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**June 21, 2010 — June 21, 2011**

George Zoubul, Mel Cahoon, and  
Richard Kolb

*Volvo Penta of the Americas, Inc.  
Chesapeake, Virginia*

**NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.**

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NREL Technical Monitor: Keith Knoll  
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**This publication received minimal editorial review at NREL.**

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# **VOLVO PENTA**

## **4.3 GL E15 Emissions and Durability Test**



**By**

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**Mel Cahoon**

**Richard Kolb**

**July 20, 2011**

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This report and the work described herein were funded by the American Reinvestment and Recovery Act (ARRA) under stewardship of the Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Vehicle Technologies Program. The technical direction of Kevin Stork (Fuels Technology Team Lead) and Steve Przesmitzki is gratefully acknowledged.

## List of Abbreviations and Acronyms

AKI	Anti Knock Index
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
DOE	Department of Energy
E0	Unleaded gasoline with no ethanol
E10	Unleaded gasoline with 10% ethanol by volume
E15	Unleaded gasoline with 15% ethanol by volume
E98	Unleaded gasoline with 98% ethanol by volume
EGT	Exhaust gas temperature
EPA	Environmental Protection Agency
g/kW-hr	Grams per kilowatt hour
HC	Total Hydrocarbons
HC + NO <sub>x</sub>	Total Hydrocarbon plus Nitrogen Oxide
hp	horsepower
ICOMIA	International Council of Marine Industry Associations
Indolene	EPA certification gasoline containing no ethanol
ISO	International Organization for Standardization
kW	kilowatt
L	liter
NMMA	National Marine Manufacturers Association
NO <sub>x</sub>	Nitrogen Oxide
NREL	National Renewable Energy Laboratory
OHV	Over head valve
SD/I	Sterndrive/Inboard
VPA	Volvo Penta of the Americas, LLC
WOT	Wide open throttle

## Executive Summary

A new Volvo Penta carbureted 4.3 GL engine was subjected to emissions and dynamometer durability testing from break in to expected end of life using an accelerated ICOMIA marine emissions cycle and E15 fuel. The accelerated ICOMIA cycle used here was based on the standard ICOMIA cycle but with limited Mode 5 (idle) and Mode 4 (25% load) operation. The E15 fuel used for this experiment was a splash blend of retail-grade gasoline (E10) with denatured ethanol (E98). No control over fuel properties or additives was exercised beyond ethanol content. All aging was conducted using this splash-blended E15 fuel. Exhaust emissions were sampled at 5 intervals during the test cycle – at the beginning of life and at 25% intervals thereafter until completion of the abbreviated ICOMIA cycle. Emissions at each interval were measured using both the site blended E15 aging fuel and EPA (40 CFR §86.113-04) certification fuel (E0). Numerous engine operating parameters were monitored at each test interval, including exhaust gas temperature (EGT), torque, power, barometric pressure, air temp, fuel flow, HC, NO<sub>x</sub>, CO and CO<sub>2</sub>.

The engine completed the durability test cycle with no noticeable impact on mechanical durability or engine power. Emissions performance degraded beyond the CARB 3-Star certification limit for this engine family. The majority of this emissions degradation occurred by the first emissions test interval (at 83 hours or 28 % of expected life) with HC+NO<sub>x</sub> just exceeding the CARB limit of 14.0 g/kW-hr with E0. This rapid degradation in emissions is inconsistent with VPA's prior experience with other 4.3 GL engines aged on E0 and E10 fuels. It should be noted, however, that this result is from only one engine under laboratory test conditions. It would be inappropriate to consider these results conclusive and applicable to the fleet at-large. The test engine finished the durability cycle with emissions of HC+NO<sub>x</sub> about 4% over the CARB 3-Star standard.

Although the E15 fuel used for emissions testing was not blended from certification-grade gasoline, emissions tests were performed on both fuels to provide some indication of the effects of increased ethanol. Emissions comparisons between E0 (certification-grade) and E15 (retail-grade) fuels at each test interval showed that E15 resulted in lower emissions of CO and HC, but with an increase in NO<sub>x</sub> emission. This is the expected behavior for non-feedback controlled carbureted engines with increased oxygen content in the fuel. Fuel consumption also increased with E15 compared with E0 – again, as expected due to ethanol's lower energy density compared with gasoline.

Immediate impacts of increased ethanol in fuel for E15 vs. certification gasoline are shown in the following table.

**Summary Table**  
**Engine Emissions, Fuel consumption and Exhaust Gas Temperatures**  
**E15 (retail-grade) VS E0 (certification-grade)**

<b>HC</b> <b>(g/kW-hr)</b>	<b>NO<sub>x</sub></b> <b>(g/kW-hr)</b>	<b>HC+NO<sub>x</sub></b> <b>(g/kW-hr)</b>	<b>CO</b> <b>(g/kW-hr)</b>	<b>CO<sub>2</sub></b> <b>(g/kW-hr)</b>	<b>Fuel</b> <b>(g/kW-hr)</b>	<b>EGT</b> <b>°C</b>
-23.25%	+8.81%	-1.66%	-39.69%	+0.79%	+2.18%	+2.23%

Values included in this table are the average values over the five consecutive emissions tests.

Throughout testing, the engine exhibited poor starting characteristics on E15 fuel for both hot re-start and cold-start conditions. These characteristics included backfire, stumble, idle surge, and stall on initial start-up. Cranking time to start and smooth idle was roughly doubled compared with typical E0 operation. This result was expected since the carburetor on this engine is factory set for lean operation to ensure emissions compliance. Test protocols did not include carburetor adjustment to account for the increased oxygen present in the E15 fuel.



## **Background**

DOE via its national labs has been heavily engaged in evaluating the potential impacts of mid-level ethanol blends – gasoline blended with 15% to 20% ethanol – on the U.S. motor vehicle population as well as non-road and specialty engines. Because on-highway vehicles consume the vast majority of gasoline in the U.S., vehicle impacts have been the dominant focus of DOE’s studies to-date. However, no credible data currently exists to suggest how marine engines would adapt to these higher ethanol blends in conventional gasoline.

The present study was commissioned to provide an initial assessment of how marine engines would adapt to higher ethanol blends in gasoline. This study is one part of a larger effort including evaluations of both sterndrive/inboard (SD/I) and outboard marine engine durability. Both evaluations are considered only as pilot studies and represent only a small portion of the overall test plan originally outlined by the marine industry for mid-level ethanol blends evaluation. In this study, a single SD/I engine manufactured by Volvo Penta is evaluated over an industry-standard durability test cycle using E15 fuel. Both emissions and durability assessments are included.

## **Engine Description**

A VPA 4.3 GL SD/I was used as the test engine for this program. This engine was chosen in consultation with NMMA (National Marine Manufacturers Association), a trade organization representing the U.S. recreational boating industry. The VPA 4.3 GL provides a good representation of legacy and current SD/I product which may exhibit sensitivity to increased ethanol in gasoline. Since the 4.3 GL engine began production in the early 1990s, it has retained a significant share of the entry-level boating market for VPA. Because this engine uses a non-feedback control, carbureted fuel system, it may exhibit sensitivity to increased oxygen in the fuel consistent with E15. The engine tested was a 2010 model randomly selected from the production line. Detailed engine technical data is included in the following table.

**Table 1. Engine Technical Data**

Engine designation	4.3 GL
Serial Number	A129310
Power - Crankshaft {kW, (hp)}	141 (190)
Max engine speed	4600 RPM
Displacement	4.3 L
Specific output	44.2 hp/L
Gas Exchange	4 - Stroke
Valve arrangement	OHV - 2 valves per cylinder
Number of cylinders and arrangement	V6
Fuel system	2 barrel carburetor
Fuel Requirement	87octane (AKI)
Bore/stroke (mm)	101.6/88.4
Compression ratio	9.4:1
Cooling system	Thermostatically controlled seawater cooling
Emission Compliance	CARB 3 star compliant (14 g/kW-hr HC+NO <sub>x</sub> , 150 g/kW-hr CO)

## **Test Program**

### **Test Protocol**

Prior to emissions and durability testing, the primary test engine underwent a standard 24 hour break-in procedure per owner's manual recommendation. This break-in procedure is essential to ensure that piston rings are properly seated preventing excessive oil consumption and oil dilution both of which can effect emissions measurement. This was conducted using retail grade gasoline (E10).

Following engine break-in, the test engine went through beginning of life emissions testing using certification-grade E0 (Indolene) fuel with testing protocols in accordance with Code of Federal Regulations (CFR) Title 40, Parts 1045 and 1065 requirements. Analyzed exhaust constituents included HC, NO<sub>x</sub>, CO, and CO<sub>2</sub>. Power tests were conducted per ISO 8865 protocols. The test engine was then switched to the E15 aging test fuel and emissions and power tests were repeated. All emissions testing was done in triplicate at each point on each fuel. Emissions testing was conducted at approximately each of the following accumulated durability test points: 2%, 25%, 50%, 75% and 100% of expected engine life. At each of these test points, the engine was tested for emissions using both the E15 aging and Indolene (E0) test fuels.

### **Test Cycle**

A modified ICOMIA (Fast) cycle was used for this test. This fast cycle was chosen to achieve the expected engine life in less time than the full 480 hours required. By eliminating much of the idle time which contributes very little to the engine aging process, the total time was reduced to approximately 310 hours. In a standard 480 hour ICOMIA test, the engine accumulates 28.8 hours at Mode 1 (WOT) and 67.2 hours at Mode 2. The ICOMIA Fast cycle holds these hour

accumulation times the same while reducing the total durability cycle time to 310 hours. As the table below shows, this shorter cycle is achieved by eliminating time primarily from mode 5 (idle) as well as a small portion from mode 4. Hour accumulation at the highest power conditions, modes 1, 2 and 3, are maintained (see Appendix I).

**Table 2. ICOMIA 5-mode Test Cycle (Based on ICOMIA Standard No. 36-88)**

<b>Mode</b>	<b>Engine Speed (% of Rated)</b>	<b>Engine Torque (% of Rated)</b>	<b>STANDARD ICOMIA CYCLE Time</b>	<b>FAST ICOMIA CYCLE Time</b>
5	Idle	0	40% 192 hours	22.6% 70 hours
4	40	25.3	25% 120 hours	23.2% 71.9 hours
3	60	46.5	15% 72 hours	23.2% 71.9 hours
2	80	71.6	14% 67.2 hours	21.7% 67.3 hours
1	100	100	6% 28.8 hours	9.3% 28.8 hours

The ICOMIA Fast cycle was operated as an inverted “V” pattern progressing from mode 5 (idle) to mode 1 (WOT) and then back to mode 5 (idle) again. Times accumulated at each mode point, through one iteration of this cycle, are as indicated in Table 3. This cycle is operated recursively for 480 iterations to achieve a total hour accumulation time of 310 hours.

**Table 3. ICOMIA Fast 5-Mode Test Cycle Times (1-Cycle)**

<b>Mode</b>	<b>Engine Speed (% of Rated Speed)</b>	<b>Engine Torque (% of Rated Torque)</b>	<b>Time at mode (Min)</b>
5	Idle	0	1.8
4	40	25.3	4.2
3	60	46.5	4.5
2	80	71.6	4.5
1	100	100	8.75
2	80	71.6	4.5
3	60	46.5	4.5
4	40	25.3	4.2
5	Idle	0	1.8
<b>Total Time Per inverted “V” Program</b>			<b>38.75</b>

## **Test Fuels**

### **E0**

Because E0 test fuel was to be used only for emissions testing, it was decided to use certification gasoline (i.e., Indolene). The E0 test fuel was obtained in bulk from Haltermann Products with the certified characteristics included in Appendix II.

### **E15**

Because E15 test fuel was to be used primarily for engine aging, it was decided to use retail grade gasoline as the blend stock. Use of Indolene as the blend stock would have been cost prohibitive and would have provided no significant benefit to the program objectives. After consultation with NREL it was agreed that the E15 would be splash blended on site. No control over fuel properties beyond ethanol content was to be maintained. This included no change in the additive package resulting in slightly lower additive concentration compared with the E10 base fuel. Blending was accomplished by obtaining E98 in drum quantities and mixing it in the right proportion with commercially available E10. There were two batches of E15 blended for this test program. A single batch of the test fuel could not be accommodated due to on-site fuel storage constraints. To verify consistent fuel characteristics for each batch, NREL coordinated fuels analysis at the Southwest Research Institute Fuel Analysis laboratory. Results of this analysis are included in Appendix II.

