:	4333.0 (pair)	
Weight Gain:	0.924	mg
Sample Multiplier:	2.523	

Correction Factors

NOx Humidity CF:	0.992
Dry-to-Wet CF, Sample:	0.975
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	14.28

Test Cycle Data

Sample Time:	600.00	sec		
Work:	52.25	hp-hr	38.96	kW-hr
Reference Work:	52.25	hp-hr	38.96	kW-hr
Total Volume (Vmix):	51,698.5	scf	1,464.13	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.063 g/hp-hr	0.084	g/kW-hr
CO		0.156 g/hp-hr	0.209	g/kW-hr
NOx	(Cell)	5.919 g/hp-hr	7.937	g/kW-hr
Particulate		0.045 g/hp-hr	0.060	g/kW-hr
CO2		465.3 g/hp-hr	623.96	g/kW-hr
BSFC		0.323 lb/hp-hr	0.196	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DU8B-3	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/05/2002 Time: 10:24	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R050

Ambient/Test Cell Conditions

Barometer:	29.18	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	68.7	gr/lb	9.8 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	69.9	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		10.89	ppm	
HC Bckgrd	6.0	2	6.07	ppm	
CO	6.9	2	6.52	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		60.14	ppm	(Dry)
NOx Bckgrd	1.3	1	0.33	ppm	
CO2 Sample	76.4	1	0.6809	%	(Wet)
CO2 Bckgrd	3.0	3	0.0493	%	

Corrected Concentrations

HC	5.12	ppm
CO	5.56	ppm
NOx	58.51	ppm
CO2	0.6341	%

Mass Emissions

HC	4.357	grams	
CO	9.587	grams	
NOx	162.980	grams	
Particulate	3.344	grams	
CO2	17.171	kg	
Fuel	11.91 lb	5.40	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,012.4	85.31
Blower 2 Rate:	2,104.9	59.61
90 mm System:		
Gas Meter 1:	2.25	0.06
Gas Meter 2:	4.29	0.12
Sample Rate:	2.04	0.06
20X20 Sample Rate:	57.92	1.64
47 mm Sample Rate:	51.31	1.45
Total Flow Rate:	5,228.60	148.08

Particulate Data

Filter Number:	4334.0 (pair)	
Weight Gain:	1.308	mg
Sample Multiplier:	2.557	

Correction Factors

NOx Humidity CF:	0.984
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	19.94

Test Cycle Data

Sample Time:	599.80	sec		
Work:	34.87	hp-hr	26.00	kW-hr
Reference Work:	34.87	hp-hr	26.00	kW-hr
Total Volume (Vmix):	52,268.6	scf	1,480.28	scm

Brake-Specific Emission Results

BSHC (Cell)	0.125	g/hp-hr	0.168	g/kW-hr
CO	0.275	g/hp-hr	0.369	g/kW-hr
NOx (Cell)	4.674	g/hp-hr	6.268	g/kW-hr
Particulate	0.096	g/hp-hr	0.129	g/kW-hr
CO2	492.4	g/hp-hr	660.35	g/kW-hr
BSFC	0.342	lb/hp-hr	0.208	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
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Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E12DU8B-4	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/05/2002 Time:	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Steady-State		100R010	

Ambient/Test Cell Conditions

Barometer:	29.18	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	68.7	gr/lb	9.8 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	69.9	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		14.32	ppm	
HC Bckgrd	5.8	2	5.87	ppm	
CO	18.1	2	17.34	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		18.19	ppm	(Dry)
NOx Bckgrd	0.5	1	0.13	ppm	
CO2 Sample	36.0	1	0.2528	%	(Wet)
CO2 Bckgrd	7.3	1	0.0464	%	

Corrected Concentrations

HC	8.56	ppm
CO	16.76	ppm
NOx	17.73	ppm
CO2	0.2073	%

Mass Emissions

HC	7.384	grams
CO	29.299	grams
NOx	50.112	grams
Particulate	4.061	grams
CO2	5.694	kg
Fuel	3.99 lb	1.81 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,061.2	86.70
Blower 2 Rate:	2,131.0	60.35
90 mm System:		
Gas Meter 1:	2.25	0.06
Gas Meter 2:	4.31	0.12
Sample Rate:	2.06	0.06
20X20 Sample Rate:	58.42	1.65
47 mm Sample Rate:	51.42	1.46
Total Flow Rate:	5,304.12	150.22

Particulate Data

Filter Number:	4335.0 (pair)	
Weight Gain:	1.577	mg
Sample Multiplier:	2.575	

Correction Factors

NOx Humidity CF:	0.984
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	53.18

Test Cycle Data

Sample Time:	599.80	sec		
Work:	6.79	hp-hr	5.06	kW-hr
Reference Work:	6.79	hp-hr	5.06	kW-hr
Total Volume (Vmix):	53,023.5	scf	1,501.66	scm

Brake-Specific Emission Results

BSHC (Cell)	1.087	g/hp-hr	1.458	g/kW-hr
CO	4.315	g/hp-hr	5.787	g/kW-hr
NOx (Cell)	7.380	g/hp-hr	9.897	g/kW-hr
Particulate	0.598	g/hp-hr	0.802	g/kW-hr
CO2	838.6	g/hp-hr	1,124.58	g/kW-hr
BSFC	0.588	lb/hp-hr	0.358	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DU8B-5	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/05/2002 Time: 11:04	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	29.17	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	56.4	°F	13.6 °C
Abs. Humidity:	69.8	gr/lb	10.0 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	69.9	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.92	ppm	
HC Bckgrd	6.2	2	6.27	ppm	
CO	50.9	3	118.49	ppm	(Dry)
CO Bckgrd	0.2	3	0.44	ppm	
NOx Sample	n/a		125.06	ppm	(Dry)
NOx Bckgrd	0.9	1	0.23	ppm	
CO2 Sample	58.0	3	1.0799	%	(Wet)
CO2 Bckgrd	3.1	3	0.0510	%	

Corrected Concentrations

HC	1.15	ppm
CO	114.12	ppm
NOx	121.66	ppm
CO2	1.0330	%

Mass Emissions

HC		0.962	grams	
CO		193.040	grams	
NOx		333.543	grams	
Particulate		7.048	grams	
CO2		27.459	kg	
Fuel	19.23	lb	8.72	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,956.9	83.74
Blower 2 Rate:	2,064.9	58.48
90 mm System:		
Gas Meter 1:	2.25	0.06
Gas Meter 2:	4.19	0.12
Sample Rate:	1.94	0.05
20X20 Sample Rate:	56.31	1.59
47 mm Sample Rate:	51.45	1.46
Total Flow Rate:	5,131.53	145.33

Particulate Data

Filter Number:	4336.0 (pair)	
Weight Gain:	2.667	mg
Sample Multiplier:	2.643	

Correction Factors

NOx Humidity CF:	0.987
Dry-to-Wet CF, Sample:	0.974
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	12.46

Test Cycle Data

Sample Time:	599.90	sec		
Work:	60.79	hp-hr	45.33	kW-hr
Reference Work:	60.79	hp-hr	45.33	kW-hr
Total Volume (Vmix):	51,306.7	scf	1,453.04	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.016 g/hp-hr	0.021	g/kW-hr
CO		3.176 g/hp-hr	4.258	g/kW-hr
NOx	(Cell)	5.487 g/hp-hr	7.358	g/kW-hr
Particulate		0.116 g/hp-hr	0.155	g/kW-hr
CO2		451.7 g/hp-hr	605.74	g/kW-hr
BSFC		0.316 lb/hp-hr	0.192	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DU8B-6	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/05/2002 Time: 11:23	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R075

Ambient/Test Cell Conditions

Barometer:	29.17	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	70.8	gr/lb	10.1 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	84.0	°F	28.9 °C
Abs. Humidity	73.4	gr/lb	10.5 g/kg
Rel. Humidity:	41	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.73	ppm	
HC Bckgrd	6.4	2	6.47	ppm	
CO	18.6	2	17.82	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		89.05	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	87.2	1	0.8357	%	(Wet)
CO2 Bckgrd	7.4	1	0.0471	%	

Corrected Concentrations

HC	1.66	ppm
CO	17.04	ppm
NOx	86.72	ppm
CO2	0.7915	%

Mass Emissions

HC		1.399	grams	
CO		29.131	grams	
NOx		240.884	grams	
Particulate		1.938	grams	
CO2		21.261	kg	
Fuel	14.76	lb	6.69	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,989.6	84.67
Blower 2 Rate:	2,085.1	59.05
90 mm System:		
Gas Meter 1:	2.24	0.06
Gas Meter 2:	4.27	0.12
Sample Rate:	2.03	0.06
20X20 Sample Rate:	57.41	1.63
47 mm Sample Rate:	51.30	1.45
Total Flow Rate:	5,185.46	146.86

Particulate Data

Filter Number:	4337.0 (pair)		
Weight Gain:	0.758	mg	
Sample Multiplier:	2.557		

Correction Factors

NOx Humidity CF:	0.989
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	16.24

Test Cycle Data

Sample Time:	599.90	sec		
Work:	45.71	hp-hr	34.09	kW-hr
Reference Work:	45.71	hp-hr	34.09	kW-hr
Total Volume (Vmix):	51,845.9	scf	1,468.31	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.031 g/hp-hr	0.041	g/kW-hr
CO		0.637 g/hp-hr	0.855	g/kW-hr
NOx	(Cell)	5.270 g/hp-hr	7.067	g/kW-hr
Particulate		0.042 g/hp-hr	0.057	g/kW-hr
CO2		465.1 g/hp-hr	623.74	g/kW-hr
BSFC		0.323 lb/hp-hr	0.196	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E12DU8B-7	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/05/2002 Time: 11:47	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Steady-State		060R050	

Ambient/Test Cell Conditions

Barometer:	29.17	in Hg	98.8 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	68.8	gr/lb	9.8 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	84.0	°F	28.9 °C
Abs. Humidity	73.4	gr/lb	10.5 g/kg
Rel. Humidity:	41	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.70	ppm	
HC Bckgrd	6.8	2	6.87	ppm	
CO	10.1	2	9.59	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		62.33	ppm	(Dry)
NOx Bckgrd	1.0	1	0.25	ppm	
CO2 Sample	68.4	1	0.5781	%	(Wet)
CO2 Bckgrd	7.5	1	0.0477	%	

Corrected Concentrations

HC	1.12	ppm
CO	8.56	ppm
NOx	60.73	ppm
CO2	0.5324	%

Mass Emissions

HC	0.957	grams
CO	14.800	grams
NOx	169.664	grams
Particulate	1.798	grams
CO2	14.459	kg
Fuel	10.03 lb	4.55 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,027.2	85.73
Blower 2 Rate:	2,103.8	59.58
90 mm System:		
Gas Meter 1:	2.24	0.06
Gas Meter 2:	4.30	0.12
Sample Rate:	2.05	0.06
20X20 Sample Rate:	57.91	1.64
47 mm Sample Rate:	51.49	1.46
Total Flow Rate:	5,242.39	148.47

Particulate Data

Filter Number:	4372.0 (pair)	
Weight Gain:	0.704	mg
Sample Multiplier:	2.554	

Correction Factors

NOx Humidity CF:	0.984
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	23.48

Test Cycle Data

Sample Time:	599.90	sec		
Work:	30.73	hp-hr	22.92	kW-hr
Reference Work:	30.73	hp-hr	22.92	kW-hr
Total Volume (Vmix):	52,415.2	scf	1,484.43	scm

Brake-Specific Emission Results

BSHC (Cell)	0.031	g/hp-hr	0.042	g/kW-hr
CO	0.482	g/hp-hr	0.646	g/kW-hr
NOx (Cell)	5.521	g/hp-hr	7.404	g/kW-hr
Particulate	0.059	g/hp-hr	0.078	g/kW-hr
CO2	470.5	g/hp-hr	630.97	g/kW-hr
BSFC	0.326	lb/hp-hr	0.199	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E12DU8B-8	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/05/2002 Time: 12:03	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100I000

Ambient/Test Cell Conditions

Barometer:	29.16	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	54.3	°F	12.4 °C
Abs. Humidity:	64.6	gr/lb	9.2 g/kg
Rel. Humidity:	50	%	
Dilution Air:			
Temperature:	84.0	°F	28.9 °C
Abs. Humidity	73.4	gr/lb	10.5 g/kg
Rel. Humidity:	41	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.47	ppm	
HC Bckgrd	6.6	2	6.67	ppm	
CO	3.3	2	3.10	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		7.22	ppm	(Dry)
NOx Bckgrd	0.7	1	0.18	ppm	
CO2 Sample	11.6	1	0.0745	%	(Wet)
CO2 Bckgrd	7.6	1	0.0484	%	

Corrected Concentrations

HC	0.84	ppm
CO	2.87	ppm
NOx	6.92	ppm
CO2	0.0264	%

Mass Emissions

HC	1.445	grams
CO	10.034	grams
NOx	38.699	grams
Particulate	2.024	grams
CO2	1.450	kg
Fuel	1.02 lb	0.46 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,055.3	86.53
Blower 2 Rate:	2,139.1	60.58
90 mm System:		
Gas Meter 1:	2.25	0.06
Gas Meter 2:	4.31	0.12
Sample Rate:	2.07	0.06
20X20 Sample Rate:	58.87	1.67
47 mm Sample Rate:	51.63	1.46
Total Flow Rate:	5,307.02	150.30

Particulate Data

Filter Number:	4373.0 (pair)	
Weight Gain:	0.788	mg
Sample Multiplier:	2.568	

Correction Factors

NOx Humidity CF:	0.974
Dry-to-Wet CF, Sample:	0.983
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	180.16

Test Cycle Data

Sample Time:	1,199.60	sec		
Work:	0.43	hp-hr	0.32	kW-hr
Reference Work:	0.43	hp-hr	0.32	kW-hr
Total Volume (Vmix):	106,105.1	scf	3,004.96	scm

Brake-Specific Emission Results

BSHC	(Cell)	3.360 g/hp-hr	4.506	g/kW-hr
CO		23.334 g/hp-hr	31.291	g/kW-hr
NOx	(Cell)	89.998 g/hp-hr	120.690	g/kW-hr
Particulate		4.706 g/hp-hr	6.311	g/kW-hr
CO2		3,371.1 g/hp-hr	4,520.69	g/kW-hr
BSFC		2.368 lb/hp-hr	1.440	kg/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRU8E-1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/07/2002 Time: 08:39	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R100

Ambient/Test Cell Conditions

Barometer:	29.13	in Hg	98.6 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	55.3	°F	12.9 °C
Abs. Humidity:	67.1	gr/lb	9.6 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.4	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		8.75	ppm	
HC Bckgrd	8.2	2	8.28	ppm	
CO	9.0	2	8.53	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		192.57	ppm	(Dry)
NOx Bckgrd	1.4	1	0.35	ppm	
CO2 Sample	63.2	3	1.1921	%	(Wet)
CO2 Bckgrd	3.3	3	0.0543	%	
CH4 Sample	n/a	n/a	2.54	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.97	ppm	

Corrected Concentrations

HC	1.20	ppm	
CO	7.88	ppm	
NOx	187.00	ppm	
CO2	1.1426	%	
CH4	-0.17	ppm	(1.00)

Mass Emissions

HC	0.996	grams		
CO	13.291	grams		
NOx	507.703	grams		
Particulate	5.842	grams		
CO2	30.284	kg		
CH4	0.000	grams		
Fuel	20.99	lb	9.52	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,946.9	83.46
Blower 2 Rate:	2,060.0	58.34
90 mm System:		
Gas Meter 1:	2.20	0.06
Gas Meter 2:	4.31	0.12
Sample Rate:	2.11	0.06
20X20 Sample Rate:	58.34	1.65
47 mm Sample Rate:	51.92	1.47
Total Flow Rate:	5,119.28	144.98

Particulate Data

Filter Number:	4419 (pair)	
Weight Gain:	2.403	mg
Sample Multiplier:	2.431	

Correction Factors

NOx Humidity CF:	0.980
Dry-to-Wet CF, Sample:	0.973
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	11.40

Test Cycle Data

Sample Time:	599.60	sec		
Work:	69.63	hp-hr	51.92	kW-hr
Reference Work:	69.63	hp-hr	51.92	kW-hr
Total Volume (Vmix):	51,158.6	scf	1,448.84	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.014 g/hp-hr	0.019	g/kW-hr
CO		0.191 g/hp-hr	0.256	g/kW-hr
NOx	(Cell)	7.291 g/hp-hr	9.778	g/kW-hr
Particulate		0.084 g/hp-hr	0.113	g/kW-hr
CO2		434.9 g/hp-hr	583.25	g/kW-hr
BSFC		0.301 lb/hp-hr	0.183	kg/kW-hr
NMHC		0.012 g/hp-hr	0.017	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRU8E-2	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/07/2002 Time: 09:00	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R075

Ambient/Test Cell Conditions

Barometer:	29.13	in Hg	98.6 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	55.4	°F	13.0 °C
Abs. Humidity:	67.4	gr/lb	9.6 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	71.7	gr/lb	10.2 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		10.83	ppm	
HC Bckgrd	7.9	2	7.98	ppm	
CO	5.5	2	5.19	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		110.19	ppm	(Dry)
NOx Bckgrd	1.5	1	0.38	ppm	
CO2 Sample	93.8	1	0.9390	%	(Wet)
CO2 Bckgrd	8.1	1	0.0516	%	
CH4 Sample	n/a	n/a	2.71	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.88	ppm	

Corrected Concentrations

HC	3.40	ppm	
CO	4.85	ppm	
NOx	107.12	ppm	
CO2	0.8910	%	
CH4	0.03	ppm	(1.00)

Mass Emissions

HC	2.855	grams	
CO	8.254	grams	
NOx	293.547	grams	
Particulate	5.243	grams	
CO2	23.820	kg	
CH4	0.029	grams	
Fuel	16.51 lb	7.49 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,975.6	84.27
Blower 2 Rate:	2,078.0	58.85
90 mm System:		
Gas Meter 1:	2.20	0.06
Gas Meter 2:	4.32	0.12
Sample Rate:	2.12	0.06
20X20 Sample Rate:	57.96	1.64
47 mm Sample Rate:	51.76	1.47
Total Flow Rate:	5,165.41	146.29

Particulate Data

Filter Number:	4420 (pair)	
Weight Gain:	2.150	mg
Sample Multiplier:	2.439	

Correction Factors

NOx Humidity CF:	0.981
Dry-to-Wet CF, Sample:	0.975
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	14.47

Test Cycle Data

Sample Time:	599.40	sec		
Work:	51.91	hp-hr	38.71	kW-hr
Reference Work:	51.91	hp-hr	38.71	kW-hr
Total Volume (Vmix):	51,602.4	scf	1,461.41	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.055 g/hp-hr	0.074	g/kW-hr
CO		0.159 g/hp-hr	0.213	g/kW-hr
NOx	(Cell)	5.655 g/hp-hr	7.583	g/kW-hr
Particulate		0.101 g/hp-hr	0.135	g/kW-hr
CO2		458.9 g/hp-hr	615.36	g/kW-hr
BSFC		0.318 lb/hp-hr	0.193	kg/kW-hr
NMHC		0.048 g/hp-hr	0.064	g/kW-hr
CH4		0.001 g/hp-hr	0.001	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E2NRU8E-3	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/07/2002 Time: 09:20	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Steady-State		100R050	

Ambient/Test Cell Conditions

Barometer:	29.13	in Hg	98.6 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	56.0	°F	13.3 °C
Abs. Humidity:	68.9	gr/lb	9.8 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	70.0	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		12.26	ppm	
HC Bckgrd	7.9	2	7.98	ppm	
CO	6.4	2	6.05	ppm	(Dry)
CO Bckgrd	0.3	2	0.28	ppm	
NOx Sample	n/a		58.95	ppm	(Dry)
NOx Bckgrd	0.7	1	0.18	ppm	
CO2 Sample	75.8	1	0.6728	%	(Wet)
CO2 Bckgrd	7.9	1	0.0503	%	
CH4 Sample	n/a	n/a	2.58	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.92	ppm	

Corrected Concentrations

HC	4.68	ppm	
CO	5.63	ppm	
NOx	57.49	ppm	
CO2	0.6250	%	
CH4	-0.19	ppm	(1.00)

Mass Emissions

HC	3.972	grams	
CO	9.696	grams	
NOx	160.051	grams	
Particulate	5.495	grams	
CO2	16.910	kg	
CH4	0.000	grams	
Fuel	11.73 lb	5.32	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,012.0	85.30
Blower 2 Rate:	2,103.2	59.56
90 mm System:		
Gas Meter 1:	2.20	0.06
Gas Meter 2:	4.31	0.12
Sample Rate:	2.11	0.06
20X20 Sample Rate:	57.75	1.64
47 mm Sample Rate:	51.60	1.46
Total Flow Rate:	5,226.70	148.02

Particulate Data

Filter Number:	4421 (pair)	
Weight Gain:	2.217	mg
Sample Multiplier:	2.479	

Correction Factors

NOx Humidity CF:	0.984
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	20.18

Test Cycle Data

Sample Time:	599.50	sec		
Work:	35.22	hp-hr	26.26	kW-hr
Reference Work:	35.22	hp-hr	26.26	kW-hr
Total Volume (Vmix):	52,223.4	scf	1,479.00	scm

Brake-Specific Emission Results

BSHC (Cell)	0.113	g/hp-hr	0.151	g/kW-hr
CO	0.275	g/hp-hr	0.369	g/kW-hr
NOx (Cell)	4.544	g/hp-hr	6.094	g/kW-hr
Particulate	0.156	g/hp-hr	0.209	g/kW-hr
CO2	480.1	g/hp-hr	643.87	g/kW-hr
BSFC	0.333	lb/hp-hr	0.203	kg/kW-hr
NMHC	0.098	g/hp-hr	0.131	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.:	E2NRU8E-4	DIESEL 2D, 2D=EM4684F	
Engine Desc.:	10.0 L (610 CID) 6	Date:	08/07/2002 Time: 09:39	HCR:	1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	6AR02540	Cell:	16 Bag Cart: 1	Oil Code: EM-3049-EO	
		Steady-State		100R010	

Ambient/Test Cell Conditions

Barometer:	29.13	in Hg	98.6 kPa
Engine Inlet Air			
Temperature:	71.0	°F	21.7 °C
Dew Point:	56.4	°F	13.6 °C
Abs. Humidity:	69.9	gr/lb	10.0 g/kg
Rel. Humidity:	60	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	70.0	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		15.09	ppm	
HC Bckgrd	7.6	2	7.68	ppm	
CO	18.4	2	17.63	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		18.29	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	37.7	1	0.2669	%	(Wet)
CO2 Bckgrd	8.1	1	0.0516	%	
CH4 Sample	n/a	n/a	2.64	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.49	ppm	

Corrected Concentrations

HC	7.56	ppm	
CO	17.13	ppm	
NOx	17.81	ppm	
CO2	0.2163	%	
CH4	0.20	ppm	(1.00)

Mass Emissions

HC	6.465	grams	
CO	29.675	grams	
NOx	50.024	grams	
Particulate	8.341	grams	
CO2	5.890	kg	
CH4	0.200	grams	
Fuel	4.13 lb	1.87	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,031.3	85.85
Blower 2 Rate:	2,112.9	59.84
90 mm System:		
Gas Meter 1:	2.19	0.06
Gas Meter 2:	4.31	0.12
Sample Rate:	2.11	0.06
20X20 Sample Rate:	58.11	1.65
47 mm Sample Rate:	51.67	1.46
Total Flow Rate:	5,256.06	148.85

Particulate Data

Filter Number:	4417 (pair)	
Weight Gain:	3.352	mg
Sample Multiplier:	2.488	

Correction Factors

NOx Humidity CF:	0.987
Dry-to-Wet CF, Sample:	0.982
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	50.39

Test Cycle Data

Sample Time:	599.90	sec		
Work:	7.30	hp-hr	5.44	kW-hr
Reference Work:	7.30	hp-hr	5.44	kW-hr
Total Volume (Vmix):	52,551.8	scf	1,488.30	scm

Brake-Specific Emission Results

BSHC (Cell)	0.886	g/hp-hr	1.188	g/kW-hr
CO	4.065	g/hp-hr	5.451	g/kW-hr
NOx (Cell)	6.853	g/hp-hr	9.190	g/kW-hr
Particulate	1.143	g/hp-hr	1.532	g/kW-hr
CO2	806.8	g/hp-hr	1,081.98	g/kW-hr
BSFC	0.565	lb/hp-hr	0.344	kg/kW-hr
NMHC	0.770	g/hp-hr	1.032	g/kW-hr
CH4	0.027	g/hp-hr	0.037	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRU8E-5	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/07/2002 Time: 09:59	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	29.14	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	57.9	°F	14.4 °C
Abs. Humidity:	73.8	gr/lb	10.5 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	70.0	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.88	ppm	
HC Bckgrd	6.9	2	6.98	ppm	
CO	52.2	3	121.71	ppm	(Dry)
CO Bckgrd	3.0	3	6.61	ppm	
NOx Sample	n/a		124.21	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	57.8	3	1.0757	%	(Wet)
CO2 Bckgrd	3.1	3	0.0510	%	
CH4 Sample	n/a	n/a	1.92	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.14	ppm	

Corrected Concentrations

HC	0.46	ppm	
CO	111.64	ppm	
NOx	120.95	ppm	
CO2	1.0288	%	
CH4	-0.05	ppm	(1.00)

Mass Emissions

HC	0.381	grams	
CO	188.236	grams	
NOx	333.991	grams	
Particulate	4.902	grams	
CO2	27.259	kg	
CH4	0.000	grams	
Fuel	19.08 lb	8.66 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,947.1	83.46
Blower 2 Rate:	2,059.2	58.32
90 mm System:		
Gas Meter 1:	2.20	0.06
Gas Meter 2:	3.97	0.11
Sample Rate:	1.77	0.05
20X20 Sample Rate:	56.01	1.59
47 mm Sample Rate:	50.98	1.44
Total Flow Rate:	5,115.08	144.86

Particulate Data

Filter Number:	4418 (pair)	
Weight Gain:	1.701	mg
Sample Multiplier:	2.882	

Correction Factors

NOx Humidity CF:	0.997
Dry-to-Wet CF, Sample:	0.975
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	12.51

Test Cycle Data

Sample Time:	599.90	sec		
Work:	60.70	hp-hr	45.26	kW-hr
Reference Work:	60.70	hp-hr	45.26	kW-hr
Total Volume (Vmix):	51,142.3	scf	1,448.38	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.006 g/hp-hr	0.008	g/kW-hr
CO		3.101 g/hp-hr	4.159	g/kW-hr
NOx	(Cell)	5.502 g/hp-hr	7.379	g/kW-hr
Particulate		0.081 g/hp-hr	0.108	g/kW-hr
CO2		449.1 g/hp-hr	602.23	g/kW-hr
BSFC		0.314 lb/hp-hr	0.191	kg/kW-hr
NMHC		0.005 g/hp-hr	0.007	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRU8E-6	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/07/2002 Time: 10:18	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R075

Ambient/Test Cell Conditions

Barometer:	29.14	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	58.2	°F	14.6 °C
Abs. Humidity:	74.6	gr/lb	10.7 g/kg
Rel. Humidity:	62	%	
Dilution Air:			
Temperature:	84.0	°F	28.9 °C
Abs. Humidity	73.5	gr/lb	10.5 g/kg
Rel. Humidity:	41	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.60	ppm	
HC Bckgrd	7.1	2	7.18	ppm	
CO	19.2	2	18.41	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		86.83	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	87.1	1	0.8342	%	(Wet)
CO2 Bckgrd	7.7	1	0.0490	%	
CH4 Sample	n/a	n/a	2.06	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.02	ppm	

Corrected Concentrations

HC	0.86	ppm	
CO	17.70	ppm	
NOx	84.64	ppm	
CO2	0.7882	%	
CH4	0.16	ppm	(1.00)

Mass Emissions

HC	0.725	grams	
CO	30.174	grams	
NOx	236.821	grams	
Particulate	3.879	grams	
CO2	21.117	kg	
CH4	0.156	grams	
Fuel	14.66 lb	6.65 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,980.7	84.41
Blower 2 Rate:	2,082.9	58.99
90 mm System:		
Gas Meter 1:	2.19	0.06
Gas Meter 2:	4.27	0.12
Sample Rate:	2.08	0.06
20X20 Sample Rate:	57.74	1.64
47 mm Sample Rate:	50.95	1.44
Total Flow Rate:	5,174.39	146.54

Particulate Data

Filter Number:	4416 (pair)	
Weight Gain:	1.560	mg
Sample Multiplier:	2.486	

Correction Factors

NOx Humidity CF:	0.999
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	16.27

Test Cycle Data

Sample Time:	599.60	sec		
Work:	45.29	hp-hr	33.77	kW-hr
Reference Work:	45.29	hp-hr	33.77	kW-hr
Total Volume (Vmix):	51,709.4	scf	1,464.44	scm

Brake-Specific Emission Results

BSHC (Cell)	0.016	g/hp-hr	0.021	g/kW-hr
CO	0.666	g/hp-hr	0.893	g/kW-hr
NOx (Cell)	5.229	g/hp-hr	7.012	g/kW-hr
Particulate	0.086	g/hp-hr	0.115	g/kW-hr
CO2	466.3	g/hp-hr	625.26	g/kW-hr
BSFC	0.324	lb/hp-hr	0.197	kg/kW-hr
NMHC	0.014	g/hp-hr	0.019	g/kW-hr
CH4	0.003	g/hp-hr	0.005	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRU8E-7	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/07/2002 Time: 10:37	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R050

Ambient/Test Cell Conditions

Barometer:	29.14	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	58.8	°F	14.9 °C
Abs. Humidity:	76.3	gr/lb	10.9 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	84.0	°F	28.9 °C
Abs. Humidity	73.5	gr/lb	10.5 g/kg
Rel. Humidity:	41	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.44	ppm	
HC Bckgrd	6.6	2	6.67	ppm	
CO	9.6	2	9.11	ppm	(Dry)
CO Bckgrd	1.0	2	0.94	ppm	
NOx Sample	n/a		60.70	ppm	(Dry)
NOx Bckgrd	0.4	1	0.10	ppm	
CO2 Sample	68.8	1	0.5830	%	(Wet)
CO2 Bckgrd	7.7	1	0.0490	%	
CH4 Sample	n/a	n/a	1.90	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.03	ppm	

Corrected Concentrations

HC	1.06	ppm	
CO	8.00	ppm	
NOx	59.28	ppm	
CO2	0.5361	%	
CH4	-0.04	ppm	(1.00)

Mass Emissions

HC	0.901	grams
CO	13.823	grams
NOx	168.795	grams
Particulate	3.196	grams
CO2	14.555	kg
CH4	0.000	grams
Fuel	10.10 lb	4.58 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,021.4	85.57
Blower 2 Rate:	2,109.8	59.75
90 mm System:		
Gas Meter 1:	2.19	0.06
Gas Meter 2:	4.28	0.12
Sample Rate:	2.09	0.06
20X20 Sample Rate:	57.62	1.63
47 mm Sample Rate:	50.99	1.44
Total Flow Rate:	5,241.82	148.45

Particulate Data

Filter Number:	4415 (pair)	
Weight Gain:	1.275	mg
Sample Multiplier:	2.507	

Correction Factors

NOx Humidity CF:	1.003
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	23.28

Test Cycle Data

Sample Time:	599.80	sec		
Work:	30.62	hp-hr	22.83	kW-hr
Reference Work:	30.62	hp-hr	22.83	kW-hr
Total Volume (Vmix):	52,400.8	scf	1,484.02	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.029 g/hp-hr	0.039	g/kW-hr
CO		0.451 g/hp-hr	0.605	g/kW-hr
NOx	(Cell)	5.513 g/hp-hr	7.392	g/kW-hr
Particulate		0.104 g/hp-hr	0.140	g/kW-hr
CO2		475.3 g/hp-hr	637.43	g/kW-hr
BSFC		0.330 lb/hp-hr	0.201	kg/kW-hr
NMHC		0.026 g/hp-hr	0.034	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.803

Engine Model:	2001 Cat 3196 Nonroad	Test No.: E2NRU8E-8	DIESEL 2D, 2D=EM4684F
Engine Desc.:	10.0 L (610 CID) 6	Date: 08/07/2002 Time: 10:56	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	6AR02540	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100I000

Ambient/Test Cell Conditions

Barometer:	29.14	in Hg	98.7 kPa
Engine Inlet Air			
Temperature:	75.0	°F	23.9 °C
Dew Point:	57.8	°F	14.3 °C
Abs. Humidity:	73.5	gr/lb	10.5 g/kg
Rel. Humidity:	55	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	70.0	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.08	ppm	
HC Bckgrd	6.4	2	6.47	ppm	
CO	4.0	2	3.77	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		8.07	ppm	(Dry)
NOx Bckgrd	0.2	1	0.05	ppm	
CO2 Sample	12.8	1	0.0825	%	(Wet)
CO2 Bckgrd	7.6	1	0.0484	%	
CH4 Sample	n/a	n/a	2.75	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.05	ppm	

Corrected Concentrations

HC	0.65	ppm	
CO	3.53	ppm	
NOx	7.89	ppm	
CO2	0.0344	%	
CH4	0.71	ppm	(1.00)

Mass Emissions

HC	1.116	grams	
CO	12.286	grams	
NOx	44.938	grams	
Particulate	1.512	grams	
CO2	1.882	kg	
CH4	1.425	grams	
Fuel	1.32 lb	0.60 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	3,045.0	86.24
Blower 2 Rate:	2,124.8	60.18
90 mm System:		
Gas Meter 1:	2.19	0.06
Gas Meter 2:	4.31	0.12
Sample Rate:	2.11	0.06
20X20 Sample Rate:	58.72	1.66
47 mm Sample Rate:	51.28	1.45
Total Flow Rate:	5,281.98	149.59

Particulate Data

Filter Number:	4414 (pair)	
Weight Gain:	0.605	mg
Sample Multiplier:	2.499	

Correction Factors

NOx Humidity CF:	0.996
Dry-to-Wet CF, Sample:	0.983
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	162.86

Test Cycle Data

Sample Time:	1,199.60	sec		
Work:	0.92	hp-hr	0.69	kW-hr
Reference Work:	0.92	hp-hr	0.69	kW-hr
Total Volume (Vmix):	105,604.5	scf	2,990.78	scm

Brake-Specific Emission Results

BSHC (Cell)	1.213	g/hp-hr	1.627	g/kW-hr
CO	13.354	g/hp-hr	17.908	g/kW-hr
NOx (Cell)	48.845	g/hp-hr	65.503	g/kW-hr
Particulate	1.643	g/hp-hr	2.204	g/kW-hr
CO2	2,045.6	g/hp-hr	2,743.26	g/kW-hr
BSFC	1.434	lb/hp-hr	0.872	kg/kW-hr
NMHC	1.054	g/hp-hr	1.414	g/kW-hr
CH4	1.549	g/hp-hr	2.078	g/kW-hr

APPENDIX L

DETAILED COMPUTER PRINTOUTS FOR TYPE-C1 STEADY-STATE EMISSION TESTS ON A CATERPILLAR 3196 USING TWO FUELS

Test Name	Cycle or Mode	Fuel	Toxics Information	Description	Page
B02DXS8	C1 Test	2D	Without	Steady-State Emissions Summary	L-1
B12DU8B-1	C1-1	2D	Yes	Steady-State Emissions Summary	L-4
B12DU8B-2	C1-2	2D	Yes	Steady-State Emissions Summary	L-5
B12DU8B-3	C1-3	2D	Yes	Steady-State Emissions Summary	L-6
B12DU8B-4	C1-4	2D	Yes	Steady-State Emissions Summary	L-7
B12DU8B-5	C1-5	2D	Yes	Steady-State Emissions Summary	L-8
B12DU8B-6	C1-6	2D	Yes	Steady-State Emissions Summary	L-9
B12DU8B-7	C1-7	2D	Yes	Steady-State Emissions Summary	L-10
B12DU8B-8	C1-8	2D	Yes	Steady-State Emissions Summary	L-11
B2NRU8E-1	C1-1	NR	Yes	Steady-State Emissions Summary	L-12
B2NRU8E-2	C1-2	NR	Yes	Steady-State Emissions Summary	L-13
B2NRU8E-3	C1-3	NR	Yes	Steady-State Emissions Summary	L-14
B2NRU8E-4	C1-4	NR	Yes	Steady-State Emissions Summary	L-15
B2NRU8E-5	C1-5	NR	Yes	Steady-State Emissions Summary	L-16
B2NRU8E-6	C1-6	NR	Yes	Steady-State Emissions Summary	L-17
B2NRU8E-7	C1-7	NR	Yes	Steady-State Emissions Summary	L-18
B2NRU8E-8	C1-8	NR	Yes	Steady-State Emissions Summary	L-19

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.804

Engine Model: 2001 Cummins ISB190
Engine Desc.: 5.9 L (359 CID) 6
Engine Cycle: Diesel
Engine S/N: 46109691

Test No.: B02DXS8
Date: 09/17/2002 Time:
Program SSDIL: 2.28-R
Cell: 16 Bag Cart: 1
Baseline Test

DIESEL 2D, 2D=EM4684F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: EM-3049-EO

	Target				Measured		C - B	Intake Air			Factors			
Mode	Speed rpm	Load pct	Torque lb-ft	Time sec	Speed rpm	Torque lb-ft	Fuel lb/hr	Temp °F	Humid g/kg	Baro. in-Hg	NOx Hum.	Part. Hum.	Dry Wet	F (TC)
1	2,300	100.0	445.0	600	2,300	445.0	69.6	72.0	10.5	29.11	0.997	1.003	0.969	1.002
2	2,300	75.0	333.8	600	2,299	334.0	54.3	72.0	10.7	29.11	0.999	1.001	0.971	1.002
3	2,300	50.0	222.5	600	2,299	225.0	39.7	72.0	10.9	29.11	1.004	0.997	0.975	1.002
4	2,300	10.0	44.5	600	2,298	44.0	13.8	73.0	10.9	29.11	1.004	0.997	0.980	1.005
5	1,400	100.0	503.0	600	1,400	503.0	45.7	73.0	11.2	29.12	1.009	0.993	0.973	1.005
6	1,400	75.0	377.3	600	1,400	376.0	34.3	75.0	11.3	29.12	1.012	0.992	0.975	1.011
7	1,400	50.0	251.5	600	1,399	250.0	23.0	74.0	11.1	29.12	1.006	0.995	0.977	1.008
8	875	0.0	0.0	1,200	875	0.0	2.1	97.0	10.6	29.12	0.997	1.002	0.982	1.073

	BHP from	Grams/Hour					Mode	Power	Weighted Results Grams/Hour				
Mode	Work	HC	CO	NOx	Part.	CO2	wf	bhp	HC	CO	NOx	Part.	CO2
1	194.2	1.06	45.9	767.9	12.45	100,355	.150	29.1	0.16	6.89	115.19	1.87	15,053
2	145.6	0.47	48.3	453.0	10.42	78,338	.150	21.8	0.07	7.25	67.94	1.56	11,751
3	98.3	6.84	67.6	286.4	29.96	57,224	.150	14.7	1.03	10.15	42.97	4.49	8,584
4	19.8	13.93	121.3	186.8	6.24	19,725	.100	2.0	1.39	12.13	18.68	0.62	1,972
5	133.6	0.00	35.4	527.6	5.71	65,997	.100	13.4	0.00	3.54	52.76	0.57	6,600
6	99.8	0.00	23.1	391.5	3.90	49,461	.100	10.0	0.00	2.31	39.15	0.39	4,946
7	66.5	3.67	24.4	282.8	3.69	33,219	.100	6.7	0.37	2.44	28.28	0.37	3,322
8	0.3	2.39	20.0	61.8	1.24	3,046	.150	0.0	0.36	3.01	9.26	0.19	457
							Total	97.7	3.37	47.72	374.24	10.06	52,684

Weighted Modal Contribution g/hp-hr					
Mode	HC	CO	NOx	Part.	CO2
1	0.00	0.07	1.18	0.019	154
2	0.00	0.07	0.70	0.016	120
3	0.01	0.10	0.44	0.046	88
4	0.01	0.12	0.19	0.006	20
5	0.00	0.04	0.54	0.006	68
6	0.00	0.02	0.40	0.004	51
7	0.00	0.03	0.29	0.004	34
8	0.00	0.03	0.09	0.002	5

Composite Results

BSHC	=	0.03	g/hp-hr	=	0.05 g/kW-hr
BSCO	=	0.49	g/hp-hr	=	0.65 g/kW-hr
BSNOx	=	3.83	g/hp-hr	=	5.14 g/kW-hr
Particulate	=	0.103	g/hp-hr	=	0.138 g/kW-hr
BSCO2	=	539	g/hp-hr	=	723 g/kW-hr
BSFC	=	0.374	lb/hp-hr	=	0.228 kg/kW-hr

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.804

Engine Model: 2001 Cummins ISB190
Engine Desc.: 5.9 L (359 CID) 6
Engine Cycle: Diesel
Engine S/N: 46109691

Test No.: B02DXS8
Date: 09/17/2002 Time:
Program SSDIL: 2.28-R
Cell: 16 Bag Cart: 1
Baseline Test

DIESEL 2D, 2D=EM4684F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: EM-3049-EO