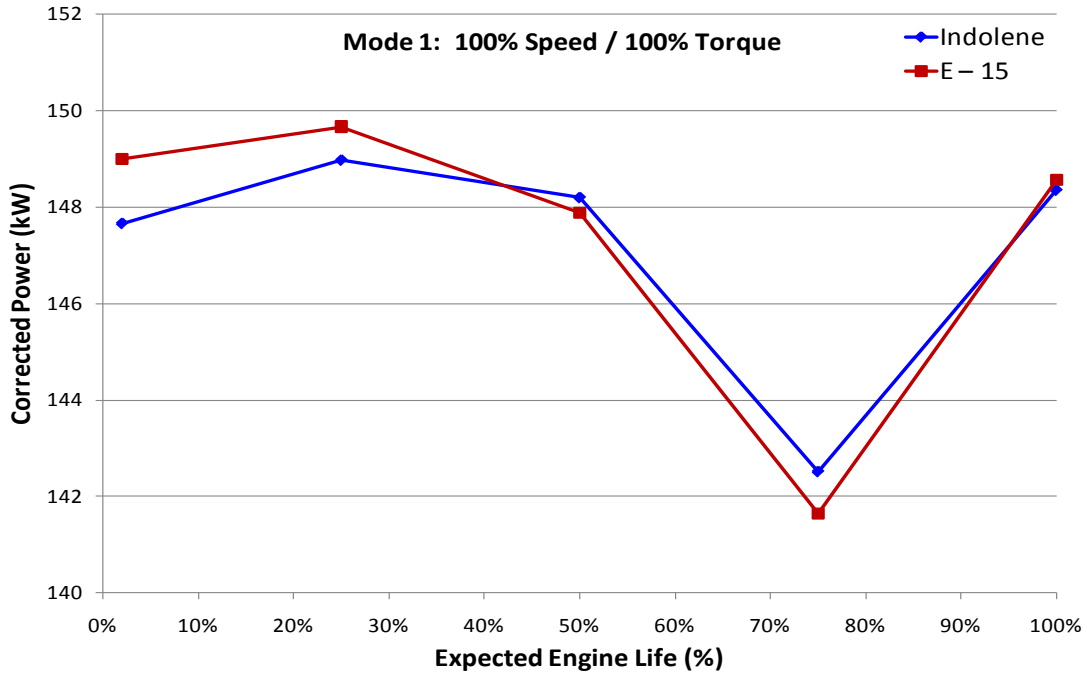
## **Test Results**

While many engine test parameters were recorded throughout this test program, only engine power, regulated emissions, fuel economy and exhaust gas temperatures are included in the body of this report – and discussed below. It is believed that these parameters are the most relevant to the focus of this study; impacts of E15 fuel on engine durability, performance and emissions. All other recorded parameters can be found in Appendix III.

### **Engine Durability**

Engine mechanical durability appeared to be mostly unaffected by E15 over the 310 hour test cycle used. As Figure 1 shows, engine power was maintained at a nearly constant level from beginning to end of test. The dip in power at 75% of life is believed to be caused by inadvertently over filling the crankcase with oil. This was corrected at the next oil change and the power came back roughly where it had been. This engine has been in the line up for over a decade and has remained virtually unchanged. In its production run, it has had a reputation for modest specific output (44.2 hp/L) with good durability (few mechanical issues reported from the field) as a marine engine.

**Figure 1. Mode 1 Engine Power at each test interval on E0 and E15 fuels**



## Emissions and Fuel Consumption

Overall emissions results showed that some pollutants were up while others were down. Fuel economy was down with E15 as expected due to the lower energy content of this fuel. Exhaust gas temperature effects were variable depending on operating mode. The graphs below show the results from the test.

As shown in Figures 2 through 7, the immediate impact of increasing ethanol in fuel was to reduce hydrocarbon (HC) and carbon monoxide (CO) emissions, increase nitrogen oxide (NO<sub>x</sub>) emissions and increase fuel consumption. This is the expected result for an open-loop engine which can not compensate for increased oxygen content in the fuel. The roughly 5.5 wt-% oxygen in the E15 test fuel resulted in leaner combustion than with E0 which contains 0% oxygen. Also, according to fuel chemistry results contained in Appendix II, the E15 test fuel contained roughly 5% less energy content than did the E0 certification fuel. Averaged across engine life and the five-mode test points, E15 resulted in approximately a 23% reduction in HC, a 40% reduction in CO, and a 9% increase in NO<sub>x</sub>. HC + NO<sub>x</sub> was reduced by about 2% while fuel consumption increased by an average of about 2%. These results are summarized in Table 4 and Figure 2.

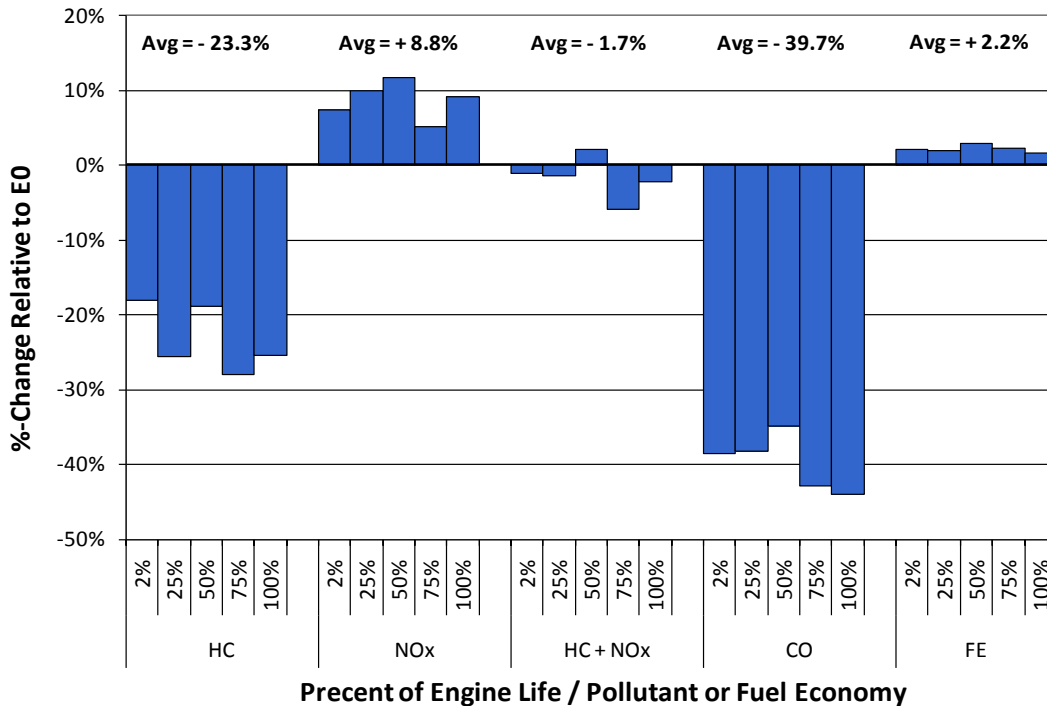
**Table 4. Comparison of Emissions, Fuel Consumption and Exhaust Gas Temperatures E15 vs. Indolene (E0) Certification Fuel**

HC (g/kW-hr)	NO <sub>x</sub> (g/kW-hr)	HC+NO <sub>x</sub> (g/kW-hr)	CO (g/kW-hr)	CO <sub>2</sub> (g/kW-hr)	Fuel (g/kW-hr)	EGT °C
-23.25%	+8.81%	-1.66%	-39.69%	+0.79%	+2.18%	+2.23%

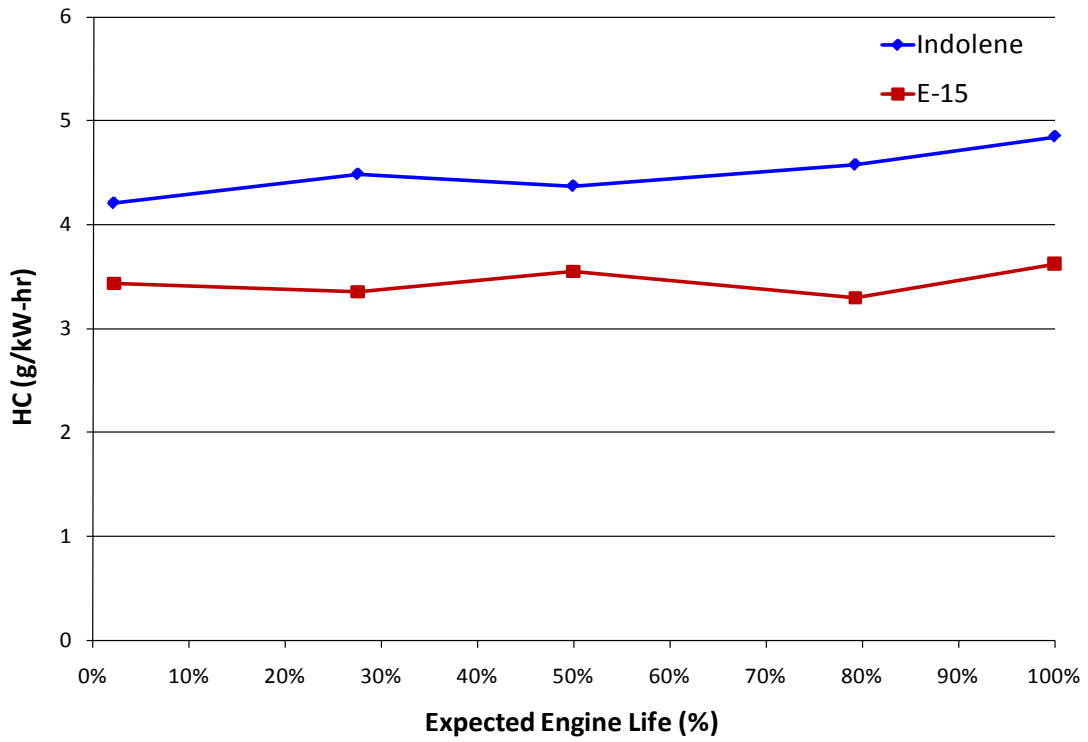
The long term impacts of operating on E15 fuel are more difficult to discern from these graphs and must rely on historical knowledge of this engine’s performance. This engine family has historically had low degradation factors for emissions over the 480 hour expected life. The degradation for HC+NO<sub>x</sub> has traditionally been under 1% with CO being under 7%. With those values these engines have had no issues in being compliant with CARB 3-Star requirements over the expected engine life.

For the engine tested in this study, HC emissions on E0 increased by about 15% from beginning to end of life, while NO<sub>x</sub> emissions increased about 14%. HC + NO<sub>x</sub> increased by 14.5%, exceeding CARB 3-Star compliance by about 4% at end of life. CO emissions remained mostly unchanged. Fuel consumption showed a generally decreasing trend with engine aging, finishing the aging cycle at about 2.5% below post break-in value.