Mode Number	1	2	3	4
Barometer, kPa (in Hg)	98.6 (29.11)	98.6 (29.11)	98.6 (29.11)	98.6 (29.11)
Dil. Air: Temp, °C (°F) / AH, g/kg	26.7 (80.0) / 10.7	27.2 (81.0) / 11.2	27.8 (82.0) / 11.0	26.7 (80.0) / 10.7
Engine Air Dew Pt., °C (°F)	14.3 (57.8)	14.6 (58.2)	14.9 (58.8)	14.9 (58.8)
Engine Air Temp, °C (°F)	22.2 (72.0)	22.2 (72.0)	22.2 (72.0)	22.8 (73.0)
Engine Air: RH,% / AH, g/kg	61 / 10.5	62 / 10.7	63 / 10.9	61 / 10.9
NOx Humidity C.F.	.997	.999	1.004	1.004
Dry-to-Wet C.F.	.969	.971	.975	.980
Time, seconds	600.0	599.5	599.7	599.9
Tot. Blower Rate, scmm (scfm)*	57.28 (2,170.5)	57.44 (2,176.7)	57.74 (2,187.8)	57.67 (2,185.4)
90mm Sample Rate, scmm (scfm)*	0.0539 (2.04)	0.0548 (2.07)	0.0569 (2.16)	0.0583 (2.21)
Total Volume, scm (scf)*	573.3 (21,726)	574.5 (21,770)	577.6 (21,889)	577.2 (21,873)
HC Sample Meter/Range/ppm	0.0/0/4.3	0.0/0/4.7	0.0/0/14.4	0.0/0/19.8
HC Bckgrd Meter/Range/ppm	4.2/100/4.3	4.9/100/5.0	11.9/100/12.0	13.5/100/13.6
CO Sample Meter/Range/ppm (Dry)	12.2/100/11.6	12.6/100/12.0	17.5/100/16.8	30.0/100/29.0
CO Bckgrd Meter/Range/ppm	0.5/100/0.5	0.4/100/0.4	0.7/100/0.7	0.4/100/0.4
CO2 Sample Meter/Range/% (Wet)	78.3/2/1.5341	63.7/2/1.2031	90.1/1/0.8803	45.1/1/0.3315
CO2 Bckgrd Meter/Range/%	3.3/2/0.0543	3.1/2/0.0510	6.7/1/0.0425	6.7/1/0.0425
NOx Sample Meter/Range/ppm (Dry)	0.0/0/112.8	0.0/0/66.1	0.0/0/41.3	0.0/0/26.8
NOx Bckgrd Meter/Range/ppm	0.7/25/0.2	1.0/25/0.3	0.6/25/0.2	0.4/25/0.1
Dilution Factor	8.86	11.30	15.41	40.47
HC Concentration, ppm	0.50	0.22	3.20	6.53
CO Concentration, ppm	10.68	11.21	15.61	28.03
CO2 Concentration, %	1.49	1.16	0.84	0.29
NOx Concentration, ppm	109.15	64.02	40.10	26.18
HC Mass, grams	0.18	0.08	1.14	2.32
CO Mass, grams	7.65	8.04	11.27	20.21
CO2 Mass, grams	16,725.78	13,045.43	9,532.52	3,286.94
NOx Mass, grams	127.99	75.43	47.72	31.12
Part. Mass, grams	2.070	1.734	5.004	1.043
Fuel, kg (lb)	5.257 (11.59)	4.102 (9.04)	3.001 (6.62)	1.045 (2.30)
KW-HR (hp-hr)	24.14 (32.37)	18.08 (24.25)	12.21 (16.37)	2.46 (3.30)
Filter Number	6119.0-730	6120.0-732	6121.0-732	6122.0-733
Weight Gain, mg	1.945	1.651	4.926	1.054
Sample Multiplier	1.064	1.050	1.016	0.990
Blower 1, scf	21,705.4	21,749.2	21,867.5	21,850.7
Blower 2, scf	0.0	0.0	0.0	0.0
Gas Meter 1, scf	20.705	20.731	20.768	20.749
Gas Meter 2, scf	41.121	41.462	42.314	42.854

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research

ISO 8178 C1 Emission Test Results

Project No. 5004.04.804

Engine Model: 2001 Cummins ISB190
Engine Desc.: 5.9 L (359 CID) 6
Engine Cycle: Diesel
Engine S/N: 46109691

Test No.: B02DXS8
Date: 09/17/2002 Time:
Program SSDIL: 2.28-R
Cell: 16 Bag Cart: 1
Baseline Test

DIESEL 2D, 2D=EM4684F
HCR: 1.796 FID Resp: 1.00
H= 0.131 C= 0.869 O= 0.000 X= 0.000
Oil Code: EM-3049-EO

Mode Number	5	6	7	8
Barometer, kPa (in Hg)	98.6 (29.12)	98.6 (29.12)	98.6 (29.12)	98.6 (29.12)
Dil. Air: Temp, °C (°F) / AH, g/kg	27.2 (81.0) / 11.2	27.2 (81.0) / 11.2	27.2 (81.0) / 11.2	26.7 (80.0) / 10.7
Engine Air Dew Pt., °C (°F)	15.3 (59.6)	15.5 (59.9)	15.1 (59.2)	14.4 (57.9)
Engine Air Temp, °C (°F)	22.8 (73.0)	23.9 (75.0)	23.3 (74.0)	36.1 (97.0)
Engine Air: RH,% / AH, g/kg	63 / 11.2	59 / 11.3	60 / 11.1	27 / 10.6
NOx Humidity C.F.	1.009	1.012	1.006	.997
Dry-to-Wet C.F.	.973	.975	.977	.982
Time, seconds	599.6	599.6	600.0	1,199.9
Tot. Blower Rate, scmm (scfm)*	57.76 (2,188.8)	57.82 (2,190.9)	57.82 (2,190.9)	57.54 (2,180.3)
90mm Sample Rate, scmm (scfm)*	0.0694 (2.63)	0.0702 (2.66)	0.0709 (2.69)	0.0715 (2.71)
Total Volume, scm (scf)*	577.9 (21,900)	578.5 (21,921)	578.9 (21,936)	1,152.1 (43,657)
HC Sample Meter/Range/ppm	0.0/0/6.5	0.0/0/5.4	0.0/0/6.5	0.0/0/5.7
HC Bckgrd Meter/Range/ppm	7.6/100/7.7	5.8/100/5.9	4.9/100/5.0	4.5/100/4.6
CO Sample Meter/Range/ppm (Dry)	9.3/100/8.8	6.3/100/6.0	6.4/100/6.1	5.4/100/5.1
CO Bckgrd Meter/Range/ppm	0.4/100/0.4	0.5/100/0.5	0.3/100/0.3	0.4/100/0.4
CO2 Sample Meter/Range/% (Wet)	54.9/2/1.0144	82.5/1/0.7661	64.4/1/0.5305	13.6/1/0.0878
CO2 Bckgrd Meter/Range/%	3.0/2/0.0493	6.8/1/0.0432	7.1/1/0.0451	6.8/1/0.0432
NOx Sample Meter/Range/ppm (Dry)	0.0/0/75.6	0.0/0/55.8	0.0/0/40.5	0.0/0/9.0
NOx Bckgrd Meter/Range/ppm	0.5/25/0.1	0.5/25/0.1	0.7/25/0.2	0.5/25/0.1
Dilution Factor	13.40	17.74	25.60	153.17
HC Concentration, ppm	0.00	0.00	1.71	1.12
CO Concentration, ppm	8.18	5.33	5.63	4.64
CO2 Concentration, %	0.97	0.73	0.49	0.04
NOx Concentration, ppm	73.39	54.29	39.42	8.73
HC Mass, grams	0.00	0.00	0.61	0.80
CO Mass, grams	5.90	3.86	4.07	6.68
CO2 Mass, grams	10,992.13	8,237.93	5,536.49	1,015.16
NOx Mass, grams	87.88	65.21	47.14	20.59
Part. Mass, grams	0.958	0.656	0.617	0.413
Fuel, kg (lb)	3.455 (7.62)	2.589 (5.71)	1.742 (3.84)	0.323 (0.71)
KW-HR (hp-hr)	16.60 (22.26)	12.39 (16.62)	8.27 (11.09)	0.07 (0.09)
Filter Number	6123.0-734	6124.0-735	6125.0-736	6126.0-737
Weight Gain, mg	1.149	0.795	0.756	0.512
Sample Multiplier	0.834	0.825	0.817	0.806
Blower 1, scf	21,873.7	21,894.7	21,908.6	43,602.4
Blower 2, scf	0.0	0.0	0.0	0.0
Gas Meter 1, scf	15.732	15.769	15.751	31.560
Gas Meter 2, scf	42.007	42.348	42.613	85.709

* scf at 68°F and scm at 0°C

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-1	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/10/2002 Time: 09:20	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R100

Ambient/Test Cell Conditions

Barometer:	29.05	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	57.8	°F	14.3 °C
Abs. Humidity:	73.8	gr/lb	10.5 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	78.0	°F	25.6 °C
Abs. Humidity	73.7	gr/lb	10.5 g/kg
Rel. Humidity:	50	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.59	ppm	
HC Bckgrd	6.5	2	6.57	ppm	
CO	11.2	2	10.65	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		108.28	ppm	(Dry)
NOx Bckgrd	1.0	1	0.25	ppm	
CO2 Sample	75.2	3	1.4619	%	(Wet)
CO2 Bckgrd	3.3	3	0.0543	%	
CH4 Sample	n/a	n/a	1.77	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.99	ppm	

Corrected Concentrations

HC	0.73	ppm	
CO	9.45	ppm	
NOx	104.83	ppm	
CO2	1.4134	%	
CH4	-0.01	ppm	(1.00)

Mass Emissions

HC	0.269	grams	
CO	7.082	grams	
NOx	128.707	grams	
Particulate	2.133	grams	
CO2	16.653	kg	
CH4	0.000	grams	
Fuel	11.54 lb	5.23 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,172.9	61.54
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.21	0.06
Gas Meter 2:	4.12	0.12
Sample Rate:	1.91	0.05
20X20 Sample Rate:	49.22	1.39
47 mm Sample Rate:	50.82	1.44
Total Flow Rate:	2,274.82	64.42

Particulate Data

Filter Number:	5000.0 (pair)	
Weight Gain:	1.792	mg
Sample Multiplier:	1.190	

Correction Factors

NOx Humidity CF:	0.997
Dry-to-Wet CF, Sample:	0.970
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	9.30

Test Cycle Data

Sample Time:	599.80	sec		
Work:	32.18	hp-hr	24.00	kW-hr
Reference Work:	32.18	hp-hr	24.00	kW-hr
Total Volume (Vmix):	22,740.6	scf	644.03	scm

Brake-Specific Emission Results

BSHC (Cell)	0.008	g/hp-hr	0.011	g/kW-hr
CO	0.220	g/hp-hr	0.295	g/kW-hr
NOx (Cell)	4.000	g/hp-hr	5.364	g/kW-hr
Particulate	0.066	g/hp-hr	0.089	g/kW-hr
CO2	517.5	g/hp-hr	693.97	g/kW-hr
BSFC	0.359	lb/hp-hr	0.218	kg/kW-hr
NMHC	0.007	g/hp-hr	0.010	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-2	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/10/2002 Time: 09:44	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R075

Ambient/Test Cell Conditions

Barometer:	29.06	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	58.6	°F	14.8 °C
Abs. Humidity:	75.9	gr/lb	10.8 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.7	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.82	ppm	
HC Bckgrd	7.6	2	7.68	ppm	
CO	13.9	2	13.25	ppm	(Dry)
CO Bckgrd	1.8	2	1.69	ppm	
NOx Sample	n/a		62.41	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	61.4	3	1.1530	%	(Wet)
CO2 Bckgrd	3.3	3	0.0543	%	
CH4 Sample	n/a	n/a	1.72	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.05	ppm	

Corrected Concentrations

HC	0.79	ppm	
CO	11.24	ppm	
NOx	60.54	ppm	
CO2	1.1033	%	
CH4	-0.15	ppm	(1.00)

Mass Emissions

HC	0.293	grams
CO	8.427	grams
NOx	74.728	grams
Particulate	1.769	grams
CO2	12.996	kg
CH4	0.000	grams
Fuel	9.01 lb	4.09 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,178.5	61.70
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.16	0.12
Sample Rate:	2.09	0.06
20X20 Sample Rate:	42.31	1.20
47 mm Sample Rate:	51.30	1.45
Total Flow Rate:	2,274.20	64.41

Particulate Data

Filter Number:	5001.0 (pair)	
Weight Gain:	1.629	mg
Sample Multiplier:	1.086	

Correction Factors

NOx Humidity CF:	1.002
Dry-to-Wet CF, Sample:	0.973
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	11.78

Test Cycle Data

Sample Time:	599.80	sec		
Work:	24.03	hp-hr	17.92	kW-hr
Reference Work:	24.03	hp-hr	17.92	kW-hr
Total Volume (Vmix):	22,734.4	scf	643.85	scm

Brake-Specific Emission Results

BSHC (Cell)	0.012	g/hp-hr	0.016	g/kW-hr
CO	0.351	g/hp-hr	0.470	g/kW-hr
NOx (Cell)	3.110	g/hp-hr	4.170	g/kW-hr
Particulate	0.074	g/hp-hr	0.099	g/kW-hr
CO2	540.8	g/hp-hr	725.23	g/kW-hr
BSFC	0.375	lb/hp-hr	0.228	kg/kW-hr
NMHC	0.011	g/hp-hr	0.014	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Analyzed: 09/26/2002 15:02

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-3	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/10/2002 Time: 10:04	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R050

Ambient/Test Cell Conditions

Barometer:	29.06	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	59.3	°F	15.2 °C
Abs. Humidity:	77.9	gr/lb	11.1 g/kg
Rel. Humidity:	62	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	72.0	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		12.55	ppm	
HC Bckgrd	8.4	2	8.48	ppm	
CO	16.3	2	15.58	ppm	(Dry)
CO Bckgrd	1.0	2	0.94	ppm	
NOx Sample	n/a		39.66	ppm	(Dry)
NOx Bckgrd	1.0	1	0.25	ppm	
CO2 Sample	88.7	1	0.8586	%	(Wet)
CO2 Bckgrd	7.5	1	0.0477	%	
CH4 Sample	n/a	n/a	2.02	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	1.99	ppm	

Corrected Concentrations

HC	4.61	ppm	
CO	14.24	ppm	
NOx	38.47	ppm	
CO2	0.8139	%	
CH4	0.16	ppm	(1.00)

Mass Emissions

HC	1.719	grams	
CO	10.771	grams	
NOx	48.162	grams	
Particulate	1.367	grams	
CO2	9.673	kg	
CH4	0.068	grams	
Fuel	6.71 lb	3.05 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,190.9	62.05
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.26	0.12
Sample Rate:	2.19	0.06
20X20 Sample Rate:	49.71	1.41
47 mm Sample Rate:	51.38	1.46
Total Flow Rate:	2,294.21	64.97

Particulate Data

Filter Number:	5002.0 (pair)	
Weight Gain:	1.303	mg
Sample Multiplier:	1.049	

Correction Factors

NOx Humidity CF:	1.008
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	15.80

Test Cycle Data

Sample Time:	599.90	sec		
Work:	16.55	hp-hr	12.34	kW-hr
Reference Work:	16.55	hp-hr	12.34	kW-hr
Total Volume (Vmix):	22,938.3	scf	649.63	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.104 g/hp-hr	0.139	g/kW-hr
CO		0.651 g/hp-hr	0.873	g/kW-hr
NOx	(Cell)	2.910 g/hp-hr	3.902	g/kW-hr
Particulate		0.083 g/hp-hr	0.111	g/kW-hr
CO2		584.5 g/hp-hr	783.78	g/kW-hr
BSFC		0.406 lb/hp-hr	0.247	kg/kW-hr
NMHC		0.090 g/hp-hr	0.121	g/kW-hr
CH4		0.004 g/hp-hr	0.005	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-4	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/10/2002 Time: 10:24	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R010

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	58.8	°F	14.9 °C
Abs. Humidity:	76.5	gr/lb	10.9 g/kg
Rel. Humidity:	61	%	
Dilution Air:			
Temperature:	83.0	°F	28.3 °C
Abs. Humidity	70.3	gr/lb	10.0 g/kg
Rel. Humidity:	40	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		16.60	ppm	
HC Bckgrd	8.4	2	8.48	ppm	
CO	28.5	2	27.53	ppm	(Dry)
CO Bckgrd	0.2	2	0.19	ppm	
NOx Sample	n/a		25.40	ppm	(Dry)
NOx Bckgrd	1.0	1	0.25	ppm	
CO2 Sample	43.7	1	0.3189	%	(Wet)
CO2 Bckgrd	7.1	1	0.0451	%	
CH4 Sample	n/a	n/a	2.11	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.07	ppm	

Corrected Concentrations

HC	8.32	ppm	
CO	26.82	ppm	
NOx	24.68	ppm	
CO2	0.2749	%	
CH4	0.09	ppm	(1.00)

Mass Emissions

HC	3.092	grams	
CO	20.197	grams	
NOx	30.645	grams	
Particulate	1.061	grams	
CO2	3.253	kg	
CH4	0.038	grams	
Fuel	2.28 lb	1.03 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,182.6	61.81
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.26	0.12
Sample Rate:	2.19	0.06
20X20 Sample Rate:	49.74	1.41
47 mm Sample Rate:	51.31	1.45
Total Flow Rate:	2,285.86	64.74

Particulate Data

Filter Number:	5003.0 (pair)	
Weight Gain:	1.019	mg
Sample Multiplier:	1.041	

Correction Factors

NOx Humidity CF:	1.004
Dry-to-Wet CF, Sample:	0.981
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	42.11

Test Cycle Data

Sample Time:	599.50	sec		
Work:	3.30	hp-hr	2.46	kW-hr
Reference Work:	3.30	hp-hr	2.46	kW-hr
Total Volume (Vmix):	22,839.6	scf	646.83	scm

Brake-Specific Emission Results

BSHC (Cell)	0.937	g/hp-hr	1.256	g/kW-hr
CO	6.120	g/hp-hr	8.207	g/kW-hr
NOx (Cell)	9.287	g/hp-hr	12.453	g/kW-hr
Particulate	0.322	g/hp-hr	0.431	g/kW-hr
CO2	985.6	g/hp-hr	1,321.76	g/kW-hr
BSFC	0.691	lb/hp-hr	0.420	kg/kW-hr
NMHC	0.814	g/hp-hr	1.092	g/kW-hr
CH4	0.012	g/hp-hr	0.016	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-5	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/11/2002 Time: 09:03	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	55.1	°F	12.8 °C
Abs. Humidity:	66.7	gr/lb	9.5 g/kg
Rel. Humidity:	53	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.3	gr/lb	10.8 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.10	ppm	
HC Bckgrd	8.1	2	8.18	ppm	
CO	9.7	2	9.20	ppm	(Dry)
CO Bckgrd	1.0	2	0.94	ppm	
NOx Sample	n/a		75.33	ppm	(Dry)
NOx Bckgrd	1.0	1	0.25	ppm	
CO2 Sample	53.7	3	0.9893	%	(Wet)
CO2 Bckgrd	3.5	3	0.0576	%	
CH4 Sample	n/a	n/a	1.89	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.19	ppm	

Corrected Concentrations

HC	-0.48	ppm	
CO	8.03	ppm	
NOx	73.15	ppm	
CO2	0.9359	%	
CH4	-0.14	ppm	(1.00)

Mass Emissions

HC	0.000	grams
CO	6.062	grams
NOx	88.839	grams
Particulate	1.031	grams
CO2	11.107	kg
CH4	0.000	grams
Fuel	7.70 lb	3.49 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,187.6	61.95
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.23	0.12
Sample Rate:	2.16	0.06
20X20 Sample Rate:	50.02	1.42
47 mm Sample Rate:	51.64	1.46
Total Flow Rate:	2,291.40	64.89

Particulate Data

Filter Number:	5006.0 (pair)	
Weight Gain:	0.972	mg
Sample Multiplier:	1.060	

Correction Factors

NOx Humidity CF:	0.979
Dry-to-Wet CF, Sample:	0.974
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	13.74

Test Cycle Data

Sample Time:	599.80	sec		
Work:	22.10	hp-hr	16.48	kW-hr
Reference Work:	22.10	hp-hr	16.48	kW-hr
Total Volume (Vmix):	22,906.4	scf	648.72	scm

Brake-Specific Emission Results

BSHC (Cell)	0.000	g/hp-hr	0.000	g/kW-hr
CO	0.274	g/hp-hr	0.368	g/kW-hr
NOx (Cell)	4.020	g/hp-hr	5.391	g/kW-hr
Particulate	0.047	g/hp-hr	0.063	g/kW-hr
CO2	502.6	g/hp-hr	673.97	g/kW-hr
BSFC	0.348	lb/hp-hr	0.212	kg/kW-hr
NMHC	0.000	g/hp-hr	0.000	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-6	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/11/2002 Time: 09:25	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R075

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	55.2	°F	12.9 °C
Abs. Humidity:	67.0	gr/lb	9.6 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.3	gr/lb	10.8 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.29	ppm	
HC Bckgrd	7.9	2	7.98	ppm	
CO	6.1	2	5.76	ppm	(Dry)
CO Bckgrd	0.7	2	0.66	ppm	
NOx Sample	n/a		56.33	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	82.0	1	0.7589	%	(Wet)
CO2 Bckgrd	7.2	1	0.0458	%	
CH4 Sample	n/a	n/a	1.96	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.17	ppm	

Corrected Concentrations

HC	-0.24	ppm	
CO	4.97	ppm	
NOx	54.85	ppm	
CO2	0.7157	%	
CH4	-0.09	ppm	(1.00)

Mass Emissions

HC	0.000	grams	
CO	3.734	grams	
NOx	66.243	grams	
Particulate	0.717	grams	
CO2	8.441	kg	
CH4	0.000	grams	
Fuel	5.85 lb	2.65 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,176.5	61.64
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.25	0.12
Sample Rate:	2.18	0.06
20X20 Sample Rate:	47.72	1.35
47 mm Sample Rate:	51.30	1.45
Total Flow Rate:	2,277.67	64.51

Particulate Data

Filter Number:	5007.0 (pair)	
Weight Gain:	0.686	mg
Sample Multiplier:	1.045	

Correction Factors

NOx Humidity CF:	0.980
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	17.91

Test Cycle Data

Sample Time:	599.70	sec		
Work:	16.92	hp-hr	12.62	kW-hr
Reference Work:	16.92	hp-hr	12.62	kW-hr
Total Volume (Vmix):	22,765.3	scf	644.73	scm

Brake-Specific Emission Results

BSHC (Cell)	0.000	g/hp-hr	0.000	g/kW-hr
CO	0.221	g/hp-hr	0.296	g/kW-hr
NOx (Cell)	3.915	g/hp-hr	5.250	g/kW-hr
Particulate	0.042	g/hp-hr	0.057	g/kW-hr
CO2	498.9	g/hp-hr	669.00	g/kW-hr
BSFC	0.346	lb/hp-hr	0.210	kg/kW-hr
NMHC	0.000	g/hp-hr	0.000	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-7	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/11/2002 Time: 09:47	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R050