**Figure 2. Percent-change of emissions and fuel economy for E15 relative to E0**



**Figure 3. Total hydrocarbon emissions at each test interval on E0 and E15 fuel**



**Figure 4. Nitrogen oxide emissions at each test interval on E0 and E15 fuel**

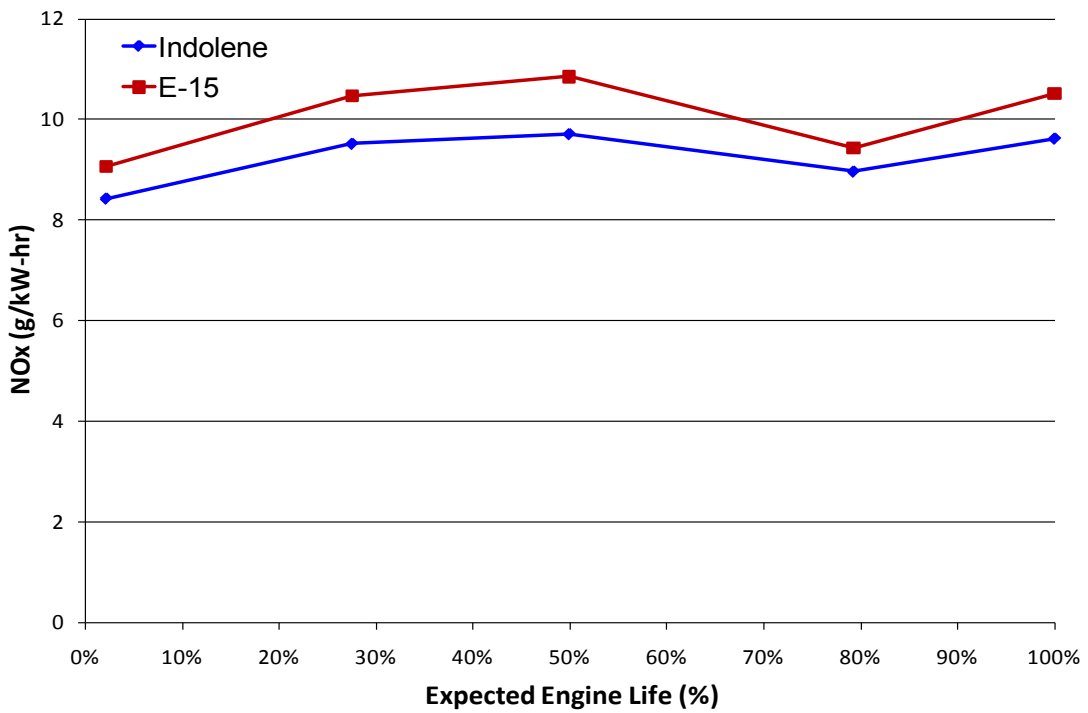


Figure 5. HC + NO<sub>x</sub> emissions at each test interval on E0 and E15 fuel

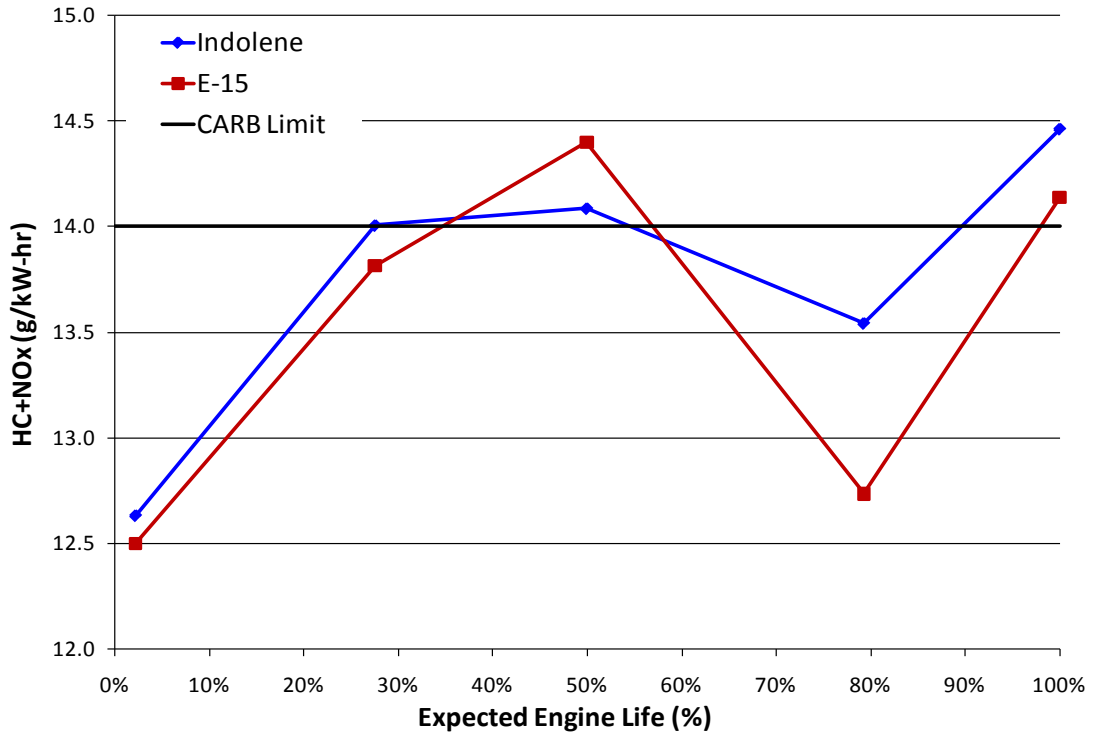
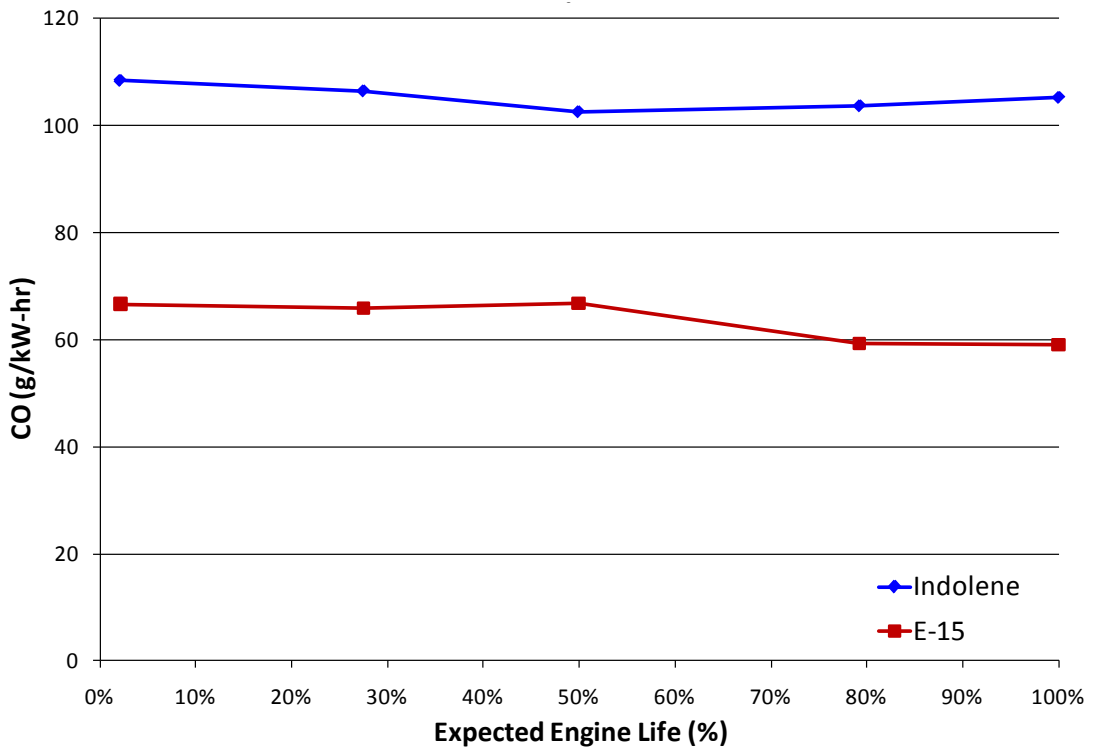
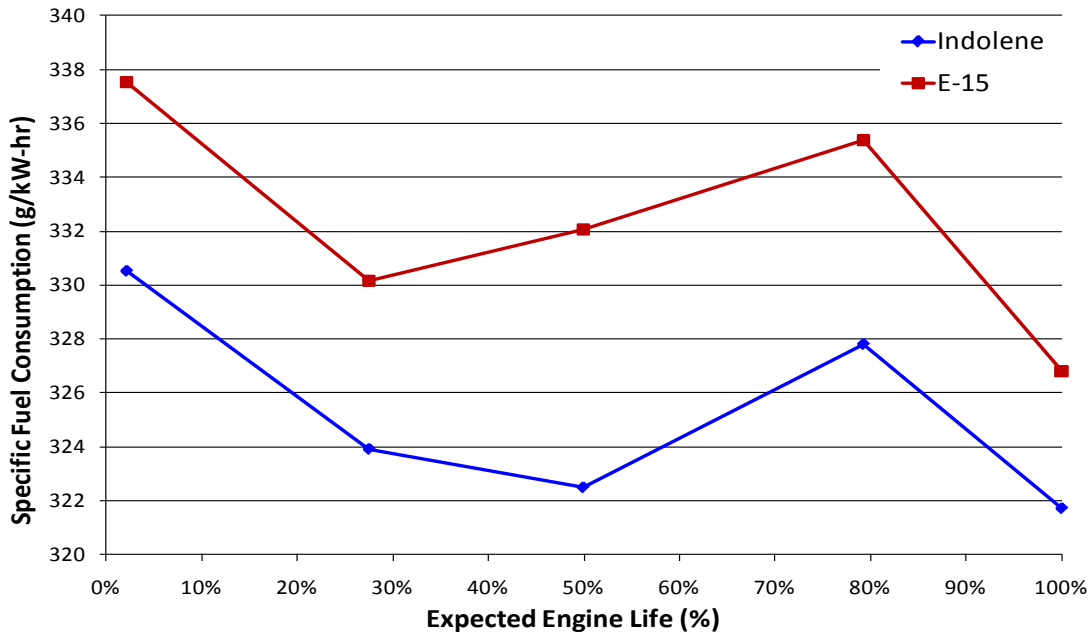


Figure 6. Carbon Monoxide emissions at each test interval on E0 and E15 fuel





**Figure 7. Fuel consumption at each test interval on E0 and E15 fuel**



### Engine Exhaust Temperatures

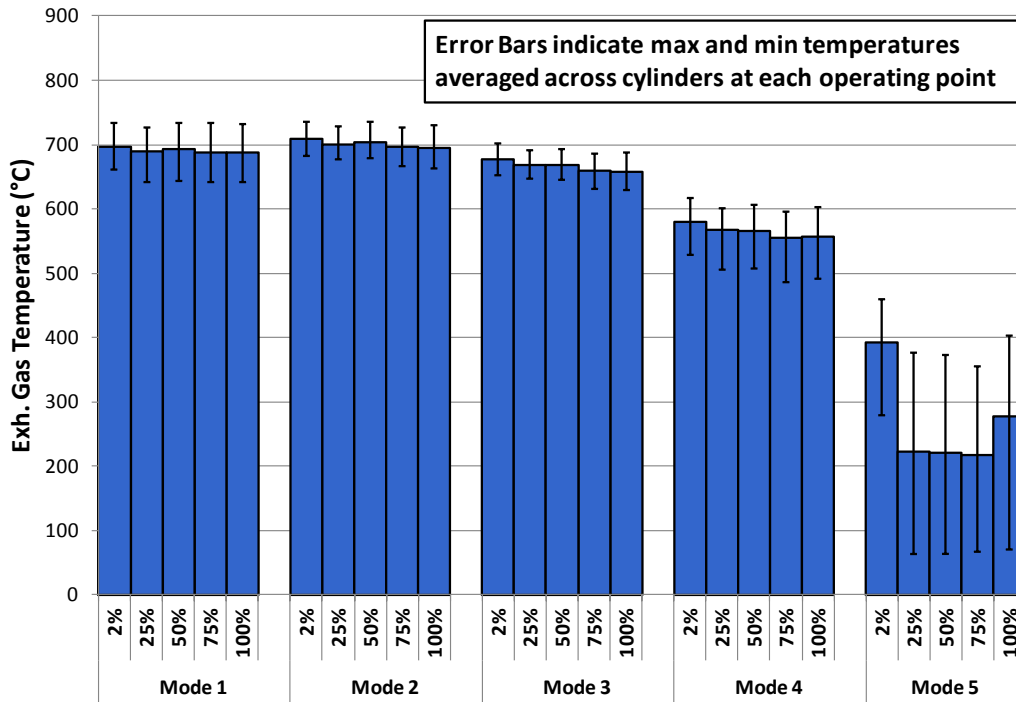
The effect of E15 on exhaust gas temperature was variable. For modes 1 and 4, E15 generally resulted in increased exhaust gas temperatures compared with E0. For modes 2 and 3, E15 exhaust gas temperatures were slightly below those for E0. Results at idle were highly variable. These results are shown in Figure 8 through 14.

Figures 8 and 9 show average exhaust gas temperatures for each test fuel over all operating modes and across expected engine life. In these charts, each temperature is the average value for all 6 cylinders and for the three triplicate tests. Error bars indicate maximum and minimum temperature values across the six cylinders. As the error bars show, there was considerable variation in exhaust gas temperature among the cylinders, especially at the mode 5 (idle) operating point. This amount of scatter is generally expected for a carbureted engine due to variation of charge among the six cylinders.