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	55.4	°F	13.0 °C
Abs. Humidity:	67.5	gr/lb	9.6 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.3	gr/lb	10.8 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.27	ppm	
HC Bckgrd	7.9	2	7.98	ppm	
CO	5.7	2	5.38	ppm	(Dry)
CO Bckgrd	0.4	2	0.37	ppm	
NOx Sample	n/a		41.34	ppm	(Dry)
NOx Bckgrd	0.7	1	0.18	ppm	
CO2 Sample	64.5	1	0.5316	%	(Wet)
CO2 Bckgrd	7.1	1	0.0451	%	
CH4 Sample	n/a	n/a	1.91	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.04	ppm	

Corrected Concentrations

HC	1.60	ppm	
CO	4.89	ppm	
NOx	40.27	ppm	
CO2	0.4883	%	
CH4	-0.04	ppm	(1.00)

Mass Emissions

HC	0.599	grams	
CO	3.705	grams	
NOx	49.131	grams	
Particulate	0.721	grams	
CO2	5.811	kg	
CH4	0.000	grams	
Fuel	4.03 lb	1.83 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,194.2	62.14
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.08	0.06
Gas Meter 2:	4.27	0.12
Sample Rate:	2.20	0.06
20X20 Sample Rate:	50.13	1.42
47 mm Sample Rate:	51.59	1.46
Total Flow Rate:	2,298.06	65.08

Particulate Data

Filter Number:	5008.0 (pair)	
Weight Gain:	0.689	mg
Sample Multiplier:	1.047	

Correction Factors

NOx Humidity CF:	0.981
Dry-to-Wet CF, Sample:	0.978
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	25.54

Test Cycle Data

Sample Time:	599.70	sec		
Work:	11.43	hp-hr	8.52	kW-hr
Reference Work:	11.43	hp-hr	8.52	kW-hr
Total Volume (Vmix):	22,969.2	scf	650.50	scm

Brake-Specific Emission Results

BSHC (Cell)	0.052	g/hp-hr	0.070	g/kW-hr
CO	0.324	g/hp-hr	0.435	g/kW-hr
NOx (Cell)	4.298	g/hp-hr	5.764	g/kW-hr
Particulate	0.063	g/hp-hr	0.085	g/kW-hr
CO2	508.4	g/hp-hr	681.72	g/kW-hr
BSFC	0.353	lb/hp-hr	0.214	kg/kW-hr
NMHC	0.046	g/hp-hr	0.061	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B12DU8B-8	DIESEL 2D, 2D=EM4684F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/11/2002 Time: 10:08	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100I000

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	55.8	°F	13.2 °C
Abs. Humidity:	68.5	gr/lb	9.8 g/kg
Rel. Humidity:	50	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.6	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.77	ppm	
HC Bckgrd	8.0	2	8.08	ppm	
CO	7.0	2	6.62	ppm	(Dry)
CO Bckgrd	0.9	2	0.84	ppm	
NOx Sample	n/a		9.63	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	14.2	1	0.0918	%	(Wet)
CO2 Bckgrd	6.8	1	0.0432	%	
CH4 Sample	n/a	n/a	2.06	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.12	ppm	

Corrected Concentrations

HC	1.75	ppm	
CO	5.69	ppm	
NOx	9.31	ppm	
CO2	0.0489	%	
CH4	-0.04	ppm	(1.00)

Mass Emissions

HC	1.310	grams
CO	8.656	grams
NOx	22.886	grams
Particulate	0.468	grams
CO2	1.169	kg
CH4	0.000	grams
Fuel	0.82 lb	0.37 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,203.5	62.40
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.07	0.06
Gas Meter 2:	4.29	0.12
Sample Rate:	2.21	0.06
20X20 Sample Rate:	50.17	1.42
47 mm Sample Rate:	52.06	1.47
Total Flow Rate:	2,307.93	65.36

Particulate Data

Filter Number:	5044.0 (pair)	
Weight Gain:	0.449	mg
Sample Multiplier:	1.043	

Correction Factors

NOx Humidity CF:	0.983
Dry-to-Wet CF, Sample:	0.983
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	145.69

Test Cycle Data

Sample Time:	1,199.60	sec		
Work:	0.49	hp-hr	0.37	kW-hr
Reference Work:	0.49	hp-hr	0.37	kW-hr
Total Volume (Vmix):	46,143.2	scf	1,306.80	scm

Brake-Specific Emission Results

BSHC	(Cell)	2.674 g/hp-hr	3.586	g/kW-hr
CO		17.666 g/hp-hr	23.690	g/kW-hr
NOx	(Cell)	46.707 g/hp-hr	62.635	g/kW-hr
Particulate		0.956 g/hp-hr	1.282	g/kW-hr
CO2		2,385.6 g/hp-hr	3,199.18	g/kW-hr
BSFC		1.677 lb/hp-hr	1.020	kg/kW-hr
NMHC		2.324 g/hp-hr	3.116	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRU8E-1	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/12/2002 Time: 09:22	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R100

Ambient/Test Cell Conditions

Barometer:	29.06	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	55.8	°F	13.2 °C
Abs. Humidity:	68.5	gr/lb	9.8 g/kg
Rel. Humidity:	57	%	
Dilution Air:			
Temperature:	78.0	°F	25.6 °C
Abs. Humidity	73.6	gr/lb	10.5 g/kg
Rel. Humidity:	50	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		6.70	ppm	
HC Bckgrd	7.2	2	7.28	ppm	
CO	12.9	2	12.29	ppm	(Dry)
CO Bckgrd	1.0	2	0.94	ppm	
NOx Sample	n/a		109.51	ppm	(Dry)
NOx Bckgrd	1.3	1	0.33	ppm	
CO2 Sample	76.4	3	1.4898	%	(Wet)
CO2 Bckgrd	3.8	3	0.0626	%	
CH4 Sample	n/a	n/a	2.15	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.28	ppm	

Corrected Concentrations

HC	0.22	ppm	
CO	10.92	ppm	
NOx	105.93	ppm	
CO2	1.4341	%	
CH4	0.11	ppm	(1.00)

Mass Emissions

HC	0.081	grams
CO	8.186	grams
NOx	128.263	grams
Particulate	3.237	grams
CO2	16.890	kg
CH4	0.048	grams
Fuel	11.71 lb	5.31 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,172.0	61.51
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.06	0.06
Gas Meter 2:	4.22	0.12
Sample Rate:	2.16	0.06
20X20 Sample Rate:	49.42	1.40
47 mm Sample Rate:	50.51	1.43
Total Flow Rate:	2,274.04	64.40

Particulate Data

Filter Number:	5815 (pair)	
Weight Gain:	3.079	mg
Sample Multiplier:	1.051	

Correction Factors

NOx Humidity CF:	0.983
Dry-to-Wet CF, Sample:	0.970
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	9.13

Test Cycle Data

Sample Time:	599.80	sec		
Work:	32.42	hp-hr	24.18	kW-hr
Reference Work:	32.42	hp-hr	24.18	kW-hr
Total Volume (Vmix):	22,732.8	scf	643.81	scm

Brake-Specific Emission Results

BSHC (Cell)	0.002	g/hp-hr	0.003	g/kW-hr
CO	0.252	g/hp-hr	0.339	g/kW-hr
NOx (Cell)	3.956	g/hp-hr	5.305	g/kW-hr
Particulate	0.100	g/hp-hr	0.134	g/kW-hr
CO2	521.0	g/hp-hr	698.65	g/kW-hr
BSFC	0.361	lb/hp-hr	0.220	kg/kW-hr
NMHC	0.002	g/hp-hr	0.003	g/kW-hr
CH4	0.001	g/hp-hr	0.002	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRU8E-2	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/12/2002 Time: 09:43	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R075

Ambient/Test Cell Conditions

Barometer:	29.07	in Hg	98.4 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	56.4	°F	13.6 °C
Abs. Humidity:	70.0	gr/lb	10.0 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.3	gr/lb	10.8 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.83	ppm	
HC Bckgrd	7.8	2	7.88	ppm	
CO	13.3	2	12.67	ppm	(Dry)
CO Bckgrd	1.9	2	1.78	ppm	
NOx Sample	n/a		62.15	ppm	(Dry)
NOx Bckgrd	1.2	1	0.30	ppm	
CO2 Sample	61.5	3	1.1551	%	(Wet)
CO2 Bckgrd	3.6	3	0.0593	%	
CH4 Sample	n/a	n/a	1.93	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.25	ppm	

Corrected Concentrations

HC	0.62	ppm	
CO	10.59	ppm	
NOx	60.17	ppm	
CO2	1.1008	%	
CH4	-0.13	ppm	(1.00)

Mass Emissions

HC	0.230	grams
CO	7.953	grams
NOx	73.260	grams
Particulate	3.022	grams
CO2	12.986	kg
CH4	0.000	grams
Fuel	9.00 lb	4.08 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,175.5	61.61
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.10	0.06
Gas Meter 2:	4.21	0.12
Sample Rate:	2.11	0.06
20X20 Sample Rate:	49.62	1.41
47 mm Sample Rate:	50.81	1.44
Total Flow Rate:	2,278.09	64.52

Particulate Data

Filter Number:	5091 (pair)	
Weight Gain:	2.800	mg
Sample Multiplier:	1.079	

Correction Factors

NOx Humidity CF:	0.987
Dry-to-Wet CF, Sample:	0.973
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	11.76

Test Cycle Data

Sample Time:	599.70	sec		
Work:	23.74	hp-hr	17.70	kW-hr
Reference Work:	23.74	hp-hr	17.70	kW-hr
Total Volume (Vmix):	22,769.5	scf	644.85	scm

Brake-Specific Emission Results

BSHC (Cell)	0.010	g/hp-hr	0.013	g/kW-hr
CO	0.335	g/hp-hr	0.449	g/kW-hr
NOx (Cell)	3.086	g/hp-hr	4.138	g/kW-hr
Particulate	0.127	g/hp-hr	0.171	g/kW-hr
CO2	547.0	g/hp-hr	733.58	g/kW-hr
BSFC	0.379	lb/hp-hr	0.231	kg/kW-hr
NMHC	0.008	g/hp-hr	0.011	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRU8E-3	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/12/2002 Time: 10:03	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100R050

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	72.0	°F	22.2 °C
Dew Point:	56.8	°F	13.8 °C
Abs. Humidity:	71.0	gr/lb	10.1 g/kg
Rel. Humidity:	59	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	71.9	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		11.53	ppm	
HC Bckgrd	7.8	2	7.88	ppm	
CO	18.5	2	17.73	ppm	(Dry)
CO Bckgrd	2.6	2	2.44	ppm	
NOx Sample	n/a		39.95	ppm	(Dry)
NOx Bckgrd	0.8	1	0.20	ppm	
CO2 Sample	88.5	1	0.8556	%	(Wet)
CO2 Bckgrd	7.6	1	0.0484	%	
CH4 Sample	n/a	n/a	2.02	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.17	ppm	

Corrected Concentrations

HC	4.15	ppm	
CO	14.94	ppm	
NOx	38.81	ppm	
CO2	0.8103	%	
CH4	-0.02	ppm	(1.00)

Mass Emissions

HC	1.544	grams	
CO	11.275	grams	
NOx	47.610	grams	
Particulate	2.355	grams	
CO2	9.607	kg	
CH4	0.000	grams	
Fuel	6.67 lb	3.02 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,186.9	61.93
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.10	0.06
Gas Meter 2:	4.24	0.12
Sample Rate:	2.14	0.06
20X20 Sample Rate:	49.73	1.41
47 mm Sample Rate:	51.28	1.45
Total Flow Rate:	2,290.08	64.86

Particulate Data

Filter Number:	5092 (pair)	
Weight Gain:	2.202	mg
Sample Multiplier:	1.070	

Correction Factors

NOx Humidity CF:	0.990
Dry-to-Wet CF, Sample:	0.976
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	15.86

Test Cycle Data

Sample Time:	599.60	sec		
Work:	16.50	hp-hr	12.30	kW-hr
Reference Work:	16.50	hp-hr	12.30	kW-hr
Total Volume (Vmix):	22,885.5	scf	648.13	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.094 g/hp-hr	0.125	g/kW-hr
CO		0.683 g/hp-hr	0.916	g/kW-hr
NOx	(Cell)	2.885 g/hp-hr	3.869	g/kW-hr
Particulate		0.143 g/hp-hr	0.191	g/kW-hr
CO2		582.3 g/hp-hr	780.81	g/kW-hr
BSFC		0.404 lb/hp-hr	0.246	kg/kW-hr
NMHC		0.081 g/hp-hr	0.109	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B2NRU8E-4	DIESEL 2D, NR=EM2831F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/12/2002 Time: 10:23	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Steady-State		100R010	

Ambient/Test Cell Conditions

Barometer:	29.08	in Hg	98.5 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	57.4	°F	14.1 °C
Abs. Humidity:	72.6	gr/lb	10.4 g/kg
Rel. Humidity:	58	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	77.1	gr/lb	11.0 g/kg
Rel. Humidity:	46	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		15.17	ppm	
HC Bckgrd	8.7	2	8.79	ppm	
CO	27.9	2	26.94	ppm	(Dry)
CO Bckgrd	2.9	2	2.73	ppm	
NOx Sample	n/a		26.09	ppm	(Dry)
NOx Bckgrd	0.6	1	0.15	ppm	
CO2 Sample	45.6	1	0.3361	%	(Wet)
CO2 Bckgrd	7.5	1	0.0477	%	
CH4 Sample	n/a	n/a	2.07	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.22	ppm	

Corrected Concentrations

HC	6.60	ppm	
CO	23.75	ppm	
NOx	25.41	ppm	
CO2	0.2896	%	
CH4	-0.10	ppm	(1.00)

Mass Emissions

HC	2.466	grams	
CO	17.986	grams	
NOx	31.422	grams	
Particulate	1.448	grams	
CO2	3.447	kg	
CH4	0.000	grams	
Fuel	2.41 lb	1.09 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,194.9	62.16
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	2.36	0.07
Gas Meter 2:	4.26	0.12
Sample Rate:	1.90	0.05
20X20 Sample Rate:	49.82	1.41
47 mm Sample Rate:	51.71	1.46
Total Flow Rate:	2,298.37	65.09

Particulate Data

Filter Number:	5093 (pair)	
Weight Gain:	1.198	mg
Sample Multiplier:	1.209	

Correction Factors

NOx Humidity CF:	0.994
Dry-to-Wet CF, Sample:	0.980
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	40.00

Test Cycle Data

Sample Time:	599.70	sec		
Work:	3.66	hp-hr	2.73	kW-hr
Reference Work:	3.66	hp-hr	2.73	kW-hr
Total Volume (Vmix):	22,972.2	scf	650.59	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.674 g/hp-hr	0.904	g/kW-hr
CO		4.914 g/hp-hr	6.590	g/kW-hr
NOx	(Cell)	8.585 g/hp-hr	11.513	g/kW-hr
Particulate		0.396 g/hp-hr	0.531	g/kW-hr
CO2		941.7 g/hp-hr	1,262.87	g/kW-hr
BSFC		0.659 lb/hp-hr	0.401	kg/kW-hr
NMHC		0.586 g/hp-hr	0.785	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRU8E-5	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/13/2002 Time: 08:42	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R100

Ambient/Test Cell Conditions

Barometer:	29.03	in Hg	98.3 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	54.2	°F	12.3 °C
Abs. Humidity:	64.7	gr/lb	9.2 g/kg
Rel. Humidity:	50	%	
Dilution Air:			
Temperature:	80.0	°F	26.7 °C
Abs. Humidity	75.4	gr/lb	10.8 g/kg
Rel. Humidity:	48	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		7.65	ppm	
HC Bckgrd	8.2	2	8.28	ppm	
CO	10.0	2	9.49	ppm	(Dry)
CO Bckgrd	2.2	2	2.07	ppm	
NOx Sample	n/a		73.98	ppm	(Dry)
NOx Bckgrd	1.6	1	0.40	ppm	
CO2 Sample	53.5	3	0.9851	%	(Wet)
CO2 Bckgrd	4.1	3	0.0676	%	
CH4 Sample	n/a	n/a	2.33	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.54	ppm	

Corrected Concentrations

HC	-0.03	ppm	
CO	7.28	ppm	
NOx	71.69	ppm	
CO2	0.9224	%	
CH4	-0.02	ppm	(1.00)

Mass Emissions

HC	0.000	grams
CO	5.505	grams
NOx	86.768	grams
Particulate	1.518	grams
CO2	10.966	kg
CH4	0.000	grams
Fuel	7.60 lb	3.45 kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,190.1	62.03
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.84	0.05
Gas Meter 2:	4.25	0.12
Sample Rate:	2.40	0.07
20X20 Sample Rate:	49.78	1.41
47 mm Sample Rate:	51.25	1.45
Total Flow Rate:	2,293.53	64.95

Particulate Data

Filter Number:	5946, (pair)	
Weight Gain:	1.590	mg
Sample Multiplier:	0.955	

Correction Factors

NOx Humidity CF:	0.974
Dry-to-Wet CF, Sample:	0.974
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	13.79

Test Cycle Data

Sample Time:	600.30	sec		
Work:	22.23	hp-hr	16.58	kW-hr
Reference Work:	22.23	hp-hr	16.58	kW-hr
Total Volume (Vmix):	22,946.8	scf	649.87	scm

Brake-Specific Emission Results

BSHC (Cell)	0.000	g/hp-hr	0.000	g/kW-hr
CO	0.248	g/hp-hr	0.332	g/kW-hr
NOx (Cell)	3.903	g/hp-hr	5.234	g/kW-hr
Particulate	0.068	g/hp-hr	0.092	g/kW-hr
CO2	493.3	g/hp-hr	661.53	g/kW-hr
BSFC	0.342	lb/hp-hr	0.208	kg/kW-hr
NMHC	0.000	g/hp-hr	0.000	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRU8E-6	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/13/2002 Time: 09:02	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	060R075

Ambient/Test Cell Conditions

Barometer:	29.03	in Hg	98.3 kPa
Engine Inlet Air			
Temperature:	73.0	°F	22.8 °C
Dew Point:	541.0	°F	282.8 °C
Abs. Humidity:	-4,415.:	gr/lb	-630.8 g/kg
Rel. Humidity:	254,63	%	
Dilution Air:			
Temperature:	81.0	°F	27.2 °C
Abs. Humidity	73.8	gr/lb	10.5 g/kg
Rel. Humidity:	45	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		9.19	ppm	
HC Bckgrd	9.5	2	9.59	ppm	
CO	8.5	2	8.05	ppm	(Dry)
CO Bckgrd	3.8	2	3.58	ppm	
NOx Sample	n/a		54.68	ppm	(Dry)
NOx Bckgrd	1.5	1	0.38	ppm	
CO2 Sample	81.0	1	0.7446	%	(Wet)
CO2 Bckgrd	8.3	1	0.0529	%	
CH4 Sample	n/a	n/a	2.92	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	3.13	ppm	

Corrected Concentrations

HC	0.13	ppm	
CO	4.48	ppm	
NOx	53.04	ppm	
CO2	0.6946	%	
CH4	-0.04	ppm	(1.00)

Mass Emissions

HC	0.047	grams		
CO	3.385	grams		
NOx	5.189	grams		
Particulate	1.066	grams		
CO2	8.239	kg		
CH4	0.000	grams		
Fuel	5.71	lb	2.59	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,185.6	61.90
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.85	0.05
Gas Meter 2:	4.24	0.12
Sample Rate:	2.39	0.07
20X20 Sample Rate:	50.21	1.42
47 mm Sample Rate:	51.58	1.46
Total Flow Rate:	2,289.82	64.85

Particulate Data

Filter Number:	5947 (pair)	
Weight Gain:	1.113	mg
Sample Multiplier:	0.958	

Correction Factors

NOx Humidity CF:	0.079
Dry-to-Wet CF, Sample:	0.977
Dry-to-Wet CF, Bckgrd:	0.983
Dilution Factor:	18.24

Test Cycle Data

Sample Time:	599.90	sec		
Work:	16.50	hp-hr	12.30	kW-hr
Reference Work:	16.50	hp-hr	12.30	kW-hr
Total Volume (Vmix):	22,894.3	scf	648.38	scm

Brake-Specific Emission Results

BSHC (Cell)	0.003	g/hp-hr	0.004	g/kW-hr
CO	0.205	g/hp-hr	0.275	g/kW-hr
NOx (Cell)	0.315	g/hp-hr	0.422	g/kW-hr
Particulate	0.065	g/hp-hr	0.087	g/kW-hr
CO2	499.3	g/hp-hr	669.62	g/kW-hr
BSFC	0.346	lb/hp-hr	0.210	kg/kW-hr
NMHC	0.002	g/hp-hr	0.003	g/kW-hr
CH4	0.000	g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.:	B2NRU8E-7	DIESEL 2D, NR=EM2831F	
Engine Desc.:	5.9 L (359 CID) 6	Date:	09/13/2002 Time: 09:22	HCR: 1.796	FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT:	4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000	
Engine S/N:	46109691	Cell: 16	Bag Cart: 1	Oil Code: EM-3049-EO	
		Steady-State		060R050	

Ambient/Test Cell Conditions

Barometer:	29.03	in Hg	98.3 kPa
Engine Inlet Air			
Temperature:	74.0	°F	23.3 °C
Dew Point:	55.1	°F	12.8 °C
Abs. Humidity:	66.8	gr/lb	9.5 g/kg
Rel. Humidity:	52	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	72.1	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		14.09	ppm	
HC Bckgrd	13.1	2	13.19	ppm	
CO	6.8	2	6.43	ppm	(Dry)
CO Bckgrd	1.2	2	1.12	ppm	
NOx Sample	n/a		40.42	ppm	(Dry)
NOx Bckgrd	1.9	1	0.48	ppm	
CO2 Sample	63.3	1	0.5178	%	(Wet)
CO2 Bckgrd	8.3	1	0.0529	%	
CH4 Sample	n/a	n/a	3.25	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	3.48	ppm	

Corrected Concentrations

HC	1.40	ppm	
CO	5.22	ppm	
NOx	39.11	ppm	
CO2	0.4669	%	
CH4	-0.10	ppm	(1.00)

Mass Emissions

HC	0.521	grams	
CO	3.920	grams	
NOx	47.289	grams	
Particulate	1.006	grams	
CO2	5.515	kg	
CH4	0.000	grams	
Fuel	3.82 lb	1.73 kg	

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,176.8	61.65
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.85	0.05
Gas Meter 2:	4.26	0.12
Sample Rate:	2.41	0.07
20X20 Sample Rate:	49.72	1.41
47 mm Sample Rate:	51.91	1.47
Total Flow Rate:	2,280.85	64.60

Particulate Data

Filter Number:	5948 (pair)	
Weight Gain:	1.061	mg
Sample Multiplier:	0.948	

Correction Factors

NOx Humidity CF:	0.979
Dry-to-Wet CF, Sample:	0.979
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	26.18

Test Cycle Data

Sample Time:	599.70	sec		
Work:	11.08	hp-hr	8.26	kW-hr
Reference Work:	11.08	hp-hr	8.26	kW-hr
Total Volume (Vmix):	22,797.1	scf	645.63	scm

Brake-Specific Emission Results

BSHC	(Cell)	0.047 g/hp-hr	0.063	g/kW-hr
CO		0.354 g/hp-hr	0.474	g/kW-hr
NOx	(Cell)	4.268 g/hp-hr	5.723	g/kW-hr
Particulate		0.091 g/hp-hr	0.122	g/kW-hr
CO2		497.7 g/hp-hr	667.47	g/kW-hr
BSFC		0.345 lb/hp-hr	0.210	kg/kW-hr
NMHC		0.041 g/hp-hr	0.055	g/kW-hr
CH4		0.000 g/hp-hr	0.000	g/kW-hr

Southwest Research Institute - Department of Emissions Research
EPA Hot Transient Emission Test Results
Project No. 5004.04.804

Engine Model:	2001 Cummins ISB190	Test No.: B2NRU8E-8	DIESEL 2D, NR=EM2831F
Engine Desc.:	5.9 L (359 CID) 6	Date: 09/13/2002 Time: 09:40	HCR: 1.796 FID Resp: 1.00
Engine Cycle:	Diesel	Program HDT: 4.11-R	H= 0.131 C= 0.869 O= 0.000 X= 0.000
Engine S/N:	46109691	Cell: 16 Bag Cart: 1	Oil Code: EM-3049-EO
		Steady-State	100I000

Ambient/Test Cell Conditions

Barometer:	29.04	in Hg	98.3 kPa
Engine Inlet Air			
Temperature:	76.0	°F	24.4 °C
Dew Point:	54.2	°F	12.3 °C
Abs. Humidity:	64.6	gr/lb	9.2 g/kg
Rel. Humidity:	47	%	
Dilution Air:			
Temperature:	82.0	°F	27.8 °C
Abs. Humidity	72.0	gr/lb	10.3 g/kg
Rel. Humidity:	43	%	

Measured Gaseous Data

	Meter	Range	Concentration		
HC Sample	n/a		12.70	ppm	
HC Bckgrd	12.3	2	12.39	ppm	
CO	6.5	2	6.14	ppm	(Dry)
CO Bckgrd	0.5	2	0.47	ppm	
NOx Sample	n/a		8.76	ppm	(Dry)
NOx Bckgrd	1.3	1	0.33	ppm	
CO2 Sample	13.9	1	0.0898	%	(Wet)
CO2 Bckgrd	7.5	1	0.0477	%	
CH4 Sample	n/a	n/a	2.77	ppm	(1.00)
CH4 Bckgrd	n/a	n/a	2.68	ppm	

Corrected Concentrations

HC	0.39	ppm	
CO	5.58	ppm	
NOx	8.28	ppm	
CO2	0.0424	%	
CH4	0.10	ppm	(1.00)

Mass Emissions

HC	0.293	grams		
CO	8.436	grams		
NOx	20.014	grams		
Particulate	0.429	grams		
CO2	1.007	kg		
CH4	0.087	grams		
Fuel	0.71	lb	0.32	kg

Sample Flows

	scfm	scmm
Blower 1 Rate:	2,187.9	61.96
Blower 2 Rate:	0.0	0.00
90 mm System:		
Gas Meter 1:	1.86	0.05
Gas Meter 2:	4.29	0.12
Sample Rate:	2.43	0.07
20X20 Sample Rate:	49.82	1.41
47 mm Sample Rate:	51.85	1.47
Total Flow Rate:	2,292.02	64.91

Particulate Data

Filter Number:	5949 (pair)	
Weight Gain:	0.455	mg
Sample Multiplier:	0.943	

Correction Factors

NOx Humidity CF:	0.974
Dry-to-Wet CF, Sample:	0.983
Dry-to-Wet CF, Bckgrd:	0.984
Dilution Factor:	148.48

Test Cycle Data

Sample Time:	1,199.40	sec		
Work:	0.25	hp-hr	0.19	kW-hr
Reference Work:	0.25	hp-hr	0.19	kW-hr
Total Volume (Vmix):	45,817.4	scf	1,297.58	scm

Brake-Specific Emission Results

BSHC	(Cell)	1.173 g/hp-hr	1.573	g/kW-hr
CO		33.743 g/hp-hr	45.250	g/kW-hr
NOx	(Cell)	80.054 g/hp-hr	107.355	g/kW-hr
Particulate		1.717 g/hp-hr	2.302	g/kW-hr
CO2		4,028.0 g/hp-hr	5,401.62	g/kW-hr
BSFC		2.829 lb/hp-hr	1.721	kg/kW-hr
NMHC		1.019 g/hp-hr	1.367	g/kW-hr
CH4		0.350 g/hp-hr	0.469	g/kW-hr

APPENDIX M

HYDROCARBON SPECIATION INFORMATION FOR TESTING ON A DEERE 6068T ENGINE USING TWO DIFFERENT FUELS

Description	Page
Transient Cycle HC Speciation using Two Different Fuels, mg/hp-hr	M-1
Steady-State HC Speciation using 2D Fuel, mg/hr	M-6
Steady-State HC Speciation using NR Fuel, mg/hr	M-11

ENGINE: DEERE 6068T	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	J12DFTP1	J12DFTP2	J12DBHL1	J2NRFTP1	J2NRFTP2	J2NRBHL1
METHANE	8.4	0.0	0.0	0.0	1.3	11.7
ETHANE	0.0	0.0	0.0	0.0	1.6	0.0
ETHYLENE	36.6	37.1	33.2	34.7	32.4	35.3
PROPANE	0.0	0.0	0.1	0.0	0.0	0.6
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	5.6	5.7	7.0	6.1	4.8	6.9
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	0.0	0.0	0.0	1.1	1.4	1.6
TRANS-2-BUTENE	4.1	4.3	3.0	2.6	2.2	2.9
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	2.3	2.1	0.0	0.0	0.0	0.3
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	0.0	3.3	3.3	0.0	2.1
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	0.0	5.7	0.0	0.0	5.6	4.6
2-METHYL-1-BUTENE	0.0	1.0	0.0	0.9	0.9	0.6
PENTANE	0.9	0.5	0.0	0.0	0.0	0.2
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.6	0.5
TRANS-2-PENTENE	0.5	0.0	0.0	0.0	0.5	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	0.5	0.0	0.0	0.0	0.0	0.0
CYCLOPENTENE	0.0	0.6	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	0.5	0.7	0.0	0.9	0.8	0.5
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.9	0.9	0.8	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	0.6	0.6	0.6
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	2.9	2.5	1.8	0.0	0.0	0.0
2-METHYL-1-PENTENE	1.7	1.7	1.0	1.6	1.6	0.7
1-HEXENE	1.7	1.7	1.0	1.6	1.6	0.7
HEXANE	0.7	0.9	0.7	0.6	0.0	0.0
UNIDENTIFIED C6 OLEFINS	1.0	0.0	0.0	2.8	1.9	0.2
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	J12DFTP1	J12DFTP2	J12DBHL1	J2NRFTP1	J2NRFTP2	J2NRBHL1
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	0.0	0.2	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	0.0	0.2	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.6	1.1	0.6	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.5	0.0	0.0	6.9
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	3.9
BENZENE	4.7	3.6	3.8	3.9	3.7	3.9
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	1.3	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	0.5	0.5	0.1	0.1	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	4.4
3-METHYLHEXANE	0.0	0.0	0.0	0.7	0.6	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.8	0.7	0.0	0.8	0.8	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	2.9	2.0	1.1	1.7	1.4	1.0
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.5	0.7	0.0	0.8	0.8	0.6
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.5	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	1.0	1.4	1.0	0.2	0.2	0.6
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	J12DFTP1	J12DFTP2	J12DBHL1	J2NRFTP1	J2NRFTP2	J2NRBHL1
2,4-DIMETHYLHEXANE	1.2	1.2	0.7	1.2	1.2	0.8
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	0.8	0.5	0.6	0.7	0.4	0.2
2,3,3-TRIMETHYLPENTANE	1.1	0.0	0.0	0.0	0.0	0.0
TOLUENE	3.9	1.7	3.3	2.6	1.7	1.6
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.6	0.7	0.7	0.7	0.6	0.6
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.6	0.0	0.7	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	1.0	1.7	1.1	1.5	1.5	1.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.5	0.5	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	1.9	1.8	1.3	1.5	1.5	1.5
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.5	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.5	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	2.6	2.7	2.5	2.0	1.9	1.9
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.9	0.9	0.9	1.0	1.0	0.8
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	3.0	2.5	2.2	1.4	1.4	1.1
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	3.6	3.3	2.7	3.2	3.3	2.6

ENGINE: DEERE 6068T	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	J12DFTP1	J12DFTP2	J12DBHL1	J2NRFTP1	J2NRFTP2	J2NRBHL1
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	1.2	1.2	1.2	8.1	1.4	1.3
3-METHYLOCTANE	1.1	1.1	1.2	1.7	1.3	1.1
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	2.3	1.4	1.2	1.4	1.4	1.2
1-NONENE	2.2	1.5	1.7	2.0	1.1	1.3
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	4.4	6.6	3.9	4.5	4.5	4.3
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.5	0.0	3.9	0.5	0.0
2,2-DIMETHYLOCTANE	1.1	1.1	1.1	1.7	0.8	0.0
2,4-DIMETHYLOCTANE	1.5	1.2	1.1	1.0	1.0	0.9
n-PROPYLBENZENE	2.1	4.5	1.3	1.6	1.5	1.4
1-METHYL-3-ETHYLBENZENE	0.8	0.0	0.0	1.9	1.6	1.0
1-METHYL-4-ETHYLBENZENE	0.6	0.0	0.0	1.3	1.3	0.0
1,3,5-TRIMETHYLBENZENE	0.6	1.0	1.0	1.1	0.9	0.9
1-METHYL-2-ETHYLBENZENE	0.0	0.6	0.7	1.4	0.9	0.0
1,2,4-TRIMETHYLBENZENE	0.9	0.7	0.5	1.1	0.7	0.9
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	0.4	0.3	1.7	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.4	0.3	1.6	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	1.2	0.5	1.2	1.1	0.9	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	2.3	1.1	1.6	0.7	0.6	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	1.2	1.4	1.3	1.3	0.0	1.1
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.8	0.0	0.0	0.5	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.5	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	0.0	0.0	4.7	1.1	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	0.0	1.2	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.8	0.7	1.0	0.7	0.7	0.5
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	J12DFTP1	J12DFTP2	J12DBHL1	J2NRFTP1	J2NRFTP2	J2NRBHL1
N-PENT-BENZENE	0.0	0.0	0.0	0.6	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	2.9	1.0	0.7	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.6	0.0
DODECANE	0.5	0.6	1.3	1.7	0.8	0.6
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	12.2	11.4	12.4	9.4	11.8	6.0
FORMALDEHYDE	47.1	47.7	34.6	42.6	44.8	35.5
ACETALDEHYDE	17.2	17.8	12.2	15.9	16.4	11.9
ACROLEIN	8.7	9.1	6.8	4.6	4.8	3.3
ACETONE	1.9	3.7	6.4	0.0	2.5	7.9
PROPIONALDEHYDE	3.7	4.2	0.0	4.7	5.9	0.0
CROTONALDEHYDE	3.8	4.2	3.8	6.6	6.6	0.0
ISOBUTYRALDEHYDE, NOTE H	1.5	1.6	1.1	1.8	2.0	0.0
METHYL ETHYL KETONE, NOTE H	1.5	1.6	1.1	1.8	2.0	0.0
BENZALDEHYDE	1.2	1.2	0.0	1.2	1.1	0.0
ISOVALERALDEHYDE	1.6	1.7	1.0	1.4	1.7	1.2
VALERALDEHYDE	0.4	1.0	0.4	1.6	1.9	0.5
O-TOLUALDEHYDE	0.9	0.0	0.0	0.6	0.0	0.0
M/P-TOLUALDEHYDE	3.4	3.6	2.3	2.4	3.3	2.3
HEXANALDEHYDE	0.7	0.8	0.1	0.6	0.6	0.0
DIMETHYLBENZALDEHYDE	0.3	0.4	1.0	0.0	0.0	0.0
SUMMED SPECIATED VALUES	236	230	184	224	211	189

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: DEERE 6068T	Test J12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	204.1	144.0	324.2	227.8	96.1	72.0	0.0	240.1
ETHANE	243.5	0.0	0.0	70.7	181.0	539.5	4.0	0.0
ETHYLENE	1635.1	562.0	994.3	3344.2	5122.1	539.6	652.4	1074.0
PROPANE	0.0	0.0	0.0	0.0	42.3	2.1	7.7	0.0
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	88.2	126.6	273.5	611.4	473.5	74.2	142.3	118.1
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-BUTENE	0.0	0.0	0.0	200.4	347.2	143.4	0.0	0.0
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	0.0	0.0	0.0	0.0	190.6	85.7	0.0	0.0
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	249.3	0.0	0.0	0.0	658.4	0.0	871.6	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	152.8	163.3	488.5	451.0	0.0	87.6	67.9	214.1
2-METHYL-1-BUTENE	28.8	0.0	0.0	34.3	59.6	0.0	47.3	0.0
PENTANE	46.4	24.1	23.2	17.3	70.3	17.1	0.0	0.0
UNIDENTIFIED C5 OLEFINS	39.8	0.0	0.0	115.7	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	24.1	0.0	0.0	46.5	27.0	0.0	0.0	0.0
TRANS-2-PENTENE	0.0	0.0	0.0	23.4	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	0.0	27.2	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	26.1	0.0	0.0	173.9	30.0	0.0	0.0	0.0
CYCLOPENTENE	30.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	27.6	18.4	17.5	22.5	48.8	20.3	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	18.8	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	124.2	0.3	0.0	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	38.8	38.8	0.0	0.0	57.2	0.0	0.0	0.0
2-METHYL-1-PENTENE	93.8	47.5	56.7	89.2	26.5	3.0	0.0	0.0
1-HEXENE	93.8	47.5	56.7	89.2	26.5	3.0	0.0	0.0
HEXANE	40.3	22.3	198.9	17.1	8.1	5.8	10.5	0.0
UNIDENTIFIED C6 OLEFINS	75.6	18.5	24.7	219.5	62.7	0.0	321.2	0.0
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	Test J12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	41.8	54.8	31.9	11.9	0.0	43.6	28.5	0.0
METHYLCYCLOPENTANE, NOTE A	40.9	53.7	31.3	11.7	0.0	42.8	27.9	0.0
2,4-DIMETHYLPENTANE	27.9	192.4	0.0	0.0	0.0	193.9	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	21.3	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	142.2	125.7	204.9	251.1	577.2	193.1	113.9	77.7
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	0.0	115.8	0.0	0.0	0.0	109.2	0.0	7.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	32.4	20.1	0.0	16.6	33.9	34.5	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	17.7	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	143.0	74.7	63.2	74.9	155.3	93.4	21.4	33.7
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	22.3	22.4	36.8	0.0	17.2	21.6	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	26.0	0.0	0.0	24.7	20.6	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	19.4	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	36.8	33.0	48.5	55.4	28.9	39.5	37.8	25.2
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	Test J12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	80.2	44.6	64.5	40.6	76.0	56.9	36.0	21.9
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	10.5	8.0	11.3	18.5	2.4	4.3	0.0	0.8
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	82.1	47.8	59.1	84.3	252.5	28.8	49.1	37.9
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	16.2	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	30.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	26.2	31.5	37.0	0.0	25.8	24.4	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	22.4	28.6	45.8	22.3	26.7	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	18.1	63.3	67.1	278.7	112.0	87.9	27.1	23.1
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	121.5	0.0	18.5	23.7	0.0	16.8	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	35.5	54.9	71.8	94.3	17.5	52.0	56.3	42.4
UNIDENTIFIED C8	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	69.9	98.5	132.8	220.3	24.8	91.7	97.4	46.5
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	20.9	35.9	45.6	50.8	0.0	33.2	33.3	17.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	70.4	74.9	124.0	165.3	58.6	81.3	78.9	45.3
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	107.3	123.1	157.1	213.0	121.4	114.0	108.5	56.2

ENGINE: DEERE 6068T	Test J12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	31.4	49.1	66.2	87.4	0.0	47.1	52.4	24.1
3-METHYLOCTANE	25.9	45.5	62.3	81.7	0.0	260.3	47.4	21.4
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	58.6	54.7	61.6	87.6	70.5	52.3	49.5	27.2
1-NONENE	109.9	63.3	109.3	97.1	89.9	91.3	44.0	24.4
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	101.8	173.6	239.1	293.6	60.5	159.2	164.9	71.3
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	20.7	30.9	63.7	76.8	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	30.3	62.8	85.8	89.7	0.0	49.1	60.6	24.5
n-PROPYLBENZENE	84.4	111.4	138.8	191.6	26.6	117.4	114.4	0.0
1-METHYL-3-ETHYLBENZENE	71.8	96.8	130.7	175.4	45.7	87.7	86.2	0.0
1-METHYL-4-ETHYLBENZENE	57.0	74.7	58.6	79.9	27.0	54.7	59.4	0.0
1,3,5-TRIMETHYLBENZENE	16.4	42.3	110.1	81.5	0.0	74.4	58.6	0.0
1-METHYL-2-ETHYLBENZENE	63.1	40.5	49.7	72.0	15.6	40.9	32.2	0.0
1,2,4-TRIMETHYLBENZENE	81.4	145.7	194.8	261.9	0.0	114.2	58.9	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	141.0	178.9	246.4	0.0	24.5	116.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	133.0	168.8	232.5	0.0	23.1	109.5	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	47.0	95.3	126.5	63.3	0.0	84.5	94.9	15.6
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	10.7	20.0	42.6	131.4	0.0	11.1	45.6	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	29.2	63.2	34.8	0.0	27.8	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	18.8	20.8	242.6
1-METHYL-2-N-PROPYLBENZENE	0.0	32.7	50.7	48.2	0.0	27.2	31.6	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	24.0	30.3	55.3	27.5	0.0	20.5	38.5	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	116.5	0.0	31.6	37.8	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	333.3	445.9	534.4	129.1	266.7	332.6	91.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	75.9	77.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	69.0	59.3	72.5	155.5	20.2	0.0	0.0	200.4
TERT-1-BUT-2-METHYLBENZENE	94.8	75.5	29.2	84.3	97.6	55.8	50.1	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	Test J12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
N-PENT-BENZENE	0.0	0.0	0.0	0.0	21.3	67.0	75.2	28.3
TERT-1-BUT-3,5-DIMETHYLBENZENE	45.3	48.7	53.1	62.4	0.0	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	17.4	33.7	73.7	24.4
DODECANE	46.3	63.8	84.6	345.9	213.2	184.9	173.1	54.1
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	810.0	1490.0	1951.6	2372.5	289.2	1024.9	849.8	213.3
FORMALDEHYDE	1562.9	787.5	1146.8	3837.4	3036.8	662.6	505.4	1559.9
ACETALDEHYDE	409.3	266.5	393.9	1494.2	746.9	190.9	170.5	597.2
ACROLEIN	199.3	73.2	115.3	610.4	564.4	44.4	46.8	212.5
ACETONE	0.0	0.0	0.0	346.6	241.4	0.0	0.0	54.6
PROPIONALDEHYDE	0.0	0.0	0.0	432.9	0.0	0.0	0.0	0.0
CROTONALDEHYDE	0.0	0.0	122.5	594.8	236.6	0.0	81.6	227.5
ISOBUTYRALDEHYDE, NOTE H	0.0	0.0	57.6	140.3	22.8	0.0	0.0	62.4
METHYL ETHYL KETONE, NOTE H	0.0	0.0	57.6	140.3	22.8	0.0	0.0	62.4
BENZALDEHYDE	16.8	15.6	16.8	154.7	200.5	0.0	0.0	36.6
ISOVALERALDEHYDE	0.0	0.0	0.0	92.3	52.8	0.0	0.0	31.8
VALERALDEHYDE	0.0	0.0	4.8	107.9	0.0	0.0	0.0	51.6
O-TOLUALDEHYDE	0.0	0.0	0.0	79.1	0.0	0.0	0.0	29.4
M/P-TOLUALDEHYDE	0.0	0.0	0.0	351.4	269.0	0.0	0.0	228.7
HEXANALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DIMETHYLBENZALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUMMED SPECIATED VALUES	8382.1	7191.6	10298.9	22193.7	15606.4	7004.1	6646.1	6298.0