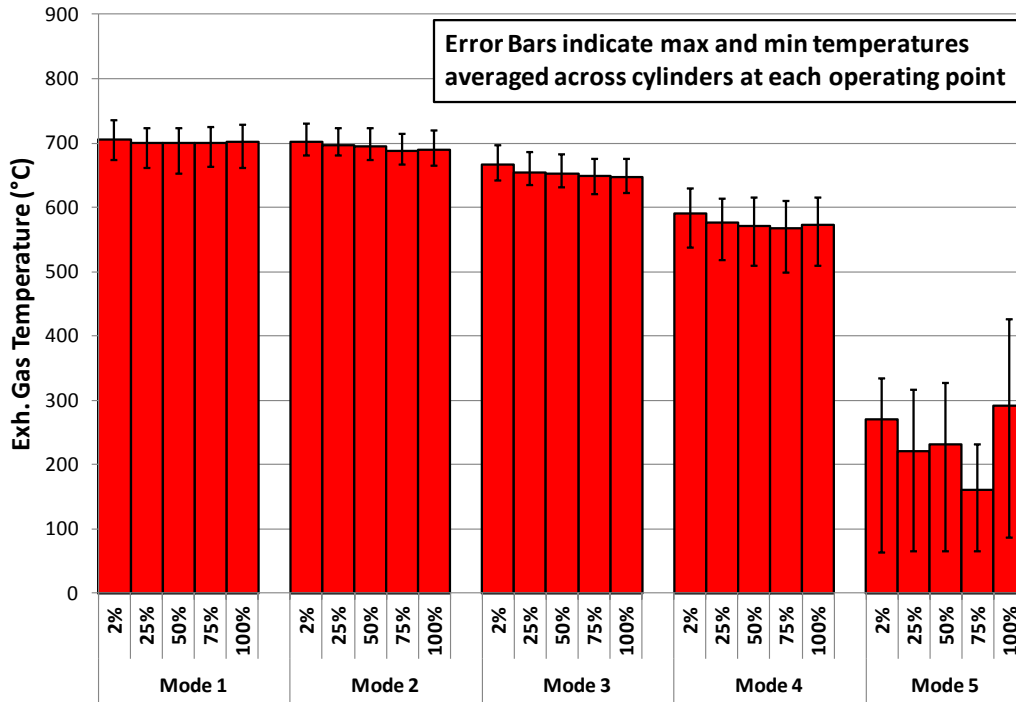
Figures 10 through 14 show exhaust gas temperature difference between E15 and E0 test fuels for each cylinder and across expected engine life. Red-shaded bars in these figures indicate operation for which E15 resulted in a higher exhaust gas temperature than E0 for a given cylinder, whereas blue-shaded bars indicate that E15 resulted in lower exhaust gas temperature than E0 for that cylinder. Notably, these charts show that for operating modes 1 and 4, E15 generally resulted in higher exhaust gas temperatures than E0 for the majority of cylinders. For operating modes 2 and 3, this trend was reversed and E0 resulted in higher exhaust gas temperatures than E15 for the majority of cylinders. Operating mode 5 showed highly variable results with E0 resulting in higher exhaust gas temperatures near beginning of life and E15 exhibiting higher exhaust gas temperatures for the majority of cylinders at the end of life.

Overall, the impact of ethanol on exhaust gas temperatures was minor. The peak exhaust gas temperature measured for both fuels actually occurred for E0 fuel during mode 2 operation at beginning of life. That temperature was 735.5 °C. The peak exhaust gas temperature for E15 fuel also occurred at beginning of life, however during mode 1 operation. That temperature was 735.2 °C.

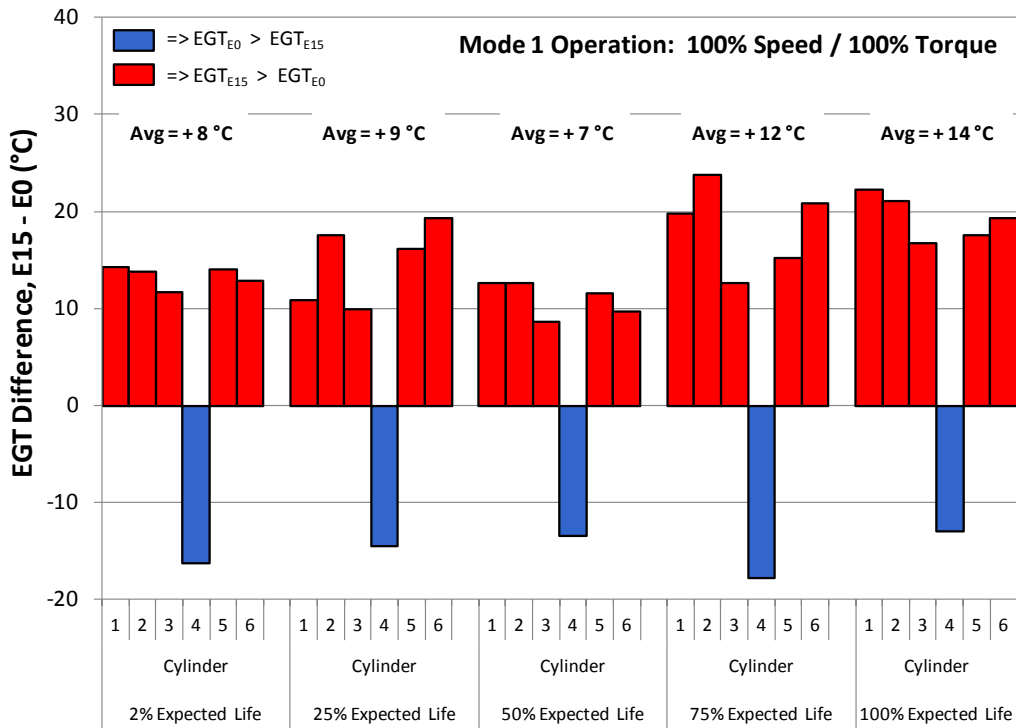
**Figure 8. Average exhaust gas temperature at each operating mode across expected engine life for Indolene (E0) Fueling**



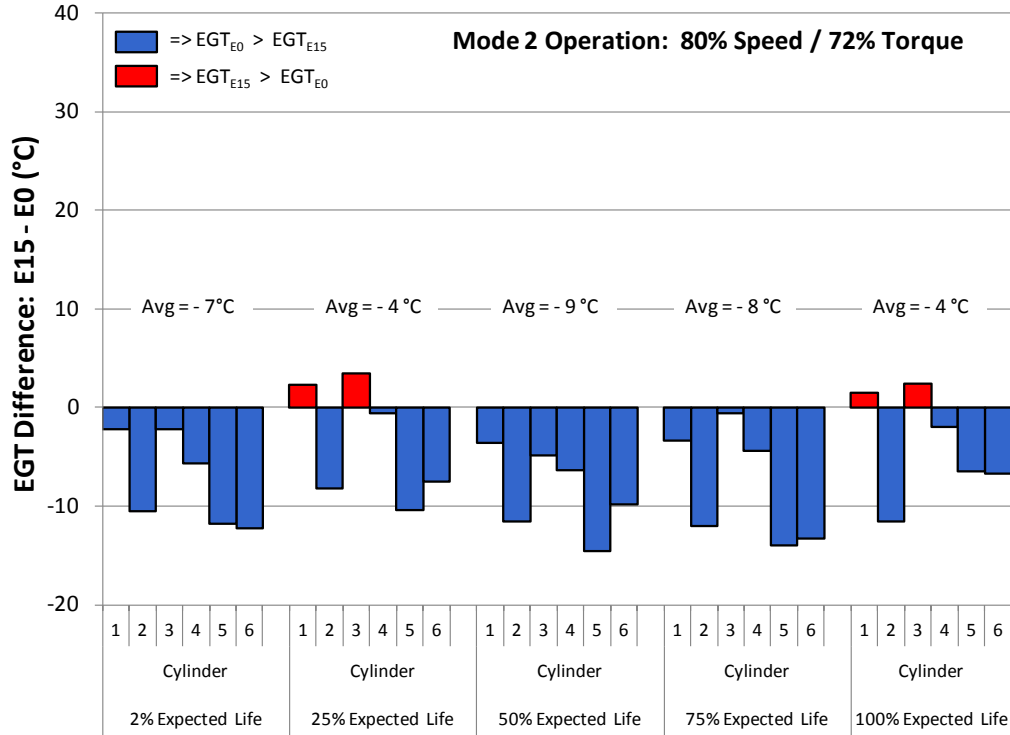
**Figure 9. Average exhaust gas temperature at each operating mode across expected engine life for E15 Fueling**



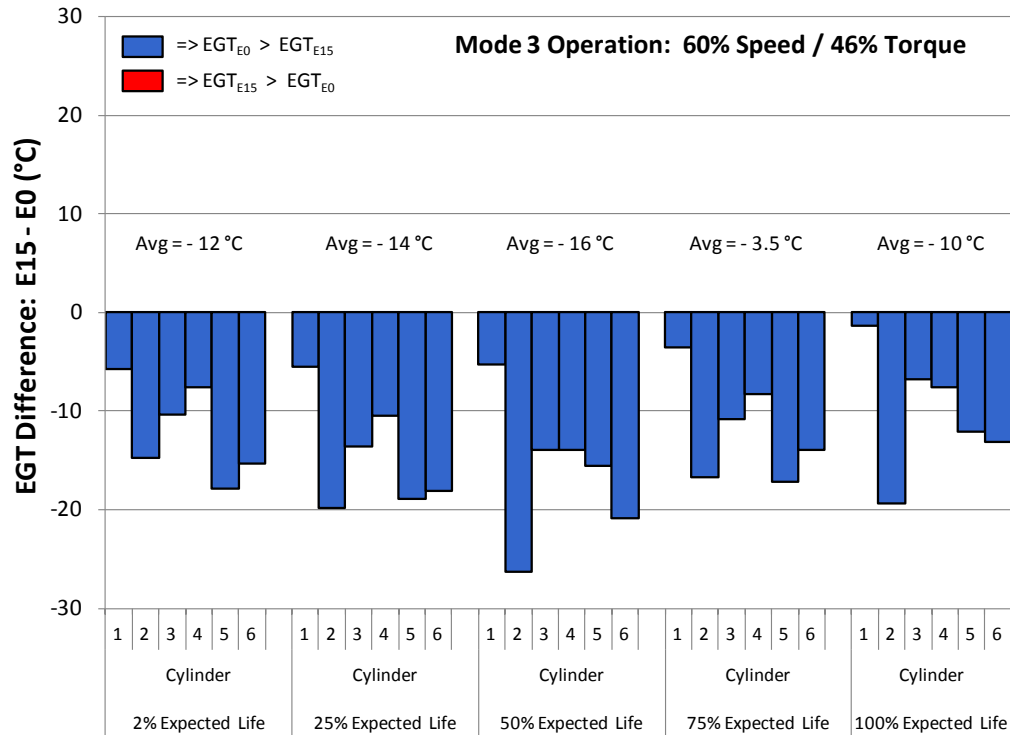
**Figure 10. Exhaust gas temperature difference (E15 – E0) for mode 1 operation across expected engine life**



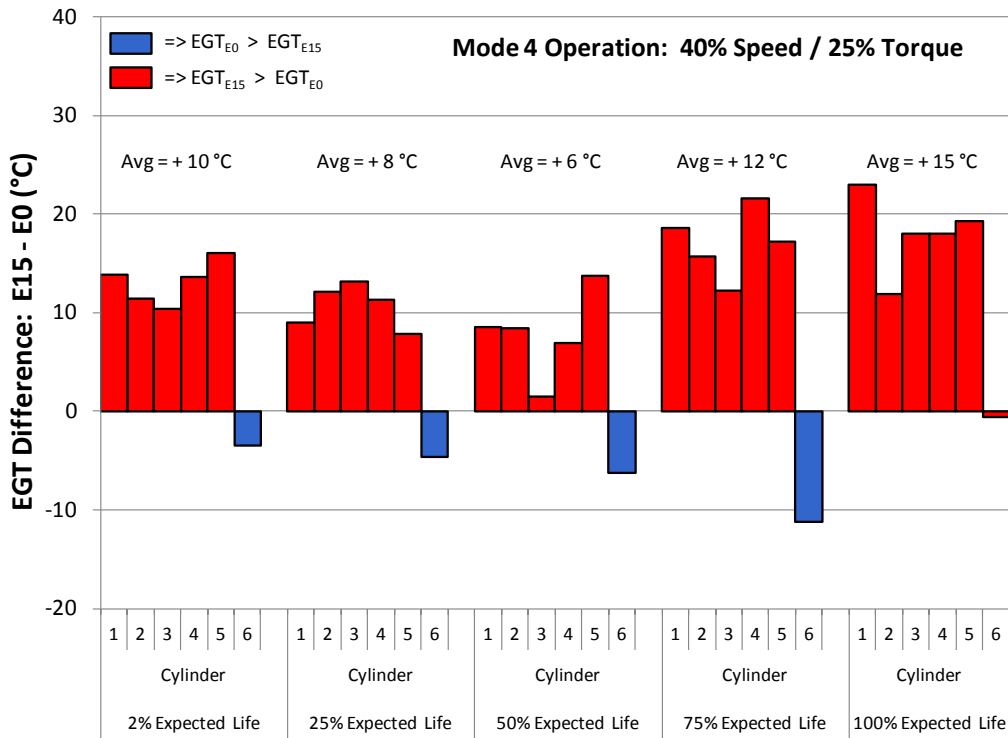
**Figure 11. Exhaust gas temperature difference (E15 – E0) for mode 2 operation across expected engine life**