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: DEERE 6068T	Test J2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	0.0	180.0	84.0	264.1	24.0	132.1	0.0	0.0
ETHANE	0.0	0.0	72.3	350.5	0.0	0.0	287.4	393.9
ETHYLENE	1676.5	508.5	1180.0	3623.5	5186.7	492.3	385.5	978.6
PROPANE	77.6	559.5	0.0	0.0	310.6	13.6	31.6	0.0
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	189.8	162.4	354.7	765.6	603.9	99.4	144.9	184.0
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	0.0	0.0	317.6	445.2	73.1	335.8	654.0	0.0
TRANS-2-BUTENE	185.4	94.0	117.2	230.8	355.9	97.9	0.0	0.0
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	119.9	0.0	97.6	112.3	848.6	0.0	0.0	0.0
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	492.6	0.0	0.0	720.7	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	518.4	0.0	0.0	407.7	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	76.3	70.3	188.8	87.4	0.0	67.7	43.3	0.0
2-METHYL-1-BUTENE	32.0	0.0	0.0	28.8	0.0	0.0	0.0	0.0
PENTANE	22.6	21.8	23.1	4.5	75.4	2.1	7.7	0.0
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	16.8	0.0	0.0	53.6	18.3	0.0	0.0	0.0
TRANS-2-PENTENE	0.0	0.0	0.0	19.9	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	19.2	256.7	27.1	121.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	20.4	0.0	0.0	17.3	32.8	0.0	0.0	0.0
CYCLOPENTENE	29.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	29.2	95.1	119.1	16.3	0.0	17.4	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	28.6	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	21.6	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	19.4	0.0	0.0	0.0	0.0	16.9	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-PENTENE	66.7	31.3	52.3	90.2	77.8	137.2	18.5	30.5
1-HEXENE	66.7	31.3	52.3	90.2	77.8	137.2	18.5	30.5
HEXANE	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C6 OLEFINS	157.2	218.0	26.4	185.1	64.8	52.4	18.1	77.9
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	Test J2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	17.8	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	203.2	64.2	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	35.3	19.0	10.4	0.0	44.5	45.5	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	34.5	18.6	10.2	0.0	43.6	44.6	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	159.7	178.7	212.4	402.8	497.9	66.9	209.9	86.1
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	1.1	1.3	0.0	2.2	8.2	7.4	0.3	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	20.9	0.0	0.0	0.0	26.8	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	18.8	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	36.8	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	130.1	46.8	57.0	64.5	102.6	65.5	8.2	0.0
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	26.5	32.3	33.0	17.5	26.2	22.3	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	231.3	244.7	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.0	234.4	30.6	37.7	0.0	21.6	18.5	16.6
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	Test J2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	64.2	70.7	62.7	34.0	63.0	0.0	0.0	17.4
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	14.6	3.4	32.6	148.6	135.8	0.0	0.7	0.0
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	251.9	52.6	68.9	177.0	192.9	59.4	49.3	23.5
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	91.9	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	25.4	0.0	17.2
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	21.1	33.3	35.5	0.0	0.0	28.4	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	27.1	39.6	0.0	0.0	17.7	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	20.3	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	89.4	47.7	191.0	70.1	97.8	68.3	0.0	21.2
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	19.2	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	30.0	57.2	82.8	94.1	0.0	57.8	57.2	25.9
UNIDENTIFIED C8	0.0	0.0	204.5	19.8	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	26.2	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	45.0	70.4	109.7	132.0	21.0	59.9	74.2	39.1
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	20.9	37.4	54.4	66.0	0.0	57.8	35.1	18.2
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	42.7	47.2	66.4	86.5	37.8	50.0	42.2	0.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	145.3	104.1	143.3	180.6	86.6	90.6	82.1	37.9

ENGINE: DEERE 6068T	Test J2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	22.8	55.5	77.1	96.2	0.0	53.1	53.7	26.7
3-METHYLOCTANE	26.5	53.3	62.8	84.6	0.0	45.9	51.5	26.8
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	52.5	54.0	64.4	82.1	37.2	138.4	38.0	17.1
1-NONENE	75.8	70.6	0.0	18.5	69.3	54.1	21.5	0.0
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	92.7	185.0	262.4	312.9	28.9	181.1	190.3	77.2
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	20.3	0.0	23.0	24.9	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	35.6	38.1	50.4	0.0	29.9	30.8	0.0
2,4-DIMETHYLOCTANE	22.3	40.8	56.8	67.6	0.0	38.4	39.2	17.3
n-PROPYLBENZENE	46.2	65.5	110.5	173.6	17.3	94.0	55.3	0.0
1-METHYL-3-ETHYLBENZENE	69.0	73.8	107.4	130.3	18.2	65.1	58.0	0.0
1-METHYL-4-ETHYLBENZENE	52.2	59.8	80.1	65.8	0.0	33.2	29.7	0.0
1,3,5-TRIMETHYLBENZENE	51.8	64.7	88.2	123.3	0.0	67.0	57.4	0.0
1-METHYL-2-ETHYLBENZENE	40.0	209.7	64.1	120.5	0.0	39.6	33.0	0.0
1,2,4-TRIMETHYLBENZENE	124.0	153.7	205.0	305.4	90.1	87.8	76.0	17.6
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	60.1	172.9	238.9	297.4	16.6	119.2	146.4	0.0
ISOBUTYLBENZENE, NOTE F	56.7	163.1	225.3	280.5	15.6	112.4	138.1	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	60.2	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	29.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	51.2	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	54.2	79.8	126.2	137.7	22.1	88.5	106.8	32.1
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	18.0	32.3	64.7	81.1	0.0	26.9	31.6	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	26.5	51.4	0.0	0.0	28.0	30.0	0.0
1,2 DIETHYLBENZENE	0.0	23.1	58.7	127.4	0.0	28.4	29.5	0.0
1-METHYL-2-N-PROPYLBENZENE	26.9	21.7	47.8	40.8	0.0	0.0	29.6	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	36.5	77.2	128.5	16.3	34.3	36.3	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	17.7	35.1	50.0	122.8	0.0	27.5	31.5	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	202.6	405.1	445.4	611.7	41.1	355.3	345.1	64.2
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	208.9	0.0	67.4	89.0	0.0	21.7	42.6	34.3
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	18.1	30.6	55.4	0.0	38.6	29.8	0.0
TERT-1-BUT-2-METHYLBENZENE	43.5	70.7	65.2	82.5	0.0	44.3	70.6	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: DEERE 6068T	Test J2NRU8E (Nonroad Fuel)							
	mg/hr							
N-PENT-BENZENE	38.8	72.3	92.1	148.9	30.6	79.3	76.9	25.5
TERT-1-BUT-3,5-DIMETHYLBENZENE	131.4	41.1	62.2	74.0	0.0	46.9	51.3	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	50.5	32.4	91.7	141.3	45.8	46.3	51.6	20.9
DODECANE	234.0	265.6	331.1	395.8	90.1	222.9	212.8	108.9
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	719.4	914.2	1459.8	2236.5	432.6	1070.5	701.5	169.8
FORMALDEHYDE	1471.2	760.8	1117.6	3783.7	3120.7	606.4	519.8	1630.4
ACETALDEHYDE	376.8	246.0	366.1	1469.3	720.7	156.1	178.9	615.9
ACROLEIN	210.0	73.2	130.8	695.0	575.4	32.4	57.6	213.1
ACETONE	0.0	0.0	0.0	51.6	84.1	0.0	0.0	76.2
PROPIONALDEHYDE	0.0	0.0	0.0	426.1	0.0	0.0	0.0	0.0
CROTONALDEHYDE	105.6	79.2	144.0	596.6	258.3	0.0	0.0	241.3
ISOBUTYRALDEHYDE, NOTE H	8.4	0.0	20.4	108.0	14.4	0.0	0.0	52.8
METHYL ETHYL KETONE, NOTE H	8.4	0.0	20.4	108.0	14.4	0.0	0.0	52.8
BENZALDEHYDE	0.0	0.0	0.0	87.6	135.7	0.0	0.0	22.8
ISOVALERALDEHYDE	10.8	0.0	3.6	100.8	19.2	0.0	0.0	50.4
VALERALDEHYDE	0.0	0.0	0.0	96.0	0.0	15.6	0.0	45.6
O-TOLUALDEHYDE	0.0	0.0	0.0	88.8	0.0	0.0	0.0	0.0
M/P-TOLUALDEHYDE	0.0	0.0	0.0	309.7	30.0	0.0	0.0	115.3
HEXANALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.8
DIMETHYLBENZALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8
SUMMED SPECIATED VALUES	8532.2	8783.0	11066.8	23112.8	16719.1	6634.7	6044.3	5835.6

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

APPENDIX N

HYDROCARBON SPECIATION INFORMATION FOR TESTING ON A CUMMINS M11C ENGINE USING TWO DIFFERENT FUELS

Description	Page
Transient Cycle HC Speciation using Two Different Fuels, mg/hp-hr	N-1
Steady-State HC Speciation using 2D Fuel, mg/hr	N-6
Steady-State HC Speciation using NR Fuel, mg/hr	N-11

ENGINE: CUMMINS M11C	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	M12DFTP1	M12DFTP2	M12DBHL1	M2NRFTP1	M2NRFTP2	M2NRBHL1
METHANE	16.4	0.0	0.0	17.9	3.0	11.4
ETHANE	0.0	0.0	0.0	1.5	1.7	0.0
ETHYLENE	70.8	74.5	38.8	73.3	66.8	43.7
PROPANE	0.0	0.0	6.3	0.0	0.0	1.5
PROPYLENE	24.9	26.4	4.1	26.5	24.2	13.8
ACETYLENE	0.0	0.0	0.0	0.0	0.0	0.0
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	8.0	7.8	5.4	6.6	6.9	8.0
TRANS-2-BUTENE	0.0	0.0	3.0	0.0	0.0	0.0
1-BUTENE	6.3	6.8	1.6	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	4.0	4.1	9.9	7.1	6.6	3.3
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	4.7	3.3	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	6.7	6.7	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	3.8	2.3	6.8	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	1.2	1.9	1.3	2.5	2.5	1.5
2-METHYL-1-BUTENE	1.2	0.9	1.2	1.4	0.8	1.3
PENTANE	1.3	0.8	0.0	0.0	4.5	0.7
UNIDENTIFIED C5 OLEFINS	1.5	0.8	0.0	1.1	0.7	0.0
2-METHYL-1,3-BUTADIENE	0.6	0.4	0.8	2.0	2.3	0.6
TRANS-2-PENTENE	0.0	0.0	0.0	0.5	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.5	0.6	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.1	0.0	0.7	1.1	0.9	0.7
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.6	0.5	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	1.0	0.4	0.6	0.0	0.0	0.0
CYCLOPENTENE	0.8	0.8	0.5	0.7	0.7	0.5
4-METHYL-1-PENTENE	2.3	1.8	0.0	0.7	0.6	0.5
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	1.7	1.6	0.9
2,3-DIMETHYLBUTANE	0.9	0.2	0.0	0.0	0.0	0.9
MTBE	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.5	0.0	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	1.2	0.5	0.8	0.8	1.1	0.0
2-METHYL-1-PENTENE	2.4	2.6	2.0	2.4	2.4	1.4
1-HEXENE	2.4	2.6	2.0	2.4	2.4	1.4
HEXANE	0.2	0.0	0.0	0.9	0.4	0.0
UNIDENTIFIED C6 OLEFINS	6.5	6.3	4.2	4.8	8.0	1.3
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	M12DFTP1	M12DFTP2	M12DBHL1	M2NRFTP1	M2NRFTP2	M2NRBHL1
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.5	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.2	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	0.0	1.6	0.3	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	0.0	1.5	0.3	0.0	0.0
2,4-DIMETHYLPENTANE	0.1	0.3	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.6	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.9	0.0	0.5	0.4	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	5.1	5.3	3.6	6.0	5.7	4.2
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	0.0	0.0	0.1	0.0	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.4	4.7	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.4	0.6	0.5	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	1.0	1.0	0.0	0.8	0.6	0.6
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	1.7	0.0	1.5	1.9	2.2	1.4
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	0.0	0.5	0.4	0.5	0.8
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	1.6	0.5	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.5	0.5	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.5	0.2	0.7	0.6	0.5	0.5
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.4	0.4	0.6	0.6
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	M12DFTP1	M12DFTP2	M12DBHL1	M2NRFTP1	M2NRFTP2	M2NRBHL1
2,4-DIMETHYLHEXANE	0.9	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	0.3	0.0	0.2	0.4	0.5	0.2
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	2.9	0.0	0.0	3.4	2.8	1.3
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.5
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.5	0.6	0.5	0.7
2,2,5-TRIMETHYLHEXANE	1.1	0.4	0.5	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	1.1	1.0	1.3	1.9	1.9	1.3
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	1.8	0.0	0.8	0.9	0.9	1.0
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.5	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	1.2	1.3	1.2	1.3	1.4	1.4
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.6	0.6	0.7	0.6
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	1.5	1.1	1.4	1.3	1.1	0.9
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	2.4	2.3	2.0	2.7	2.4	1.8

ENGINE: CUMMINS M11C	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	M12DFTP1	M12DFTP2	M12DBHL1	M2NRFTP1	M2NRFTP2	M2NRBHL1
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	0.6	0.0	5.1	0.8	0.8	1.0
3-METHYLOCTANE	0.4	0.5	0.8	0.8	0.9	0.9
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	1.3	1.0	0.9	1.2	1.1	0.7
1-NONENE	1.6	1.6	1.2	1.3	1.3	0.9
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	1.5	1.5	1.7	2.7	2.5	3.0
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	2.4	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.8	0.0	0.0	0.5
2,4-DIMETHYLOCTANE	0.5	0.6	0.6	0.5	0.6	0.0
n-PROPYLBENZENE	0.0	0.6	0.0	0.7	0.5	0.4
1-METHYL-3-ETHYLBENZENE	0.0	0.0	0.0	1.2	0.7	0.0
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.4	0.0
1,2,4-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	1.8
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	0.0	0.0	2.8	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.0	0.0	2.6	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.5	0.4	0.7	0.6	1.9	0.6
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.6	0.0	0.0	0.0	0.0	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	1.0	0.5	0.8	0.0	0.0	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.4	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	1.3	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	1.2	1.4	0.0	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.6	3.6	0.5	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	M12DFTP1	M12DFTP2	M12DBHL1	M2NRFTP1	M2NRFTP2	M2NRBHL1
N-PENT-BENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	1.2	0.6	5.0	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	0.0	0.0	0.6	1.6	0.6	0.0
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	0.0	4.3	0.5	7.7	6.7	10.6
FORMALDEHYDE	67.6	75.9	35.8	74.7	71.0	39.3
ACETALDEHYDE	25.0	24.0	12.0	25.0	24.2	13.9
ACROLEIN	6.6	4.9	1.4	6.3	6.6	2.4
ACETONE	4.8	1.9	0.0	4.3	3.8	0.0
PROPIONALDEHYDE	20.1	16.2	6.2	6.3	5.9	2.9
CROTONALDEHYDE	12.3	11.7	5.3	11.9	11.5	6.1
ISOBUTYRALDEHYDE, NOTE H	0.3	0.3	1.1	2.1	2.1	1.0
METHYL ETHYL KETONE, NOTE H	0.3	0.3	1.1	2.1	2.1	1.0
BENZALDEHYDE	3.1	2.9	1.5	8.4	7.8	4.2
ISOVALERALDEHYDE	2.9	2.8	1.5	2.2	2.1	1.1
VALERALDEHYDE	1.9	1.7	0.0	2.8	2.6	1.5
O-TOLUALDEHYDE	2.9	2.8	2.9	4.0	5.1	0.0
M/P-TOLUALDEHYDE	7.3	7.4	3.4	8.4	8.2	7.3
HEXANALDEHYDE	1.4	1.4	0.7	1.2	0.9	0.7
DIMETHYLBENZALDEHYDE	1.7	1.6	0.9	0.9	0.8	0.6
SUMMED SPECIATED VALUES	358	342	207	372	337	214

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: CUMMINS M11C	Test M12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	216.1	102.1	0.0	78.0	0.0	0.0	0.0	0.0
ETHANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLENE	2655.1	1739.3	1566.3	3521.5	5070.2	2502.1	1205.5	2548.2
PROPANE	0.0	371.1	0.0	0.0	0.0	292.9	28.2	0.0
PROPYLENE	1326.8	848.2	670.8	892.2	1971.0	313.3	505.4	783.4
ACETYLENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	231.6	208.4	253.2	626.0	372.3	167.0	205.2	340.9
TRANS-2-BUTENE	0.0	0.0	0.0	177.6	0.0	0.0	0.0	0.0
1-BUTENE	438.0	256.4	182.0	89.8	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	387.1	186.9	483.3	366.9	543.1	374.8	156.8	143.1
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	298.4	206.0	91.8	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	240.5	50.6	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	332.8	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	319.7	0.0	0.0	0.0	0.0	0.0	0.0	26.8
2-METHYL-1-BUTENE	88.7	0.0	0.0	38.4	0.0	0.0	0.0	0.0
PENTANE	230.3	52.8	39.4	0.0	131.1	64.8	0.0	42.6
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.8
2-METHYL-1,3-BUTADIENE	69.8	0.0	0.0	48.9	32.0	27.2	0.0	0.0
TRANS-2-PENTENE	39.2	24.7	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	29.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	26.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	31.5	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	179.7	0.0	0.0	0.0	52.6	30.6	0.0	0.0
CYCLOPENTENE	63.3	0.0	24.3	0.0	57.3	47.0	31.4	0.0
4-METHYL-1-PENTENE	86.8	57.4	60.2	48.2	76.3	43.8	0.0	63.1
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	139.7	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	58.7	0.0	33.9	83.8	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	29.4	0.0	197.2	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	131.1	263.0	123.1	387.5	175.5	345.0	0.0	0.0
2-METHYL-1-PENTENE	227.3	137.4	98.4	70.6	170.4	27.1	81.8	75.4
1-HEXENE	227.3	137.4	98.4	70.6	170.4	27.1	81.8	75.4
HEXANE	28.7	25.3	35.1	51.4	32.8	34.9	32.1	29.4
UNIDENTIFIED C6 OLEFINS	153.7	198.1	0.0	80.4	109.4	90.1	0.0	318.3
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	145.1	0.0	0.0

ENGINE: CUMMINS M11C	Test M12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	284.1	149.3	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	15.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	0.0	232.7	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	236.6	0.0	0.0
BENZENE	204.0	117.7	111.7	229.0	465.2	195.9	171.1	177.6
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	47.5	24.8	0.0	203.6	61.2	43.1	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	28.3	44.2	28.6
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	38.2	25.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	334.9	204.7	145.6	74.8	277.4	255.9	117.5	89.5
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	54.1	74.5	683.1	58.7	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	61.6	37.5	0.0	0.0	26.8	29.7	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	26.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	63.7	48.2	50.1	50.5	0.0	43.3	36.7	0.0
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	90.9	88.5	0.0	0.0	105.5	97.7	0.0	28.8
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	Test M12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	49.1	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	0.0	45.2	0.0	47.1	0.0	0.0	0.0	0.0
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	69.9	32.8	27.4	70.9	246.1	103.4	151.3	171.1
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	178.0	0.0	0.0	0.0	29.3	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	48.4	0.0	31.8	0.0	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	24.7	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	37.0	25.1	0.0
2,2,5-TRIMETHYLHEXANE	45.3	37.9	0.0	0.0	0.0	37.1	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	268.3	170.7	118.4	71.9	35.5	182.8	83.6	44.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	189.9	0.0	0.0	0.0
OCTANE	50.5	56.2	47.4	55.7	31.5	0.0	34.8	40.6
UNIDENTIFIED C8	29.7	0.0	0.0	72.6	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	175.7	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	207.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	40.1	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	99.4	98.7	97.7	84.6	33.5	46.2	75.0	55.8
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	29.4	0.0	32.0	0.0	230.7	0.0	0.0	0.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	87.4	84.3	30.0	98.4	67.3	30.3	54.2	67.7
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	92.3	140.9	116.6	161.7	155.3	123.2	91.8	64.2

ENGINE: CUMMINS M11C	Test M12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	42.8	152.8	52.3	0.0	0.0	0.0	43.3	0.0
3-METHYLOCTANE	42.6	39.3	47.0	43.8	23.6	0.0	27.4	23.7
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	95.4	78.1	56.5	56.1	153.3	47.8	42.2	36.2
1-NONENE	222.6	167.1	106.7	322.0	189.7	152.2	85.1	39.5
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	140.2	136.1	140.9	135.2	214.9	68.0	101.3	80.3
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	32.8	60.7	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	42.7	57.1	56.6	63.0	94.1	25.4	36.5	28.9
n-PROPYLBENZENE	0.0	0.0	0.0	0.0	25.4	38.3	68.4	33.5
1-METHYL-3-ETHYLBENZENE	113.5	101.8	88.5	74.9	48.6	0.0	0.0	0.0
1-METHYL-4-ETHYLBENZENE	78.8	87.9	61.8	60.6	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	58.3	75.9	35.8	47.2	58.8	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	27.0	38.6	0.0	0.0	40.4	0.0	0.0	0.0
1,2,4-TRIMETHYLBENZENE	103.5	115.3	0.0	0.0	35.9	0.0	0.0	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	27.7	12.3	79.6	112.5	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	26.1	11.6	75.1	106.1	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	22.9	0.0	0.0	38.8
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	62.1	70.8	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	84.1	0.0	84.9	74.2
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.0	79.4	91.0	88.2	44.3	26.1	48.8	35.9
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	45.5	36.1	47.8	55.6	30.0	0.0	27.7	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	25.3	37.1	36.5	87.6	52.7	43.5	57.4	62.7
1,2 DIETHYLBENZENE	0.0	26.8	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	60.8	44.3	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	30.2	35.3	54.5	28.0	21.7	30.2	23.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	35.6	40.2	53.8	46.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	46.9	462.3	342.1	492.1	212.7	166.1	225.3	230.4
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	38.3	71.0	81.9	72.2	38.4	0.0	52.9	107.2
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	44.7	53.7	35.7	31.3	141.4	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	52.9	116.5	83.2	101.5	54.9	0.0	62.7	33.2
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	Test M12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
N-PENT-BENZENE	0.0	37.7	98.6	145.8	204.7	51.3	50.1	55.1
TERT-1-BUT-3,5-DIMETHYLBENZENE	23.6	28.1	29.4	78.9	0.0	91.3	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	23.0	124.3	89.1	63.5	45.9	0.0	24.3	76.8
DODECANE	211.7	469.8	201.2	231.2	270.0	128.0	112.8	151.7
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	644.9	814.0	187.2	566.3	656.4	432.1	115.9	306.4
FORMALDEHYDE	1954.3	1587.8	1552.1	3561.0	2721.0	1668.6	1259.4	4217.3
ACETALDEHYDE	521.0	468.2	527.0	1324.4	713.3	401.5	418.2	1285.6
ACROLEIN	69.6	42.6	41.4	154.8	148.3	52.2	0.0	217.0
ACETONE	443.5	0.0	0.0	0.0	0.0	0.0	0.0	188.2
PROPIONALDEHYDE	97.2	95.4	127.8	277.2	90.7	64.8	107.4	322.3
CROTONALDEHYDE	189.7	199.9	216.7	634.3	258.2	78.6	111.0	564.8
ISOBUTYRALDEHYDE, NOTE H	45.6	48.0	54.6	215.4	56.4	31.2	86.4	149.1
METHYL ETHYL KETONE, NOTE H	45.6	48.0	54.6	82.8	56.4	31.2	86.4	149.1
BENZALDEHYDE	63.0	48.6	52.2	84.6	0.0	0.0	45.0	152.2
ISOVALERALDEHYDE	93.0	81.0	111.0	389.5	105.7	67.2	93.0	324.4
VALERALDEHYDE	59.4	68.4	95.4	110.4	61.8	33.0	119.4	187.6
O-TOLUALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.4
M/P-TOLUALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXANALDEHYDE	25.2	27.0	44.4	49.8	19.8	16.2	27.6	67.2
DIMETHYLBENZALDEHYDE	27.6	0.0	27.0	60.0	31.2	0.0	0.0	49.8
SUMMED SPECIATED VALUES	15241.5	12505.8	10661.7	18458.9	18512.8	10700.0	7005.8	14634.0

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: CUMMINS M11C	Test M2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	0.0	0.0	0.0	312.2	0.0	0.0	204.0	348.0
ETHANE	0.0	0.0	104.1	0.0	0.0	0.0	0.0	0.0
ETHYLENE	2191.8	1368.0	1133.3	212.3	3258.7	2723.4	1288.5	314.6
PROPANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPYLENE	1302.4	356.1	673.7	1034.2	444.8	1254.6	553.7	855.1
ACETYLENE	0.0	0.0	0.0	0.0	237.4	0.0	0.0	0.0
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	291.2	284.7	324.1	709.0	116.1	150.4	206.5	671.5
TRANS-2-BUTENE	0.0	0.0	0.0	511.2	0.0	0.0	0.0	0.0
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	330.0
2-METHYLPROPENE (ISOBUTYLENE)	461.0	285.0	208.7	184.0	261.8	432.3	198.0	203.3
2,2-DIMETHYLPROPANE (NEOPENTANE)	283.1	166.5	106.0	87.2	147.7	233.9	91.0	89.5
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	979.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	0.0	0.0	52.6	60.1	295.2	268.4	0.0	0.0
2-METHYL-1-BUTENE	89.8	73.2	41.1	27.1	113.0	44.2	46.0	104.0
PENTANE	57.9	33.4	36.4	45.9	27.9	0.0	0.0	0.0
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	50.5	35.7	0.0	43.8	176.1	95.5	23.9	46.4
TRANS-2-PENTENE	0.0	0.0	0.0	0.0	31.3	29.5	0.0	0.0
3,3-DIMETHYL-1-BUTENE	29.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	28.3	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	0.0	0.0	27.3	29.1	0.0	27.9
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	33.1	29.5	31.8	0.0	59.9	0.0	0.0	0.0
CYCLOPENTENE	57.4	252.2	29.2	30.7	72.5	60.1	0.0	0.0
4-METHYL-1-PENTENE	0.0	34.3	43.3	73.8	142.5	50.0	37.5	87.7
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	59.2	45.7	0.0
2,3-DIMETHYLBUTANE	35.7	0.0	0.0	30.7	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	32.1	1.1	0.0	0.0	25.8	0.0	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	41.6	130.7	25.5	47.7	0.0	0.0	134.6	65.1
2-METHYL-1-PENTENE	222.4	140.4	97.4	80.8	163.9	172.3	88.0	86.9
1-HEXENE	222.4	140.4	97.4	80.8	163.9	172.3	88.0	86.9
HEXANE	27.5	0.0	0.0	0.0	0.0	61.7	27.9	0.0
UNIDENTIFIED C6 OLEFINS	271.3	173.5	161.1	341.2	267.3	73.7	54.0	380.1
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	Test M2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	30.7	0.0	33.1	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	16.9	30.9	0.0	0.0	54.1	52.9	19.5	17.2
METHYLCYCLOPENTANE, NOTE A	16.6	30.3	0.0	0.0	53.0	51.8	19.1	16.9
2,4-DIMETHYLPENTANE	43.4	30.5	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	168.0	135.8	139.6	269.5	465.7	172.2	106.7	169.1
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	15.5	0.0	210.0	0.0	0.0	0.0	0.0	13.1
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	32.4	0.0	0.0	53.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	129.4	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	43.5	41.9	65.8	61.2	23.5	0.0	42.5	41.3
3-ETHYLPENTANE	30.6	25.0	0.0	0.0	138.2	24.9	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	502.5	252.7	108.7	72.3	225.8	166.0	8.2	81.0
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	31.8	44.0	38.7	42.3	0.0	0.0	25.7	31.5
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	47.1	47.4	35.8	0.0	34.2	67.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	39.6	29.6	0.0	0.0	34.9	37.4	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	134.8	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	93.7	0.0	0.0
METHYLCYCLOHEXANE	71.4	49.0	48.0	45.2	0.0	0.0	51.1	33.3
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	143.1	50.3	78.4	40.0	100.1	116.0	0.0	41.5
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	Test M2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	94.2	33.5	19.7	16.9	0.0	0.0	0.0	23.9
2,3,3-TRIMETHYLPENTANE	53.1	0.0	0.0	65.6	0.0	0.0	0.0	0.0
TOLUENE	339.5	385.9	218.5	136.5	262.3	104.7	44.3	220.4
2,3-DIMETHYLHEXANE	126.5	93.8	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	27.6	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	250.2	0.0	0.0	48.2	0.0	0.0	0.0
4-METHYLHEPTANE	57.5	0.0	45.8	43.3	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	45.3	34.0	37.1	33.6	0.0	40.8	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	41.5	35.9	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	44.3	36.5	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	237.8	182.0	124.4	75.6	190.7	199.6	101.5	42.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	52.7	29.6	28.6	0.0	23.2	23.3	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	100.1	80.9	85.0	85.3	33.2	35.7	71.4	51.2
UNIDENTIFIED C8	0.0	25.8	0.0	25.0	26.9	0.0	38.5	0.0
TRANS-2-OCTENE	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	150.3	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	27.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	51.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	31.0	0.0	0.0	0.0	31.5	31.5	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	132.8	131.6	125.7	137.3	25.2	47.0	95.2	75.3
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	29.0	30.1	31.3	31.8	0.0	0.0	22.1	18.7
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	29.0	30.1	31.3	31.8	0.0	0.0	22.1	18.7
ETHYLBENZENE	110.1	88.2	77.3	90.7	64.8	29.1	66.8	76.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	210.4	179.8	166.1	188.9	139.0	112.4	126.4	126.3

ENGINE: CUMMINS M11C	Test M2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	85.5	95.6	96.9	95.9	0.0	28.3	63.8	44.1
3-METHYLOCTANE	67.7	79.4	75.0	86.3	0.0	24.6	54.8	48.8
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	116.6	101.1	86.1	82.1	79.1	52.4	62.2	51.8
1-NONENE	212.9	151.5	86.3	25.4	139.0	152.6	103.2	39.8
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	293.8	278.1	278.2	302.2	79.4	96.0	233.0	174.8
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	23.2	0.0	22.7	0.0	0.0	0.0	0.0	24.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.6
2,4-DIMETHYLOCTANE	47.3	100.6	56.3	65.0	0.0	0.0	39.7	42.3
n-PROPYLBENZENE	8.9	0.0	0.0	0.0	33.1	0.0	132.6	106.5
1-METHYL-3-ETHYLBENZENE	159.0	143.2	113.9	114.7	37.5	132.9	145.4	82.6
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	128.0	123.6	30.1	34.9	0.0	0.0	121.8	0.0
1-METHYL-2-ETHYLBENZENE	76.7	79.0	82.4	91.1	0.0	0.0	43.2	53.8
1,2,4-TRIMETHYLBENZENE	282.4	216.5	143.0	151.6	156.7	0.0	41.7	38.5
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	187.5	129.5	104.9	120.7	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	62.8	36.9	119.6	0.0	216.5	56.6	141.6	88.5
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	130.3	126.0	124.1	153.4	38.7	0.0	81.8	82.8
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	41.2	35.4	38.8	63.9	0.0	0.0	35.1	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	50.6	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	0.0	48.7	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	38.6	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	28.8	29.4	41.2	51.9	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	30.6	48.7	46.2	68.5	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	503.3	394.2	448.1	502.3	184.4	127.2	301.4	344.7
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	53.6	38.1	32.6	52.0	0.0	0.0	75.1	0.0
TERT-1-BUT-2-METHYLBENZENE	70.5	79.3	48.4	115.7	0.0	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	87.1	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS M11C	Test M2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
N-PENT-BENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	100.2	45.2	39.9	51.1	31.2	0.0	78.8	31.4
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	35.9	30.0	44.4	70.3	324.9	198.0	134.4	116.9
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	1827.1	1946.2	1892.8	2465.7	547.3	512.5	504.2	754.0
FORMALDEHYDE	1606.5	1249.8	877.0	1982.8	2886.2	1855.5	1304.6	4283.4
ACETALDEHYDE	361.3	410.0	311.0	856.0	746.2	476.6	485.5	1513.5
ACROLEIN	55.8	24.0	1.2	165.7	266.5	112.9	51.0	369.9
ACETONE	33.0	10.2	0.0	0.0	0.0	0.0	0.0	238.5
PROPIONALDEHYDE	0.0	0.0	161.5	451.4	0.0	0.0	41.4	355.8
CROTONALDEHYDE	141.0	107.5	0.0	278.5	245.5	159.1	142.2	734.4
ISOBUTYRALDEHYDE, NOTE H	17.4	18.0	10.8	24.6	21.6	24.0	39.6	39.0
METHYL ETHYL KETONE, NOTE H	17.4	18.0	10.8	24.6	21.6	24.0	39.6	39.0
BENZALDEHYDE	17.4	0.0	0.0	0.0	66.6	12.0	0.0	35.4
ISOVALERALDEHYDE	12.0	0.0	0.0	0.0	6.6	0.0	0.0	111.3
VALERALDEHYDE	1.8	4.8	0.0	0.0	3.6	0.6	64.8	128.1
O-TOLUALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.3
M/P-TOLUALDEHYDE	0.0	0.0	0.0	0.0	135.7	0.0	0.0	856.8
HEXANALDEHYDE	0.0	0.0	31.8	0.0	0.0	0.0	40.2	45.6
DIMETHYLBENZALDEHYDE	0.0	0.0	0.0	0.0	27.0	0.0	0.0	143.7
SUMMED SPECIATED VALUES	15504.7	13195.7	10756.2	13953.6	14430.1	11555.2	8551.2	15974.8

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

APPENDIX O

HYDROCARBON SPECIATION INFORMATION FOR TESTING ON A CATERPILLAR 3196 ENGINE USING TWO DIFFERENT FUELS

Description	Page
Transient Cycle HC Speciation using Two Different Fuels, mg/hp-hr	O-1
Steady-State HC Speciation using 2D Fuel, mg/hr	O-6
Steady-State HC Speciation using NR Fuel, mg/hr	O-11

ENGINE: CATERPILLAR 3196	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	E12DFTP1	E12DFTP2	E12DBHL1	E2NRFTP1	E2NRFTP2	E2NRBHL1
METHANE	0.0	7.6	5.4	0.0	4.3	8.0
ETHANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLENE	5.6	16.7	3.1	11.6	12.8	9.2
PROPANE	0.4	0.0	0.0	14.8	0.0	0.0
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	0.0	0.0	0.0	2.9	1.0	5.3
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	0.0	0.0	0.0	2.0	0.0	0.0
TRANS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	2.4	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	0.6	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-BUTENE	1.1	0.6	0.0	0.0	0.0	0.0
PENTANE	2.0	1.8	0.1	1.1	0.0	0.0
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-PENTENE	1.0	0.6	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.8	0.0	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	0.6	0.6	0.0	0.0	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	0.8	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	0.1	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-PENTENE	0.4	0.0	0.0	0.0	0.0	0.0
1-HEXENE	0.4	0.0	0.0	0.0	0.0	0.0
HEXANE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C6 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	E12DFTP1	E12DFTP2	E12DBHL1	E2NRFTP1	E2NRFTP2	E2NRBHL1
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	0.2	0.0	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	0.2	0.0	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	1.1	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	2.5	1.1	2.3	5.7	3.2	1.3
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	0.2	0.2	0.0	0.6	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	0.0	0.0	0.1	1.7	0.0	0.6
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	E12DFTP1	E12DFTP2	E12DBHL1	E2NRFTP1	E2NRFTP2	E2NRBHL1
2,4-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	0.0	0.0	0.8	0.7	0.0	0.0
2,3,3-TRIMETHYLPENTANE	0.0	1.4	0.0	0.0	0.0	0.0
TOLUENE	0.0	3.4	2.2	3.3	1.3	1.2
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.7	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	0.0	0.0	0.0	0.0	0.0	0.6
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	0.0	0.0	0.6	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	0.0	0.7	0.6	0.0	0.0	0.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	0.9	0.9	0.9	0.0	0.6	0.0

ENGINE: CATERPILLAR 3196	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	E12DFTP1	E12DFTP2	E12DBHL1	E2NRFTP1	E2NRFTP2	E2NRBHL1
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLOCTANE	0.0	0.0	0.6	0.0	0.0	0.0
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	0.0	0.0	0.0	0.0	0.0	0.0
1-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
n-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	0.0	2.3	0.0	0.0	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	E12DFTP1	E12DFTP2	E12DBHL1	E2NRFTP1	E2NRFTP2	E2NRBHL1
N-PENT-BENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	3.3	1.9	8.9	3.1	1.7	0.0
FORMALDEHYDE	14.0	14.3	13.0	13.6	14.3	12.9
ACETALDEHYDE	5.5	5.1	4.3	4.8	5.1	4.5
ACROLEIN	0.6	0.5	0.5	1.2	1.2	1.2
ACETONE	0.0	0.0	0.0	0.0	0.0	41.9
PROPIONALDEHYDE	0.2	0.0	0.0	2.0	2.1	1.8
CROTONALDEHYDE	1.5	1.9	1.7	1.6	1.6	1.5
ISOBUTYRALDEHYDE, NOTE H	0.5	0.4	0.3	0.5	0.5	0.4
METHYL ETHYL KETONE, NOTE H	0.5	0.4	0.3	0.5	0.5	0.4
BENZALDEHYDE	1.4	0.2	0.0	0.0	0.4	0.0
ISOVALERALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0
VALERALDEHYDE	0.5	0.0	0.0	0.0	0.0	0.0
O-TOLUALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0
M/P-TOLUALDEHYDE	0.3	1.0	0.9	0.0	0.0	0.0
HEXANALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0
DIMETHYLBENZALDEHYDE	0.0	0.0	0.3	0.0	0.9	0.0
SUMMED SPECIATED VALUES	45	62	50	76	52	91

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: CATERPILLAR 3196	Test E12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANE	786.8	152.8	147.6	0.0	288.7	123.8	0.0	0.0
ETHYLENE	723.7	759.3	1106.1	3977.6	1260.8	1040.4	1069.1	727.5
PROPANE	916.6	555.2	420.8	858.2	905.6	157.3	0.0	0.0
PROPYLENE	267.4	0.0	0.0	0.0	138.8	0.0	0.0	0.0
ACETYLENE	182.5	180.3	361.3	694.1	0.0	0.0	124.9	166.3
PROPADIENE	0.0	0.0	0.0	0.0	230.8	0.0	0.0	0.0
BUTANE	321.1	284.5	200.7	378.5	0.0	0.0	0.0	0.0
TRANS-2-BUTENE	309.4	525.5	0.0	0.0	257.1	0.0	0.0	0.0
1-BUTENE	0.0	808.0	0.0	0.0	0.0	0.0	0.0	2011.7
2-METHYLPROPENE (ISOBUTYLENE)	0.0	0.0	223.9	1436.6	0.0	154.5	0.0	0.0
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	0.0	0.0	0.0	2878.9	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	260.7	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	0.0	0.0	0.0	0.0	65.7	0.0	0.0	0.0
2-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	61.0	0.0	0.0
PENTANE	309.2	0.0	74.6	138.4	0.0	0.0	0.0	0.0
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-PENTENE	0.0	0.0	507.9	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	60.8	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	53.1	0.0	0.0	77.2	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTENE	0.0	0.0	311.6	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	76.5	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	67.1	0.0	0.0	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	95.9	87.7	143.3	292.1	0.0	0.0	0.0	0.0
2-METHYL-1-PENTENE	36.2	0.0	0.0	57.3	45.2	53.2	36.1	0.0
1-HEXENE	36.2	0.0	0.0	57.3	45.2	53.2	36.1	0.0
HEXANE	78.5	101.2	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C6 OLEFINS	86.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	Test E12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	474.8	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	59.5	0.0	0.0	33.0	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	58.3	0.0	0.0	32.3	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	88.8	109.6	80.8	155.4	80.6	120.6	90.9	0.0
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	51.4	23.8	36.1	65.3	70.1	71.9	50.7	16.9
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	0.0	0.0	205.3	0.0	0.0	0.0	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.0	0.0	59.1	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	68.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	Test E12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	78.1	0.0	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	425.4	269.5	249.4	343.9	225.3	221.1	222.2	0.0
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	0.0	429.9	0.0	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	54.9	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	62.0	73.8	0.0	0.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	290.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	67.0	60.7	110.2	81.7	0.0	0.0	0.0	0.0
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	0.0	99.7	115.9	82.4	0.0	55.3	60.2	0.0
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	60.4	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	0.0	107.7	67.0	91.1	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	186.9	144.1	134.2	144.6	113.5	81.9	88.6	0.0

ENGINE: CATERPILLAR 3196	Test E12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLOCTANE	0.0	0.0	0.0	56.7	0.0	0.0	0.0	0.0
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	148.7	66.6	58.9	61.6	581.8	0.0	0.0	0.0
1-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	142.6	190.3	177.1	0.0	0.0	0.0	0.0	0.0
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	58.4	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	133.8	75.4	67.7	72.4	322.5	0.0	0.0	0.0
n-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	0.0	0.0	85.6	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	131.4	0.0	42.5	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	123.9	0.0	40.1	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	93.0	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.0	513.9	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	58.3	59.6	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	51.2	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	194.2	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	316.9	260.1	0.0	0.0	121.2	73.6	0.0	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	168.6	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	491.9	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	Test E12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
N-PENT-BENZENE	0.0	71.9	0.0	75.6	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	659.5	344.0	234.1	154.8	339.5	105.1	76.4	78.2
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	301.0	336.1	318.9	191.6	488.8	251.8	0.0	0.0
FORMALDEHYDE	2082.1	1465.1	1585.5	5118.1	1346.2	1068.5	926.9	1112.8
ACETALDEHYDE	699.2	536.6	558.1	1866.4	389.5	302.0	289.9	423.1
ACROLEIN	222.1	166.9	198.0	856.3	192.1	148.9	127.3	149.7
ACETONE	0.0	0.0	0.0	145.9	0.0	0.0	0.0	0.0
PROPIONALDEHYDE	169.3	148.2	162.6	613.7	103.2	0.0	0.0	106.5
CROTONALDEHYDE	88.2	98.4	145.2	766.8	202.3	25.2	43.8	144.3
ISOBUTYRALDEHYDE, NOTE H	36.0	25.8	29.4	120.1	18.0	0.0	0.0	30.3
METHYL ETHYL KETONE, NOTE H	36.0	25.8	29.4	120.1	18.0	0.0	0.0	30.3
BENZALDEHYDE	0.0	130.2	0.0	552.5	21.0	0.0	21.0	100.2
ISOVALERALDEHYDE	4.2	2.4	5.4	85.9	0.6	0.0	0.0	8.1
VALERALDEHYDE	23.4	14.4	10.2	97.3	38.4	0.0	0.0	23.1
O-TOLUALDEHYDE	0.0	0.0	0.0	240.2	0.0	0.0	0.0	0.0
M/P-TOLUALDEHYDE	35.4	33.6	0.0	365.7	71.4	0.0	0.0	130.2
HEXANALDEHYDE	0.0	0.0	0.0	36.0	2.4	0.0	0.0	0.0
DIMETHYLBENZALDEHYDE	0.0	0.0	0.0	7.8	16.2	0.0	0.0	0.0
SUMMED SPECIATED VALUES	10136.2	10002.3	8904.4	21213.6	11803.3	4398.3	3264.3	5259.4