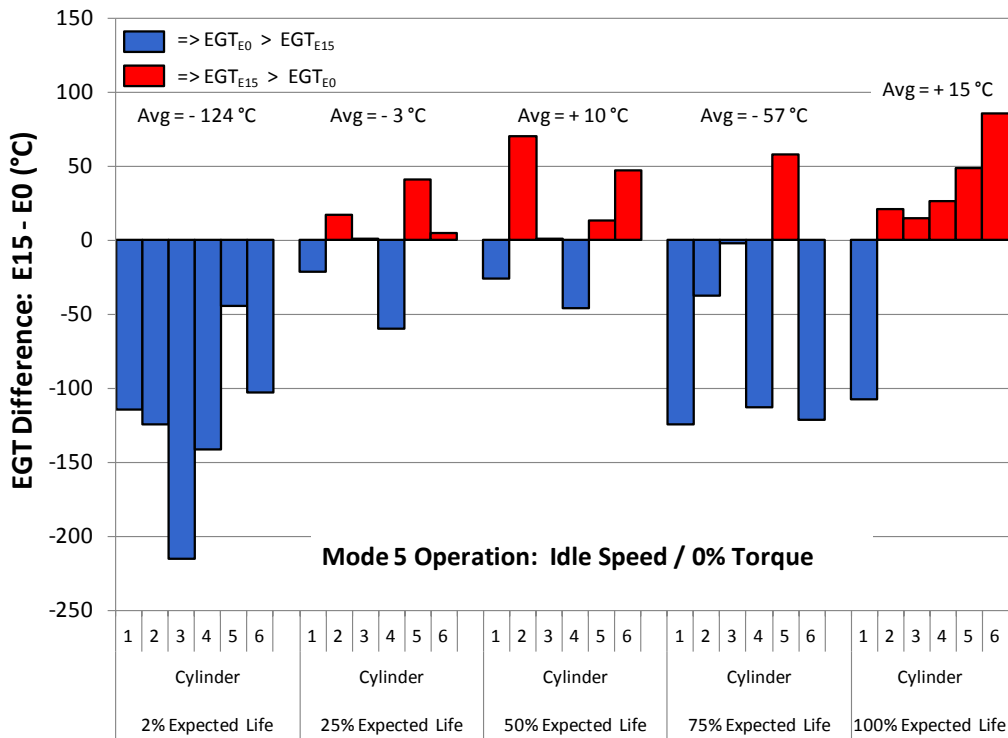
**Figure 12. Exhaust gas temperature difference (E15 – E0) for mode 3 operation across expected engine life**



**Figure 13. Exhaust gas temperature difference (E15 – E0) for mode 4 operation across expected engine life**



**Figure 14. Exhaust gas temperature difference (E15 – E0) for mode 5 operation across expected engine life**



## **Hard Starting**

Throughout the test, the engine exhibited poor starting characteristics on E15 fuel regardless of whether it was starting cold or hot. These characteristics included backfiring, stumbling on start up, dying after initial startup and surging at idle. This is explainable given that the carburetor on this model is set lean to insure emissions compliance. Based on existing consumer feedback associated with this model, additional enleanment caused by E15 would make starting this engine unacceptable to the consumer.

## **Conclusions**

While this laboratory test on this one engine showed measurable differences between the two fuels, these differences are slight. While there was no noticeable mechanical damage to the engine, it is noteworthy that overall total emissions performance degraded faster than expected. It would be unwise to draw too many conclusions from a sample of one engine subjected to an ideal laboratory test.

# Appendix I

## ICOMIA Fast Cycle Explanation

Icomia_fast cycle								Full Icomia cycle			
			ramp s	stage s	total s	% basis	%		%	Hours	
WOT	M1	4400	15	93	108	4.6%	9.3%	M1	6.0%	28.8	
	M2	3520	15	237	252	10.8%	21.7%	M2	14.0%	67.2	
	M3	2640	15	255	270	11.6%	23.2%	M3	15.0%	72	
	M4	1760	15	255	270	11.6%	23.2%	M4	25.0%	120	
idle	M5	900	15	510	525	22.6%	22.6%	M5	40.0%	192	
	M4	1760	15	255	270	11.6%			100.0%	480	
	M3	2640	15	255	270	11.6%					
	M2	3520	15	237	252	10.8%					
WOT	M1	4400	15	93	108	4.6%					

The full 480 cycle yields 28.8 hrs of WOT

Note, at the three higher speeds the accumulated time is a larger percentage then the 480 hr test

216	sec	M1	2325	sec	100.0%
0.06	hrs		38.75	min	
480	cycles		0.65	hrs	
103680	seconds				
28.8	hrs	M1	30.97	20	The bulk of the time is borrowed from idle
310	hrs	Test Time	31		

The fast cycle is run until 28.8 hrs of WOT is achieved

		Full cycle	Fast cycle
WOT	M1	6.0%	9.3%
	M2	14.0%	21.7%
	M3	15.0%	23.2%
	M4	25.0%	23.2%
IDLE	M5	40.0%	22.6%

# Appendix II

## Test Fuel Characteristics Indolene (E-0)

### Haltermann

PRODUCTS

Product Information

Telephone: (800) 969-2542

FAX: (281) 457-1469

Johann Haltermann Ltd.

PRODUCT: EPA TIER II EEE  
FEDERAL REGISTER  
PRODUCT CODE: HF437

Batch No.: YD2621LT10  
MTS  
Tank No.: 107  
Analysis Date: 4/27/2010

TEST	METHOD	UNITS	HALTERMANN Specs			RESULTS
			MIN	TARGET	MAX	
Distillation - IBP	ASTM D86	°F	75		95	84
5%		°F				111
10%		°F	120		135	125
20%		°F				147
30%		°F				171
40%		°F				200
50%		°F	200		230	221
60%		°F				233
70%		°F				244
80%		°F				266
90%		°F	305		325	318
95%		°F				335
Distillation - EP		°F			415	392
Recovery		vol %		Report		97.7
Residue		vol %		Report		1.1
Loss		vol %		Report		1.2
Gravity	ASTM D4052	°API	58.7		61.2	59.2
Density	ASTM D4052	kg/l	0.734		0.744	0.741
Reid Vapor Pressure	ASTM D5191	psi	8.7		9.2	8.9
Carbon	ASTM D3343	wt fraction		Report		0.8646
Carbon	ASTM E191	wt fraction		Report		0.8611
Hydrogen	ASTM E191	wt fraction		Report		0.1360
Hydrogen/Carbon ratio	ASTM E191	mole/mole		Report		1.881
Stoichiometric Air/Fuel Ratio				Report		14.628
Oxygen	ASTM D4815	wt %			0.05	<0.01
Sulfur	ASTM D5453	wt %	0.0025		0.0035	0.0034
Lead	ASTM D3237	g/gal			0.01	<0.004
Phosphorous	ASTM D3231	g/gal			0.005	<0.001
Silicon	ASTM 5184	mg/kg			4	<1
Composition, aromatics	ASTM D1319	vol %			35	28
Composition, olefins	ASTM D1319	vol %			10	0
Composition, saturates	ASTM D1319	vol %		Report		72
Particulate matter	ASTM D5452	mg/l			1	0.7
Oxidation Stability	ASTM D525	minutes	240			1000+
Copper Corrosion	ASTM D130				1	1a
Gum content, washed	ASTM D381	mg/100mls			5	1.0
Fuel Economy Numerator/C Density	ASTM E191		2401		2441	2417
C Factor	ASTM E191			Report		0.9996
Research Octane Number	ASTM D2699		96.0			97.2
Motor Octane Number	ASTM D2700			Report		89.0
Sensitivity			7.5			8.2
Net Heating Value, btu/lb	ASTM D3338	btu/lb		Report		18492
Net Heating Value, btu/lb	ASTM D240	btu/lb		Report		18374
Color	VISUAL			Report		Undyed

APPROVED BY:

*John P. Davis*

ANALYST PL/PH/DIX/GP



**Appendix II**  
**Test Fuel Characteristics**

**E-15**

**Fuels Analysis for Volvo Penta Marine Engine Durability**  
**(All Samples are Nominal E15 - Blended On-Site at Volvo)**

								Mol. Wt: 12.0107 1.00794 15.9994			EtOH O%: 0.347296		
Smpl No.	EtOH (vol-%)	RVP (psi)	LHV (BTU/lbm)	RON	MON	(R+M)/2	Sulfur (ppm)	SG (@ 60F)	C (wt)	H (wt)	O (wt)	H:C	O:C
Batch 1	14.8164	7.36	17426	99.6	87.2	93.4	25.4	0.7534	0.8073	0.1348	0.0542	1.990	0.050421
Batch 2	15.2922	9.07	17471	99.5	87.7	93.6	22.7	0.7442	0.8096	0.1365	0.0567	2.009	0.052534

**Appendix III**  
**Engine Dynamometer Data Sheets**

**Table A.III.1. Engine Dynamometer Data, E15 Fuel, 2% of Expected Engine Life (be4\_e15\_005b)**

Date	Time	Observed Torque	Throttle angle	Speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_preat	CO2_preat	THC_preat	NOx_preat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/8/10	24:12	0.2	0.0	895	101.73	1.82	33.4	26.3	23.5	35.2	3.0	6.7	0.9	33.4	1.5	44.5	71.4	305.6	10	0.983	0.02	0.19	26	22.3	53.4	69.1	303	409	75	364	286	356	
10/8/10	32:42	326.6	100.0	4400	101.71	45.57	25.0	28.8	23.4	35.6	4.0	12.5	456.8	1464.6	0.9	39.9	23.3	335.0	10	0.989	148.83	323.00	30	20.1	63.4	122.5	737	693	715	718	706	674	
10/8/10	33:42	327.0	100.0	4400	101.71	45.21	25.3	28.8	23.3	35.5	4.0	12.5	461.1	1476.3	0.9	39.2	23.3	333.1	10	0.989	148.93	323.21	30	20.2	63.6	123.5	737	691	714	721	703	675	
10/8/10	34:42	326.8	100.0	4398	101.71	46.03	26.3	29.0	23.3	35.5	4.0	12.5	459.2	1465.2	0.9	38.8	23.2	332.1	10	0.989	148.93	323.22	29	20.6	63.8	124.3	735	692	712	719	702	675	
10/8/10	43:12	234.1	33.6	3520	101.72	24.97	24.4	29.6	23.3	35.3	0.4	14.0	286.2	2115.0	1.0	39.6	34.2	342.5	11	0.988	85.26	231.29	30	21.5	60.8	109.5	730	725	684	683	697	697	
10/8/10	44:12	233.5	33.6	3522	101.72	24.08	25.2	29.6	23.3	35.2	0.4	14.0	277.5	2101.2	1.0	41.0	34.2	343.2	11	0.988	85.04	230.70	29	21.4	61.0	109.1	733	725	682	683	696	698	
10/8/10	45:12	234.1	33.8	3522	101.72	24.49	25.6	29.7	23.3	35.1	0.4	14.0	274.8	2107.2	1.0	40.8	34.2	343.9	11	0.988	85.26	231.30	29	21.3	60.8	108.8	731	726	680	681	695	696	
10/8/10	53:42	151.2	19.5	2639	101.73	13.39	26.5	29.8	23.2	35.1	0.1	13.8	169.2	1098.3	1.1	42.4	45.2	344.5	11	0.987	41.26	149.23	29	21.4	58.7	95.9	698	684	642	645	665	666	
10/8/10	54:42	153.1	19.4	2639	101.72	13.50	26.3	29.8	23.2	35.1	0.1	13.7	171.0	1104.7	1.1	43.1	45.2	345.2	11	0.987	41.77	151.07	28	21.4	58.8	95.4	695	684	641	645	664	664	
10/8/10	55:42	151.3	19.6	2639	101.73	13.34	26.0	29.9	23.2	35.2	0.1	13.7	173.1	1104.7	1.1	42.8	45.3	345.8	11	0.987	41.28	149.33	29	21.1	58.6	95.2	697	685	643	645	663	665	
10/8/10	04:12	81.5	9.8	1761	101.73	6.53	26.2	29.6	23.2	35.6	1.5	13.9	514.0	342.2	1.0	42.8	59.6	325.2	11	0.985	14.79	80.24	27	20.6	55.9	83.9	595	629	539	573	597	609	
10/8/10	05:12	81.8	9.4	1758	101.73	5.86	27.1	29.7	23.2	35.4	1.5	13.9	510.0	324.4	1.0	47.6	59.6	326.1	11	0.986	14.85	80.57	28	20.7	55.9	83.4	595	629	539	573	597	607	
10/8/10	06:12	82.0	9.2	1761	101.73	6.63	26.6	29.8	23.2	35.3	1.5	13.9	517.1	336.6	1.0	40.6	59.7	328.6	11	0.985	14.89	80.82	27	20.6	55.9	82.9	596	629	540	572	597	610	
10/8/10	14:17	0.3	0.0	913	101.72	1.91	33.0	27.1	23.1	35.6	3.7	12.0	2817.9	29.5	0.9	47.9	71.6	301.0	11	0.984	0.03	0.31	26	20.3	53.6	72.1	301	348	60	275	321	286	
10/8/10	15:17	0.3	0.0	898	101.72	1.90	33.1	27.0	23.1	35.6	3.7	12.1	2564.3	29.8	0.9	47.8	71.6	301.7	11	0.984	0.03	0.29	26	20.2	53.3	71.4	307	346	62	248	346	304	
10/8/10	16:17	0.3	0.0	896	101.72	1.88	33.3	26.8	23.1	35.7	3.6	12.1	2704.8	29.3	0.9	47.7	71.7	302.0	11	0.984	0.03	0.30	26	20.2	53.1	70.7	306	347	63	243	339	322	