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: CATERPILLAR 3196	Test E2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	0.0	174.2	0.0	1200.2	0.0	936.6	0.0	4276.4
ETHANE	0.0	1184.4	0.0	0.0	749.1	0.0	0.0	0.0
ETHYLENE	996.5	482.4	725.2	2391.4	1146.0	1193.0	1009.8	760.5
PROPANE	0.0	0.0	2410.0	0.0	0.0	0.0	0.0	0.0
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	402.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	0.0	0.0	0.0	0.0	29.7	0.0	0.0	0.0
TRANS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	3363.9	0.0	3147.4	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PENTANE	30.0	13.6	11.7	0.0	0.0	9.9	0.0	0.0
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	0.0	0.0	0.0	62.9	0.0	0.0	0.0	0.0
TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	40.3	42.0	11.0	30.8	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	68.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-PENTENE	25.1	0.0	45.4	64.9	42.4	53.0	35.8	0.0
1-HEXENE	25.1	0.0	45.4	64.9	42.4	53.0	35.8	0.0
HEXANE	0.0	0.0	67.9	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C6 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

ENGINE: CATERPILLAR 3196	Test E2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	711.3	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	53.6	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	52.6	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	135.9	82.5	136.4	271.2	121.8	97.9	136.9	194.1
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	337.2	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	6.3	0.0	0.0	5.4	2.5	0.0	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	414.5	0.0	0.0	25.7	0.0	2.7	0.0	0.0
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	811.2	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	Test E2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	56.6	0.0	0.0	0.0	61.3	94.4	0.0	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	348.2	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	10.4	0.0	4.0	6.0	0.0	0.0	0.0	0.0
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	282.9	647.9	248.6	125.8	129.7	107.8	112.5	0.0
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	53.9	63.7	0.0	0.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	0.0	89.1	105.7	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	0.0	86.9	86.7	63.9	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	51.8	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	60.8	72.6	61.9	57.5	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	109.3	151.4	123.9	102.3	65.4	69.2	0.0	0.0

ENGINE: CATERPILLAR 3196	Test E2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	0.0	66.2	54.6	0.0	0.0	0.0	0.0	0.0
3-METHYLOCTANE	0.0	0.0	54.7	0.0	0.0	0.0	0.0	0.0
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	74.5	65.9	766.6	0.0	0.0	0.0	0.0	0.0
1-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	0.0	210.2	126.7	56.6	0.0	0.0	0.0	0.0
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	0.0	0.0	368.9	0.0	0.0	0.0	0.0	0.0
n-PROPYLBENZENE	344.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	377.7	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	307.5	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CATERPILLAR 3196	Test E2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
N-PENT-BENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	0.0	0.0	0.0	179.8	95.2	0.0	0.0	0.0
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	0.0	357.9	0.0	0.0	0.0	0.0	0.0	0.0
FORMALDEHYDE	2130.8	1374.8	1656.2	5021.0	1406.0	1084.3	950.7	1115.5
ACETALDEHYDE	740.9	499.7	602.9	1807.5	388.3	300.8	263.5	361.0
ACROLEIN	51.0	0.0	38.4	130.8	74.4	24.6	32.4	39.6
ACETONE	0.0	0.0	161.5	136.8	10.2	0.0	0.0	0.0
PROPIONALDEHYDE	335.6	0.0	374.1	1206.8	0.0	0.0	0.0	226.9
CROTONALDEHYDE	264.2	293.7	380.1	898.9	353.5	90.1	238.9	32.7
ISOBUTYRALDEHYDE, NOTE H	75.1	0.0	79.3	84.6	73.8	14.4	33.6	99.6
METHYL ETHYL KETONE, NOTE H	75.1	0.0	79.3	84.6	73.8	14.4	33.6	99.6
BENZALDEHYDE	12.0	0.0	0.0	0.0	115.2	0.0	29.4	138.6
ISOVALERALDEHYDE	0.0	0.0	0.0	87.6	88.8	0.0	15.0	16.8
VALERALDEHYDE	16.2	0.0	0.0	38.4	26.4	0.0	0.0	0.0
O-TOLUALDEHYDE	0.0	0.0	0.0	100.8	120.6	0.0	138.6	13.2
M/P-TOLUALDEHYDE	0.0	0.0	0.0	727.3	247.2	0.0	49.8	152.8
HEXANALDEHYDE	0.0	0.0	0.0	0.0	33.6	0.0	0.0	34.5
DIMETHYLBENZALDEHYDE	82.3	0.0	0.0	0.0	67.8	0.0	0.0	0.0
SUMMED SPECIATED VALUES	10121.9	7159.2	13413.2	15460.6	5650.0	4209.9	3116.3	7561.9

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

APPENDIX P

HYDROCARBON SPECIATION INFORMATION FOR TESTING ON A CUMMINS ISB190 ENGINE USING TWO DIFFERENT FUELS

Description	Page
Transient Cycle HC Speciation using Two Different Fuels, mg/hp-hr	P-1
Steady-State HC Speciation using 2D Fuel, mg/hr	P-6
Steady-State HC Speciation using NR Fuel, mg/hr	P-11

ENGINE: CUMMINS ISB190	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	B12DFTP1	B12DFTP2	B12DBHL1	B2NRFTP1	B2NRFTP2	B2NRBHL1
METHANE	0.0	14.3	1.3	15.5	3.1	8.6
ETHANE	0.0	0.0	0.0	0.8	0.9	0.9
ETHYLENE	12.1	11.0	13.7	11.8	13.3	8.9
PROPANE	0.0	0.0	0.0	1.4	1.6	0.3
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	3.0	2.7	3.1	3.3	3.2	0.0
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	0.0	0.0	1.4	0.2	0.0	0.5
TRANS-2-BUTENE	1.8	0.0	0.0	0.0	0.0	0.0
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	0.0	0.0	0.0	0.0	0.0	0.3
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
PENTANE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.8
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-PENTENE	0.0	0.0	0.4	0.0	0.0	0.0
1-HEXENE	0.0	0.0	0.4	0.0	0.0	0.0
HEXANE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C6 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	B12DFTP1	B12DFTP2	B12DBHL1	B2NRFTP1	B2NRFTP2	B2NRBHL1
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	1.2	1.5	0.0	1.8	1.4	1.1
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.1	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	1.5	0.2	0.2	0.5	0.3	0.0
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	B12DFTP1	B12DFTP2	B12DBHL1	B2NRFTP1	B2NRFTP2	B2NRBHL1
2,4-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.1
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	2.8	0.0	5.0	4.4	1.4	0.0
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	0.0	0.0	0.0	0.0	0.0	0.7
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	0.0	0.7	0.9	0.0	0.0	0.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	0.0	0.0	1.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	B12DFTP1	B12DFTP2	B12DBHL1	B2NRFTP1	B2NRFTP2	B2NRBHL1
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	0.0	0.0	0.0	0.0	0.0	0.0
1-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0
n-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.0	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	mg/hp-hr					
	2D FUEL			NONROAD FUEL		
COMPOUND	B12DFTP1	B12DFTP2	B12DBHL1	B2NRFTP1	B2NRFTP2	B2NRBHL1
N-PENT-BENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	0.0	0.0	0.0	0.0	0.9	0.0
FORMALDEHYDE	15.7	14.8	17.8	15.0	14.4	16.4
ACETALDEHYDE	5.4	5.2	6.3	5.4	5.1	6.0
ACROLEIN	2.1	1.9	2.3	1.1	0.8	0.7
ACETONE	0.2	0.0	0.0	0.0	0.0	0.0
PROPIONALDEHYDE	1.4	1.4	2.1	1.0	1.0	1.4
CROTONALDEHYDE	2.5	2.0	2.2	1.7	1.7	27.3
ISOBUTYRALDEHYDE, NOTE H	0.2	0.1	0.2	0.3	0.4	0.1
METHYL ETHYL KETONE, NOTE H	0.2	0.1	0.2	0.3	0.4	0.1
BENZALDEHYDE	0.4	0.3	0.5	0.7	0.5	0.0
ISOVALERALDEHYDE	0.2	0.2	0.0	0.0	0.0	0.0
VALERALDEHYDE	0.3	0.3	0.4	0.4	0.7	0.5
O-TOLUALDEHYDE	0.0	0.0	0.4	0.0	0.0	1.5
M/P-TOLUALDEHYDE	1.4	1.4	1.6	2.9	2.7	0.0
HEXANALDEHYDE	0.2	0.4	0.0	0.2	0.3	0.2
DIMETHYLBENZALDEHYDE	0.0	0.0	0.8	0.4	0.0	0.0
SUMMED SPECIATED VALUES	53	58	62	69	54	76

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: CUMMINS ISB190	Test B12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	0.0	0.0	408.1	228.2	0.0	0.0	0.0	0.0
ETHANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLENE	388.1	333.2	705.7	2202.4	242.4	286.4	276.1	441.2
PROPANE	256.8	0.0	2.1	0.0	0.0	0.0	0.0	0.0
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	67.2	86.4	218.4	473.2	60.6	65.5	62.0	71.7
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	26.4	37.7	5.3	0.0	79.4	0.0	0.0	0.0
TRANS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	24.5	0.0	0.0
1-BUTENE	28.7	0.0	0.0	34.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	47.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	35.8	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PENTANE	36.7	25.5	0.0	0.0	3.0	3.6	5.6	0.3
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	46.0	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	0.0	0.0	25.3	51.6	0.0	0.0	0.0	0.0
2-METHYL-1-PENTENE	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEXENE	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXANE	69.7	34.9	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C6 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	Test B12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	27.8	41.5	0.0
2,2,3-TRIMETHYLBUTANE	33.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	68.4	49.0	82.5	156.6	45.7	45.0	0.0	0.0
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	20.0	3.3	0.0	0.0	16.2	2.6	0.2	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	31.5	10.6	1.3	5.9	11.4	0.0	4.7	0.0
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	Test B12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	26.0	0.0	0.0	0.0	34.2	0.0	31.2	0.0
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	0.0	0.0	788.1	691.7	13.7	1234.5	452.3	282.5
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	26.1	0.0	39.1	32.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	0.0	0.0	34.3	31.8	0.0	0.0	27.6	0.0
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	37.1	39.6	33.3	59.8	30.7	33.3	42.4	0.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	79.2	57.8	67.4	71.4	66.6	44.3	64.2	0.0

ENGINE: CUMMINS ISB190	Test B12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	31.9	0.0
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	42.4	33.3	30.1	32.1	0.0	0.0	0.0	0.0
1-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	0.0	0.0	34.4	0.0	0.0	0.0	0.0	0.0
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	46.9	0.0	0.0	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	97.3	0.0	14.5	72.9	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.0	13.7	68.7	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	69.3	60.9	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	49.1	0.0	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	Test B12DU8B (2D Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
N-PENT-BENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	0.0	0.0	0.0	0.0	59.3	0.0	0.0	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	143.4	0.0	0.0	94.5	0.0	0.0	0.0	0.0
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	0.0	0.0	188.0	0.0	48.7	0.0	0.0	0.0
FORMALDEHYDE	340.9	330.1	838.9	2342.6	515.0	238.9	329.0	605.0
ACETALDEHYDE	94.2	114.6	306.1	826.9	41.4	54.6	106.3	196.6
ACROLEIN	39.6	37.8	105.6	350.7	19.8	23.4	31.8	72.0
ACETONE	0.0	0.0	0.0	58.2	0.0	0.0	0.0	0.0
PROPIONALDEHYDE	0.0	0.0	7.2	330.3	17.4	0.0	40.8	67.2
CROTONALDEHYDE	25.8	25.8	85.8	321.3	29.4	36.6	55.8	112.2
ISOBUTYRALDEHYDE, NOTE H	0.0	4.2	7.8	36.0	0.0	0.0	0.0	3.0
METHYL ETHYL KETONE, NOTE H	0.0	4.2	7.8	36.0	0.0	0.0	0.0	3.0
BENZALDEHYDE	9.6	0.6	12.6	0.0	0.0	0.0	0.0	16.2
ISOVALERALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
VALERALDEHYDE	3.0	2.4	16.2	37.8	0.0	0.0	0.0	5.4
O-TOLUALDEHYDE	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M/P-TOLUALDEHYDE	0.0	0.0	71.4	364.5	0.0	0.0	0.0	51.6
HEXANALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DIMETHYLBENZALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUMMED SPECIATED VALUES	2098.3	1230.9	4220.5	9167.1	1381.8	2125.5	1638.9	1935.2

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.

ENGINE: CUMMINS ISB190	Test B2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
METHANE	288.1	0.0	0.0	0.0	0.0	0.0	0.0	261.1
ETHANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLENE	376.8	272.9	570.6	1910.6	116.1	148.6	139.8	274.4
PROPANE	0.0	0.0	0.0	24.7	0.0	0.0	9.3	0.0
PROPYLENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACETYLENE	41.9	79.7	161.6	16.1	0.0	0.0	14.7	0.0
PROPADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTANE	0.0	0.0	0.0	0.0	62.3	133.5	0.0	0.0
TRANS-2-BUTENE	26.9	25.2	0.0	35.6	0.0	25.2	0.0	0.0
1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPENE (ISOBUTYLENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPROPANE (NEOPENTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPROPANE (ISOBUTANE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTANE (ISOPENTANE)	0.0	0.0	0.0	28.8	0.0	0.0	0.0	0.0
2-BUTYNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-PENTENE	55.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1-BUTENE	0.0	0.0	0.0	36.8	0.0	0.0	0.0	0.0
PENTANE	31.2	29.4	24.8	37.6	13.0	17.0	11.7	29.6
UNIDENTIFIED C5 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-1,3-BUTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYL-1-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-BUTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTADIENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLBUTANE	0.0	0.0	0.0	28.2	0.0	0.0	0.0	0.0
MTBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6
2-METHYL-1-PENTENE	0.0	0.0	18.3	13.0	0.0	0.0	0.0	0.0
1-HEXENE	0.0	0.0	18.3	13.0	0.0	0.0	0.0	0.0
HEXANE	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C6 OLEFINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.7
TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	Test B2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
DI-ISOPROPYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLPENTANE, NOTE A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOPENTANE, NOTE A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	2.5	40.8	0.0	0.0
2,2,3-TRIMETHYLBUTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYLCYCLOPENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BENZENE	59.2	60.7	91.8	122.5	60.0	60.1	55.9	64.8
3-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLPENTANE	0.0	0.0	0.0	0.0	4.7	17.3	0.0	0.0
1,1-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-AMYL METHYL ETHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CYCLOHEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.7
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLPENTANE	23.5	5.4	2.0	13.9	0.0	0.0	0.0	0.0
2-METHYL-1-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEPTANE	0.0	0.0	0.0	0.0	27.1	32.8	25.5	0.0
CIS-3-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYL-2-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYL-TRANS-3-HEXENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYL-CIS-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-1-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-HEPTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYL-2-PENTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	Test B2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
2,4-DIMETHYLHEXANE	33.2	0.0	0.0	0.0	0.0	43.2	0.0	27.5
1-TRANS-2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-TRANS-2-CIS-3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0
2,3,3-TRIMETHYLPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOLUENE	0.0	121.6	358.6	265.1	0.0	22.2	199.3	2.1
2,3-DIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4-DIMETHYLHEXANE, NOTE B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-CIS,2-TRANS,3-TRIMETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,3-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-ETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-3-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-1-ETHYL-CYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-4-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCTANE	0.0	0.0	0.0	28.4	0.0	0.0	31.0	0.0
UNIDENTIFIED C8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-1,3-DIMETHYLCYCLOHEXANE, NOTE C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-2-OCTENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,5-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1-METHYL-2-ETHYLCYCLOPENTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-1,2-DIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,6-DIMETHYLHEPTANE, NOTE D	0.0	0.0	28.4	26.4	0.0	0.0	0.0	0.0
1,1,3-TRIMETHYLCYCLOHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,5-DIMETHYLHEPTANE, NOTE E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHYLBENZENE	0.0	23.6	33.8	36.3	24.4	26.0	24.7	0.0
2,3,4-TRIMETHYLHEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
m-& p-XYLENE	31.2	32.1	45.9	0.0	0.0	103.3	62.1	0.0

4-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINE: CUMMINS ISB190	Test B2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
3,4-DIMETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-ETHYLHEPTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-METHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STYRENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-XYLENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CIS-3-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NONANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRANS-2-NONENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPROPYLBENZENE (CUMENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,4-DIMETHYLOCTANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-BUTYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-DECENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DECANE, NOTE F	0.0	0.0	27.7	0.0	0.0	0.0	0.0	0.0
ISOBUTYLBENZENE, NOTE F	0.0	0.0	26.2	0.0	0.0	0.0	0.0	0.0
1,3,-DIMETHYL-5-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
METHYLPROPYLBENZENE (sec butylbenzene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-TRIMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INDAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-ISOPROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-3-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-4-N-PROPYLBENZENE, NOTE G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2 DIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-METHYL-2-N-PROPYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-4-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-DIMETHYL-2-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNDECANE	0.0	0.0	79.4	0.0	0.0	0.0	0.0	0.0
1,2-DIMETHYL-3-ETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-METHYLBUTYLBENZENE (sec AMYLBENZENE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,4 DIMETHYLCUMENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,5-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-2-METHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3,4-TETRAMETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINE: CUMMINS ISB190	Test B2NRU8E (Nonroad Fuel)							
	mg/hr							
COMPOUND	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
N-PENT-BENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERT-1-BUT-3,5-DIMETHYLBENZENE	70.5	0.0	0.0	0.0	124.1	141.8	74.9	0.0
TERT-1-BUTYL-4-ETHYLBENZENE	0.0	0.0	30.5	0.0	0.0	0.0	0.0	0.0
NAPHTHALENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DODECANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-TRIETHYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXYLBENZENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIDENTIFIED C9-C12+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORMALDEHYDE	324.1	305.6	804.5	1916.8	151.1	237.0	306.8	591.3
ACETALDEHYDE	116.4	129.7	305.0	701.8	37.2	69.0	106.9	206.5
ACROLEIN	38.4	25.2	45.0	98.4	0.0	1.2	3.6	29.1
ACETONE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROPIONALDEHYDE	0.0	54.0	0.0	120.1	0.0	0.0	61.2	51.3
CROTONALDEHYDE	34.2	3.6	99.1	287.5	0.0	0.0	0.0	0.0
ISOBUTYRALDEHYDE, NOTE H	0.0	0.0	16.8	51.6	0.0	0.0	0.0	4.5
METHYL ETHYL KETONE, NOTE H	0.0	0.0	16.8	51.6	0.0	0.0	0.0	4.5
BENZALDEHYDE	17.4	18.0	27.6	81.6	0.0	0.0	0.0	0.0
ISOVALERALDEHYDE	0.0	0.0	0.0	63.0	0.0	0.0	0.0	0.0
VALERALDEHYDE	0.0	0.0	35.4	65.4	0.0	0.0	0.0	0.0
O-TOLUALDEHYDE	0.0	0.0	23.4	126.7	0.0	0.0	0.0	0.0
M/P-TOLUALDEHYDE	27.6	45.6	136.9	356.6	0.0	0.0	0.0	0.0
HEXANALDEHYDE	0.0	0.0	18.0	0.0	0.0	0.0	0.0	0.0
DIMETHYLBENZALDEHYDE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUMMED SPECIATED VALUES	1596.4	1232.3	3071.3	6558.2	622.6	1130.9	1127.5	1650.5

A - 2,2-Dimethylpentane and methylcyclopentane co-elute. GC peak area split equally between the two compounds.

B - 3-Methyl-3-ethy-pentane co-elutes with reported compound. Not reported separately.

C - Cis-1,4-Dimethylcyclohexane co-elutes with reported compound. Not reported separately.

D - Propylcyclopentane co-elutes with reported compound. Not reported separately.

E - 2,5-Dimethylheptane and 3,5-dimethylheptane co-elute. GC peak area was applied to first compound only.

F - Decane and isobutylbenzene co-elute. GC peak area split equally between the two compounds.

G - n-Butylbenzene co-elutes with reported compound. Not reported separately.

H - Isobutyraldehyde and methyl ethyl ketone co-elute. LC peak area split equally between the two compounds.