**Table A.III.2. Engine Dynamometer Data, E15 Fuel, 2% of Expected Engine Life (be4\_e15\_006b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/8/10	17:07	0.3	0.0	897	101.72	1.87	33.5	26.8	23.1	35.6	0.0	0.1	3.9	2.8	142.1	47.5	71.7	302.5	11	0.984	0.03	0.30	26.1	20.1	53.0	70.3	315	361	63	264	323	309	
10/8/10	25:37	326.2	100.0	4399	101.70	46.00	29.6	29.2	23.1	36.2	4.1	12.5	476.9	1388.5	0.9	36.6	24.1	333.3	11	0.991	148.94	323.25	30.1	19.7	63.2	122.5	736	691	707	718	701	678	
10/8/10	26:37	325.9	100.0	4400	101.70	46.14	29.4	29.3	23.1	36.3	4.1	12.4	475.3	1376.0	0.9	36.9	24.0	331.6	11	0.992	148.94	323.23	29.6	20.0	63.5	123.4	735	695	706	720	700	671	
10/8/10	27:37	326.0	100.0	4399	101.70	46.03	29.5	29.5	23.1	36.3	4.1	12.4	471.0	1371.9	0.9	37.2	23.8	330.5	11	0.992	149.01	323.39	29.9	20.5	63.6	124.1	734	692	704	720	700	675	
10/8/10	36:07	233.9	33.6	3522	101.70	24.21	29.3	30.0	23.1	36.6	0.5	14.1	301.6	2077.9	1.0	40.4	34.4	340.4	11	0.991	85.47	231.87	28.9	21.5	60.9	109.7	728	726	682	683	699	697	
10/8/10	37:07	233.9	32.9	3519	101.70	24.82	29.2	30.0	23.1	36.7	0.5	14.1	305.7	2068.8	1.0	38.4	34.4	341.1	11	0.991	85.44	231.80	29.2	21.6	61.1	109.3	729	724	681	680	698	697	
10/8/10	38:07	233.7	32.4	3520	101.70	24.38	29.3	30.1	23.1	36.7	0.5	14.1	304.9	2032.0	1.0	39.8	34.3	341.7	11	0.991	85.38	231.63	29.5	21.7	61.0	109.0	728	725	680	681	698	700	
10/8/10	46:37	151.2	19.1	2642	101.70	13.49	28.8	30.3	23.1	36.6	0.1	13.8	165.2	1070.0	1.1	41.7	45.4	343.7	12	0.990	41.40	149.74	28.9	21.7	58.7	95.7	695	685	643	649	664	665	
10/8/10	47:37	151.6	20.1	2641	101.70	13.28	29.3	30.3	23.1	36.7	0.1	13.7	168.6	1078.0	1.1	42.5	45.5	344.5	12	0.990	41.49	150.06	28.4	21.6	58.5	95.4	695	685	643	647	663	661	
10/8/10	48:37	152.6	18.4	2641	101.70	13.42	29.4	30.3	23.1	36.7	0.1	13.8	167.4	1078.4	1.1	42.2	45.5	345.1	12	0.990	41.76	151.03	28.5	21.4	58.5	95.0	696	685	641	646	660	662	
10/8/10	57:07	82.2	8.9	1760	101.70	6.09	29.1	30.2	23.1	36.7	1.6	13.9	496.8	334.2	1.0	45.9	59.7	322.7	12	0.989	14.97	81.22	27.8	21.2	56.4	84.0	595	629	537	572	599	608	
10/8/10	58:07	81.8	8.8	1758	101.70	6.38	29.6	30.2	23.1	36.6	1.6	13.9	498.8	329.3	1.0	41.5	59.7	324.4	12	0.989	14.90	80.84	28	21.0	56.2	83.5	597	629	537	574	601	612	
10/8/10	59:07	81.4	9.0	1758	101.69	6.45	28.8	30.2	23.1	36.6	1.5	13.9	499.0	330.6	1.0	42.5	59.8	325.6	12	0.988	14.83	80.48	27.8	21.0	56.2	83.1	596	631	537	571	600	608	
10/8/10	07:12	0.4	0.0	914	101.69	1.90	34.7	27.5	23.2	36.9	3.7	12.0	2830.4	29.1	0.9	47.7	71.5	300.5	12	0.987	0.03	0.35	26.9	20.7	53.9	72.2	294	317	61	270	318	320	
10/8/10	08:12	0.3	0.0	915	101.69	1.90	34.9	27.4	23.2	36.9	3.7	12.0	2743.2	29.0	0.9	47.6	71.6	301.2	12	0.987	0.03	0.32	26.9	20.6	53.7	71.4	297	347	65	252	338	313	
10/8/10	09:12	0.3	0.0	895	101.69	1.89	34.5	27.4	23.2	36.9	3.6	12.1	2673.5	28.8	0.9	47.4	71.6	301.8	12	0.986	0.03	0.29	26.8	20.6	53.5	70.9	296	332	70	251	340	309	

**Table A.III.3. Engine Dynamometer Data, E15 Fuel, 2% of Expected Engine Life (be4\_e15\_007b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fueflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/8/10	10:03	0.3	0.0	891	101.68	1.88	34.9	27.3	23.2	36.8	0.0	0.1	3.8	3.0	143.5	47.0	71.6	302.3	12	0.987	0.03	0.34	27	20.5	53.5	70.3	300	333	87	254	333	263	
10/8/10	18:33	325.4	100.0	4399	101.65	46.06	28.9	29.9	23.1	37.3	4.1	12.5	471.6	1379.3	0.9	35.8	24.0	331.8	12	0.995	149.12	323.64	31	20.3	63.7	122.6	736	695	706	716	699	674	
10/8/10	19:33	325.5	100.0	4402	101.64	45.93	29.3	30.0	23.1	37.3	4.1	12.4	467.6	1366.8	0.9	36.3	23.9	330.4	12	0.994	149.02	323.42	30	20.3	63.9	123.6	735	695	706	717	699	672	
10/8/10	20:33	326.2	100.0	4400	101.64	45.83	26.8	30.1	23.1	37.2	4.1	12.4	467.7	1391.5	0.9	36.3	23.8	329.3	12	0.993	149.27	323.95	31	20.7	64.0	124.3	732	689	706	717	698	675	
10/8/10	29:03	233.2	33.1	3520	101.63	23.62	26.4	30.7	23.2	36.9	0.5	14.1	307.8	2102.6	1.0	40.0	34.4	338.7	12	0.992	85.30	231.39	30	21.8	61.2	109.7	728	725	678	681	695	696	
10/8/10	30:03	233.6	32.3	3521	101.63	25.22	26.8	30.6	23.2	37.0	0.5	14.1	306.9	2102.3	1.0	37.1	34.4	339.3	12	0.993	85.47	231.88	30	21.6	61.1	109.3	729	725	679	682	696	698	
10/8/10	31:03	233.6	32.8	3521	101.63	24.96	26.7	30.6	23.2	37.1	0.5	14.1	304.1	2096.5	1.0	39.0	34.4	339.9	12	0.992	85.41	231.71	30	21.6	61.1	109.0	729	725	678	682	696	697	
10/8/10	39:33	151.6	18.4	2639	101.62	13.28	22.8	30.9	23.3	36.5	0.1	13.8	164.9	1131.3	1.1	42.2	45.6	342.8	13	0.990	41.48	150.02	29	21.6	59.0	95.9	696	684	641	647	662	666	
10/8/10	40:33	151.2	18.8	2640	101.62	13.38	23.0	30.9	23.3	36.4	0.1	13.8	165.1	1121.0	1.1	41.3	45.6	343.6	13	0.990	41.36	149.59	29	21.6	59.0	95.5	696	684	640	647	662	667	
10/8/10	41:33	151.6	18.7	2639	101.62	13.37	23.5	30.9	23.3	36.3	0.1	13.7	163.8	1126.6	1.1	42.3	45.7	344.2	13	0.990	41.50	150.12	29	21.5	59.0	95.2	697	685	641	645	661	663	
10/8/10	50:03	81.3	9.7	1760	101.61	6.01	22.9	30.8	23.3	36.6	1.5	13.9	483.1	343.3	1.0	45.7	59.7	323.5	13	0.988	14.81	80.36	29	21.0	56.6	84.0	596	628	538	573	597	613	
10/8/10	51:03	82.1	8.5	1761	101.61	6.21	23.0	30.9	23.3	36.6	1.5	14.0	484.1	350.0	1.0	41.9	59.7	323.4	13	0.988	14.96	81.17	29	21.0	56.5	83.5	596	628	538	574	599	608	
10/8/10	52:03	80.9	9.6	1761	101.61	6.23	22.4	31.0	23.3	36.6	1.5	14.0	491.9	344.9	1.0	42.9	59.8	323.4	13	0.988	14.74	79.97	29	20.8	56.5	83.1	594	629	539	573	600	610	
10/8/10	00:08	0.4	0.0	910	101.59	1.90	25.8	28.4	23.4	36.1	3.6	12.0	2769.7	29.6	0.9	47.3	71.5	300.1	13	0.986	0.03	0.35	28	20.7	54.3	72.3	306	330	65	311	332	316	
10/8/10	01:08	0.4	0.0	909	101.59	1.89	26.0	28.3	23.4	35.9	3.6	12.0	2826.1	29.7	0.9	47.1	71.5	300.8	13	0.986	0.03	0.36	28	20.6	54.1	71.7	316	328	66	318	341	326	
10/8/10	02:08	0.4	0.0	906	101.59	1.88	25.9	28.3	23.4	35.6	3.6	12.1	2624.8	30.0	0.9	47.0	71.5	301.3	13	0.986	0.03	0.35	28	20.6	53.9	71.0	312	315	67	261	339	299	

**Table A.III.4. Engine Dynamometer Data, E15 Fuel, 28% of Expected Engine Life (be4\_e15\_008b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_preat	CO2_preat	THC_preat	NOx_preat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/18/10	35:33	0.3	0.0	954	101.45	1.87	42.2	24.0	23.1	37.4	0.2	0.2	-0.9	0.6	35.4	44.4	64.2	309.9	81	0.983	0.03	0.33	23.7	18.4	52.4	67.1	273	279	185	280	74	152
10/18/10	44:03	328.4	100.0	4401	101.43	46.13	38.4	25.2	23.1	37.9	4.2	12.2	444.1	1513.0	0.9	35.1	4.0	340.7	81	0.988	149.52	324.44	26.3	17.9	62.7	121.6	722	693	707	709	699	660
10/18/10	45:03	327.3	100.0	4401	101.41	45.91	38.7	25.3	23.2	37.9	4.2	12.3	447.0	1513.0	0.9	34.3	3.4	339.1	81	0.989	149.22	323.80	26.4	18.1	62.9	122.7	721	693	705	714	703	663
10/18/10	46:03	326.9	100.0	4399	101.41	45.87	38.2	25.5	23.2	37.9	4.2	12.3	455.6	1506.6	0.9	34.7	3.6	338.7	81	0.989	149.02	323.41	26.6	18.5	63.2	123.6	720	694	704	711	702	657
10/18/10	54:33	234.5	32.6	3520	101.41	23.99	33.8	26.7	23.1	37.6	0.5	14.0	286.5	2408.0	1.0	37.1	15.8	348.3	81	0.989	85.51	231.99	27	20.3	61.0	109.6	727	718	685	682	689	690
10/18/10	55:33	232.0	33.1	3518	101.42	23.44	33.7	26.8	23.2	37.6	0.5	14.0	277.8	2464.0	1.0	34.6	15.8	348.6	81	0.989	84.54	229.44	27	20.4	61.0	109.3	724	721	684	682	691	686
10/18/10	56:33	233.7	33.2	3520	101.42	24.09	33.7	26.8	23.2	37.6	0.4	14.0	279.0	2444.1	1.0	35.5	15.6	349.0	81	0.989	85.23	231.22	26.5	20.5	60.8	109.0	725	719	682	681	688	691
10/18/10	05:03	151.2	19.1	2640	101.44	13.20	33.5	27.2	23.3	37.7	0.1	13.6	195.4	1341.0	1.1	38.5	30.2	351.2	81	0.988	41.33	149.49	26.6	20.8	58.5	95.8	686	671	634	637	644	650
10/18/10	06:03	153.4	19.5	2640	101.44	12.62	33.7	27.2	23.3	37.8	0.1	13.6	195.2	1331.0	1.1	32.0	31.1	351.5	81	0.989	41.93	151.71	26.7	20.7	58.5	95.4	687	670	634	637	643	650
10/18/10	07:03	151.7	20.1	2640	101.43	13.03	33.6	27.2	23.3	37.8	0.1	13.6	197.3	1352.3	1.1	36.7	30.6	351.9	81	0.989	41.46	149.98	26.4	20.7	58.3	95.0	686	670	633	637	643	650
10/18/10	15:33	81.8	9.9	1759	101.43	6.32	35.0	27.3	23.3	37.8	1.6	13.8	497.2	433.3	1.0	35.0	50.2	333.9	81	0.989	14.90	80.88	26.2	20.3	55.8	83.5	581	612	514	561	578	595
10/18/10	16:33	82.2	9.5	1760	101.43	5.73	33.2	27.4	23.3	37.8	1.6	13.8	480.8	444.8	1.0	41.6	50.0	332.0	81	0.987	14.95	81.15	25.9	20.2	55.7	83.1	582	614	515	562	577	596
10/18/10	17:33	81.6	9.5	1760	101.43	5.66	33.2	27.4	23.3	37.8	1.6	13.8	486.0	438.3	1.0	40.4	50.4	330.9	81	0.988	14.84	80.54	26.1	20.0	55.6	82.7	581	612	515	563	578	597
10/18/10	25:38	1.5	0.0	948	101.41	1.86	36.9	25.8	23.3	37.9	3.2	12.4	2597.0	29.5	0.9	42.5	64.7	304.2	81	0.987	0.15	1.50	25.5	20.0	53.5	72.0	288	203	62	308	181	204
10/18/10	26:38	-0.5	0.0	940	101.42	1.82	36.6	25.7	23.4	37.9	3.3	12.3	2493.0	29.7	0.9	42.7	65.5	304.9	81	0.987	-0.05	-0.47	25.5	20.0	53.4	71.3	302	217	66	261	204	185
10/18/10	27:38	0.3	0.0	925	101.42	1.86	36.6	25.7	23.3	37.9	3.1	12.4	2793.2	28.6	0.9	40.6	65.4	305.1	81	0.987	0.03	0.30	25.5	19.9	53.4	70.7	249	229	62	205	162	155
10/18/10	28:29	0.3	0.0	929	101.41	1.83	37.4	25.7	23.4	37.8	0.0	0.1	3.0	1.1	140.7	40.7	65.4	305.6	81	0.987	0.03	0.27	25.5	19.9	53.3	70.3	299	233	64	253	239	130

**Table A.III.5. Engine Dynamometer Data, E15 Fuel, 28% of Expected Engine Life (be4\_e15\_009b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_lgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOX_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/18/10	06:20	0.3	0.0	922	101.36	1.83	31.7	27.7	23.9	35.3	0.0	0.1	4.5	2.0	228.3	45.5	61.1	307.5	81	0.993	0.03	0.30	28.4	26.8	55.5	70.6	411	457	358	413	407	404
10/18/10	14:50	326.9	100.0	4400	101.35	45.70	29.8	28.5	23.8	36.0	4.2	12.3	456.6	1538.7	0.9	33.4	-3.6	338.7	82	0.994	149.67	324.82	29	26.5	63.5	122.7	726	695	706	714	703	661
10/18/10	15:50	326.7	100.0	4399	101.35	45.63	28.9	28.6	23.8	36.1	4.2	12.3	451.4	1546.3	0.9	33.4	-3.8	337.5	82	0.994	149.55	324.57	28.7	26.7	63.9	123.7	727	695	706	712	701	662
10/18/10	16:50	326.7	100.0	4401	101.35	45.55	28.8	28.8	23.8	36.1	4.2	12.3	451.2	1538.7	0.9	33.7	-3.9	336.6	82	0.995	149.73	324.96	29.9	26.9	64.2	124.6	727	695	704	711	696	663
10/18/10	25:20	234.3	33.5	3519	101.36	24.08	28.4	29.4	23.8	36.2	0.5	14.0	291.5	2449.4	1.0	32.9	9.1	345.5	82	0.993	85.78	232.71	28.8	27.1	61.4	110.2	723	722	680	684	689	685
10/18/10	26:20	234.5	32.7	3520	101.36	25.01	28.4	29.4	23.8	36.3	0.5	14.0	293.9	2421.9	1.0	33.1	9.2	345.9	82	0.994	85.88	232.98	28.7	27.1	61.5	109.8	725	720	680	684	691	687
10/18/10	27:20	234.5	33.0	3518	101.35	24.26	28.4	29.5	23.8	36.3	0.5	14.0	289.6	2418.1	1.0	34.0	9.2	346.3	82	0.993	85.85	232.91	29.2	27.3	61.7	109.6	720	720	679	684	695	687
10/18/10	35:50	152.3	18.7	2642	101.37	12.98	26.6	30.0	23.9	36.3	0.1	13.6	198.7	1356.3	1.1	35.6	26.2	349.2	82	0.993	41.79	151.15	28.7	27.6	59.8	96.4	685	672	633	640	651	648
10/18/10	36:50	152.3	18.9	2641	101.37	13.13	27.0	30.0	23.9	36.3	0.1	13.6	198.4	1364.0	1.1	35.1	26.2	349.9	82	0.993	41.80	151.19	29.1	27.6	59.6	95.9	686	672	635	641	651	650
10/18/10	37:50	151.9	19.7	2641	101.37	12.89	27.7	30.0	23.9	36.2	0.1	13.6	197.9	1345.3	1.1	36.2	26.4	350.3	82	0.993	41.72	150.91	28.7	27.5	59.5	95.7	685	671	635	641	653	649
10/18/10	46:20	81.4	9.7	1760	101.35	5.91	26.3	30.3	24.0	36.1	1.5	13.9	486.2	440.3	1.0	35.5	48.2	329.5	82	0.992	14.89	80.77	28.3	27.5	57.6	84.8	586	614	519	568	584	589
10/18/10	47:20	81.8	10.0	1762	101.35	5.91	26.1	30.3	24.0	36.1	1.5	13.9	482.0	447.2	1.0	36.8	48.2	329.5	82	0.992	14.95	81.12	28.5	27.4	57.5	84.3	585	614	518	566	584	591
10/18/10	48:20	81.9	9.3	1760	101.35	6.26	26.1	30.2	24.0	36.1	1.5	13.9	479.6	443.8	1.0	33.8	48.2	329.7	82	0.993	14.99	81.33	28.7	27.5	57.4	83.9	587	617	517	565	586	588
10/18/10	56:25	0.4	0.0	945	101.34	1.79	30.5	28.2	24.0	36.0	3.2	12.3	2688.3	29.4	0.9	41.2	64.4	305.1	82	0.991	0.04	0.39	27.4	26.4	54.8	73.1	304	255	64	345	231	170
10/18/10	57:25	0.4	0.0	914	101.33	1.81	30.7	28.1	24.0	35.9	3.1	12.3	2667.2	29.0	0.9	39.4	64.7	305.3	82	0.991	0.04	0.37	27.3	26.4	54.5	72.3	289	271	66	340	248	236
10/18/10	58:25	0.4	0.0	929	101.34	1.82	30.9	28.0	24.0	35.8	3.0	12.4	2560.6	29.3	0.9	37.9	64.9	305.6	82	0.991	0.04	0.39	27.3	26.3	54.3	71.7	279	293	72	338	274	181

**Table A.III.6. Engine Dynamometer Data, E15 Fuel, 28% of Expected Engine Life (be4\_e15\_010b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_preat	CO2_preat	THC_preat	NOx_preat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/18/10	49:39	0.6	0.0	856	101.24	1.73	28.9	29.2	25.4	31.4	1.1	4.1	-0.5	0.9	2.8	36.4	67.2	325.6	82	1.002	0.05	0.57	32.1	27.5	45.6	53.7	312	350	121	293	234	163
10/18/10	58:09	326.0	100.0	4400	101.19	45.44	26.5	30.6	25.0	33.7	4.2	12.3	465.2	1520.9	0.9	33.1	0.1	341.0	83	1.000	150.17	325.90	31.4	28.7	63.9	121.5	727	696	701	716	698	660
10/18/10	59:09	325.7	100.0	4398	101.19	45.65	26.2	30.8	25.0	33.9	4.3	12.2	467.8	1509.8	0.9	33.0	1.1	339.4	83	1.000	150.08	325.72	31	28.7	63.9	122.7	721	695	704	717	696	662
10/18/10	00:09	325.7	100.0	4400	101.19	45.69	25.9	30.9	25.0	33.9	4.3	12.3	460.2	1498.8	0.9	33.1	0.6	338.1	83	1.000	150.05	325.66	31	28.7	64.1	123.7	724	694	703	714	698	659
10/18/10	08:39	233.5	33.0	3519	101.19	24.51	25.5	31.6	24.9	34.3	0.5	14.0	293.9	2397.1	1.0	32.4	14.1	344.6	83	1.000	86.06	233.48	31.6	29.7	62.4	110.4	721	721	682	683	695	683
10/18/10	09:39	232.8	33.5	3522	101.19	24.00	24.8	31.7	24.9	34.4	0.5	14.0	290.4	2414.1	1.0	32.9	14.1	345.3	83	1.001	85.87	232.94	31.7	29.5	62.4	110.1	720	723	680	683	692	686
10/18/10	10:39	233.8	32.8	3520	101.19	24.70	24.8	31.7	24.9	34.4	0.5	14.0	295.0	2417.4	1.0	32.0	14.0	345.8	83	1.000	86.20	233.85	31.3	29.6	62.4	109.8	718	719	680	683	693	684
10/18/10	19:09	151.5	19.4	2639	101.19	12.88	24.9	32.0	24.9	34.5	0.1	13.6	204.4	1393.5	1.1	34.6	31.2	348.9	83	0.999	41.85	151.39	30.6	29.4	60.3	96.7	686	671	634	637	649	648
10/18/10	20:09	151.4	19.6	2639	101.19	12.84	24.6	32.0	24.9	34.6	0.1	13.6	202.3	1385.9	1.1	34.3	31.2	349.6	83	0.999	41.81	151.22	30.6	29.4	60.1	96.3	685	671	633	639	648	649
10/18/10	21:09	151.8	19.0	2640	101.19	13.03	24.5	32.1	24.9	34.6	0.1	13.6	199.5	1386.8	1.1	34.1	31.3	350.1	83	0.999	41.93	151.66	30.6	29.4	60.1	95.9	686	668	636	638	647	648
10/18/10	29:39	81.6	9.6	1762	101.18	5.72	24.8	32.2	25.0	34.6	1.5	13.9	473.8	437.9	1.0	36.6	53.1	332.0	83	0.999	15.03	81.54	30.6	29.2	57.9	84.7	586	611	520	565	589	586
10/18/10	30:39	81.7	9.6	1760	101.18	6.12	24.5	32.2	25.0	34.7	1.4	13.9	480.2	444.7	1.0	32.5	53.1	330.0	83	0.999	15.03	81.55	30.3	29.2	57.8	84.2	584	613	523	565	588	585
10/18/10	31:39	81.1	9.6	1761	101.18	6.04	24.6	32.2	25.0	34.7	1.4	13.9	475.0	438.6	1.0	34.2	53.2	330.7	83	0.998	14.92	80.93	30.1	29.1	57.8	83.8	583	612	522	562	589	588
10/18/10	39:44	0.5	0.0	955	101.16	1.75	28.0	30.3	25.0	34.7	3.2	12.3	2737.5	29.5	0.9	38.4	69.4	305.7	83	0.997	0.05	0.47	29.3	28.5	55.6	73.2	188	338	63	354	200	188
10/18/10	40:44	0.5	0.0	936	101.16	1.78	27.7	30.2	25.0	34.7	3.0	12.3	2901.3	29.1	0.9	36.5	69.6	305.9	83	0.997	0.05	0.47	29.2	28.6	55.4	72.5	75	301	61	356	194	267
10/18/10	41:44	0.5	0.0	937	101.16	1.79	27.8	30.2	25.0	34.7	2.9	12.3	2987.9	28.9	0.9	35.3	69.7	306.2	83	0.997	0.05	0.48	29.3	28.5	55.4	71.9	284	327	64	347	244	256



**Table A.III.7. Engine Dynamometer Data, E15 Fuel, 50% of Expected Engine Life (be4\_e15\_014b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/21/10	06:36	0.2	0.0	921	100.73	1.97	42.0	26.0	23.4	41.0	0.0	0.1	-0.3	-0.2	89.0	41.1	69.6	324.1	137	1.005	0.02	0.16	29.4	24.5	46.2	57.2	407	426	356	394	366	419	
10/21/10	15:06	320.5	100.0	4402	100.70	45.26	40.4	26.0	22.9	43.2	4.1	12.5	491.0	1602.8	0.9	35.3	6.5	340.7	137	0.999	147.46	320.04	26.3	23.3	62.3	122.4	726	696	704	719	701	649	
10/21/10	16:06	320.4	100.0	4401	100.70	45.26	40.4	26.0	22.9	43.1	4.1	12.4	486.9	1594.7	0.9	35.4	6.3	339.3	137	0.999	147.51	320.13	26.2	23.3	62.8	123.7	724	696	704	719	699	652	
10/21/10	17:06	320.5	100.0	4401	100.70	45.41	40.9	26.0	22.8	43.0	4.2	12.4	497.2	1580.0	0.9	35.6	6.2	338.3	137	0.999	147.60	320.33	26.1	23.3	62.9	124.7	722	693	704	717	704	651	
10/21/10	25:36	229.7	32.8	3520	100.71	23.58	39.3	26.3	22.6	44.1	0.5	14.2	323.1	2460.5	1.0	35.2	20.2	352.2	138	0.997	84.46	229.11	26.3	23.6	60.2	110.1	718	727	673	684	691	678	
10/21/10	26:36	229.7	32.8	3523	100.71	24.29	38.8	26.3	22.5	44.3	0.5	14.2	322.0	2460.0	1.0	35.3	20.3	352.8	138	0.997	84.44	229.07	25.9	23.6	60.1	109.7	719	728	673	684	692	680	
10/21/10	27:36	229.6	33.1	3521	100.71	23.53	39.2	26.4	22.5	44.3	0.5	14.2	319.4	2386.2	1.0	35.9	20.3	353.2	138	0.998	84.44	229.07	25.7	23.6	60.1	109.5	719	726	674	685	691	684	
10/21/10	36:06	149.4	19.4	2639	100.71	12.38	37.9	26.4	22.4	44.3	0.1	13.8	213.7	1359.2	1.1	39.3	35.8	354.5	138	0.996	41.11	148.71	25.5	23.6	58.1	96.1	682	672	631	640	656	647	
10/21/10	37:06	148.9	20.4	2642	100.71	13.02	38.2	26.4	22.4	44.3	0.1	13.7	208.3	1323.4	1.1	36.1	35.8	355.0	138	0.996	40.98	148.23	25.3	23.6	58.1	95.5	682	670	629	639	654	644	
10/21/10	38:06	149.1	20.4	2649	100.71	12.79	38.2	26.5	22.4	44.6	0.1	13.8	212.9	1356.2	1.1	38.2	35.8	355.2	138	0.996	41.06	148.51	25.2	23.6	57.8	95.2	681	670	631	639	654	643	
10/21/10	46:36	80.0	10.3	1761	100.70	6.06	37.0	26.5	22.3	44.6	1.6	13.9	502.9	440.2	1.0	38.0	54.8	333.0	138	0.994	14.66	79.55	24.6	23.5	55.4	83.8	575	615	507	555	592	589	
10/21/10	47:36	80.4	9.7	1758	100.71	5.65	37.0	26.4	22.3	44.4	1.6	13.9	503.9	437.7	1.0	42.4	54.7	334.3	138	0.994	14.73	79.93	24.9	23.6	55.3	83.2	575	617	507	555	590	588	
10/21/10	48:36	80.1	9.9	1760	100.70	5.60	37.2	26.5	22.2	44.2	1.6	13.9	505.2	432.7	1.0	41.1	54.8	334.5	138	0.995	14.69	79.69	24.5	23.7	55.1	82.8	577	617	508	555	592	589	
10/21/10	56:41	0.2	0.0	956	100.69	1.90	42.1	24.4	22.2	44.5	3.5	12.4	2562.1	28.6	0.9	42.6	70.5	309.3	138	0.993	0.02	0.18	24	22.9	52.7	72.1	181	283	62	410	230	141	
10/21/10	57:41	0.1	0.0	942	100.69	1.91	41.8	24.3	22.2	44.7	3.3	12.3	3109.1	28.4	0.9	42.4	70.8	309.5	138	0.993	0.01	0.15	23.7	22.9	52.5	71.3	235	197	65	404	92	123	
10/21/10	58:41	0.2	0.0	950	100.68	1.90	41.1	24.3	22.1	44.7	3.3	12.4	2776.8	28.7	0.9	42.3	70.5	310.3	138	0.992	0.02	0.18	23.8	22.9	52.4	70.8	240	223	67	405	223	134	

**Table A.III.8. Engine Dynamometer Data, E15 Fuel, 50% of Expected Engine Life (be4\_e15\_015b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/21/10	59:31	0.3	0.0	956	100.68	1.90	40.6	24.3	22.1	44.4	0.0	0.1	2.9	0.5	144.9	42.2	70.7	310.8	138	0.992	0.03	0.26	23.7	22.9	52.3	70.3	232	166	68	293	176	126	
10/21/10	08:01	321.5	100.0	4402	100.66	45.60	34.0	26.5	22.1	44.3	4.1	12.4	461.7	1599.2	0.9	35.4	5.3	339.8	138	0.998	147.86	320.90	27.1	24.2	62.8	123.3	723	699	705	722	700	650	
10/21/10	09:01	321.3	100.0	4401	100.65	45.21	34.1	26.6	22.1	44.5	4.2	12.4	461.1	1586.1	0.9	35.8	5.2	339.0	138	0.998	147.81	320.78	28.4	24.3	63.2	124.2	721	695	704	720	703	657	
10/21/10	10:01	321.5	100.0	4400	100.65	45.20	33.1	26.8	22.1	44.4	4.2	12.4	460.6	1582.5	0.9	36.2	4.8	338.0	138	0.999	147.96	321.10	26.9	24.4	63.3	124.9	723	698	705	720	702	652	
10/21/10	18:31	230.2	33.2	3521	100.66	23.50	32.4	27.5	22.1	44.0	0.5	14.1	312.3	2546.8	1.0	35.2	19.2	351.4	138	0.998	84.65	229.65	26.9	25.0	61.0	110.4	719	721	675	677	692	682	
10/21/10	19:31	230.3	32.8	3519	100.66	24.83	31.9	27.6	22.1	43.9	0.5	14.1	312.2	2527.5	1.0	33.6	19.1	352.0	138	0.998	84.74	229.90	26.7	25.0	60.9	110.1	720	722	676	677	693	683	
10/21/10	20:31	230.2	32.7	3520	100.66	23.56	31.7	27.7	22.1	44.2	0.5	14.1	313.1	2521.3	1.0	36.7	19.0	352.4	138	0.999	84.76	229.95	27.5	25.1	60.7	110.0	715	722	673	680	692	681	
10/21/10	29:01	149.5	19.9	2644	100.65	12.49	30.3	28.0	22.1	43.1	0.1	13.8	224.6	1518.7	1.1	38.8	35.0	353.2	139	0.998	41.23	149.15	27.2	25.4	58.7	96.5	682	667	632	632	653	640	
10/21/10	30:01	149.7	19.4	2641	100.65	12.80	29.6	28.1	22.1	42.9	0.1	13.7	215.5	1493.8	1.1	37.0	34.9	353.6	139	0.998	41.27	149.29	27	25.4	58.7	96.1	682	668	630	631	653	635	
10/21/10	31:01	149.5	19.7	2643	100.65	12.64	29.4	28.1	22.1	42.9	0.1	13.8	220.1	1505.2	1.1	38.2	34.8	354.1	139	0.997	41.21	149.06	26.8	25.4	58.6	95.7	680	666	631	632	654	638	
10/21/10	39:31	80.2	10.2	1760	100.65	5.58	28.9	28.1	22.1	42.7	1.5	13.9	517.1	495.0	1.0	41.8	54.9	333.0	139	0.995	14.72	79.88	26.2	25.3	56.1	84.2	579	613	507	551	593	579	
10/21/10	40:31	80.3	10.3	1758	100.65	6.02	29.0	28.1	22.1	42.6	1.5	13.9	509.2	497.1	1.0	36.5	54.9	332.6	139	0.996	14.74	79.98	26.1	25.3	55.8	83.6	580	614	508	551	594	577	
10/21/10	41:31	80.5	10.0	1759	100.65	6.04	29.5	28.1	22.1	42.3	1.5	13.9	507.3	498.2	1.0	38.6	54.9	333.7	139	0.996	14.79	80.24	26.5	25.4	55.9	83.2	578	614	508	551	595	576	
10/21/10	49:36	0.2	0.0	968	100.63	1.89	32.2	26.0	22.1	42.1	3.3	12.4	2758.5	29.9	0.9	41.8	70.2	309.9	139	0.994	0.02	0.19	25.3	24.5	53.2	72.4	117	288	64	314	117	327	
10/21/10	50:36	0.2	0.0	982	100.63	1.89	32.2	25.9	22.1	42.0	3.3	12.4	2720.6	30.1	0.9	41.7	70.3	310.3	139	0.994	0.02	0.22	25.3	24.4	53.1	71.7	178	342	64	295	207	327	
10/21/10	51:36	0.2	0.0	982	100.63	1.89	32.2	25.8	22.2	41.9	3.3	12.4	2549.4	29.9	0.9	41.6	70.2	310.9	139	0.994	0.02	0.19	25.3	24.4	53.1	71.2	283	239	65	296	231	321	

**Table A.III.9. Engine Dynamometer Data, E15 Fuel, 50% of Expected Engine Life (be4\_e15\_016b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/21/10	52:27	0.2	0.0	981	100.63	1.89	32.6	25.8	22.2	41.5	0.0	0.1	2.9	0.7	143.3	41.5	70.3	311.3	139	0.994	0.02	0.19	25.2	24.3	52.9	70.7	280	251	67	244	194	313
10/21/10	00:57	321.8	100.0	4400	100.60	45.30	27.0	28.2	22.1	41.1	4.1	12.4	475.2	1616.8	0.9	35.6	4.9	341.6	139	1.000	148.20	321.65	28.3	26.0	63.5	123.2	726	696	705	719	701	650
10/21/10	01:57	321.6	100.0	4401	100.60	44.93	27.2	28.3	22.1	41.3	4.2	12.4	475.5	1598.4	0.9	35.8	4.8	340.3	139	1.001	148.27	321.80	28.4	26.1	63.6	124.4	724	690	707	725	701	658
10/21/10	02:57	321.8	100.0	4400	100.59	45.29	26.9	28.4	22.2	41.4	4.2	12.4	487.4	1598.6	0.9	35.7	4.7	339.3	139	1.000	148.30	321.85	28.8	26.1	63.9	125.1	724	689	706	724	702	656
10/21/10	11:27	230.3	33.3	3523	100.59	24.68	26.0	29.0	22.3	40.4	0.5	14.1	312.1	2540.5	1.0	34.9	18.7	351.5	139	1.000	84.88	230.28	28.5	26.4	61.3	110.7	719	721	673	688	691	683
10/21/10	12:27	230.5	33.3	3522	100.59	23.09	25.9	29.1	22.3	40.7	0.6	14.1	311.2	2532.5	1.0	37.1	18.4	352.2	139	1.000	84.96	230.48	27.8	26.4	61.3	110.4	717	722	673	688	687	681
10/21/10	13:27	230.6	33.0	3520	100.59	22.95	25.9	29.2	22.3	41.1	0.6	14.1	313.8	2559.7	1.0	35.9	18.2	352.7	139	1.000	85.02	230.65	28.8	26.5	61.2	110.1	722	722	675	686	686	678
10/21/10	21:57	149.6	20.2	2634	100.57	12.64	25.0	29.4	22.3	40.0	0.1	13.7	226.2	1482.0	1.1	38.1	34.4	352.8	139	0.999	41.31	149.40	27.7	26.4	59.0	96.6	682	665	634	639	652	639
10/21/10	22:57	149.8	19.4	2643	100.57	12.70	25.4	29.4	22.4	39.9	0.1	13.7	221.2	1469.0	1.1	36.7	34.3	353.4	139	0.999	41.37	149.66	27.4	26.5	58.9	96.2	681	665	633	638	652	639
10/21/10	23:57	149.5	20.0	2644	100.57	12.73	25.7	29.4	22.4	40.1	0.1	13.7	225.8	1470.4	1.1	37.6	34.3	353.9	139	0.999	41.31	149.42	28.1	26.6	58.9	95.7	683	665	635	639	652	638
10/21/10	32:27	80.4	10.3	1761	100.56	6.35	26.1	29.6	22.5	40.1	1.5	14.0	517.5	477.7	1.0	34.2	54.7	332.1	140	0.999	14.81	80.34	27.6	26.7	56.7	84.4	579	614	511	559	587	579
10/21/10	33:27	80.4	10.6	1762	100.56	5.78	26.1	29.6	22.5	39.7	1.5	13.9	521.3	471.8	1.0	40.1	54.7	333.5	140	1.000	14.81	80.36	27.6	26.8	56.6	83.8	579	613	510	560	587	577
10/21/10	34:27	80.4	10.5	1760	100.55	5.72	25.5	29.5	22.5	39.5	1.5	13.9	514.4	479.7	1.0	38.3	54.8	333.0	140	0.999	14.81	80.35	27.4	26.8	56.5	83.5	582	615	511	559	586	581
10/21/10	42:32	0.3	0.0	973	100.54	1.89	29.4	27.4	22.6	39.2	3.2	12.3	3052.3	30.3	0.9	41.4	70.4	309.0	140	0.998	0.03	0.26	26.7	25.9	53.8	72.6	252	395	65	251	235	355
10/21/10	43:32	0.3	0.0	970	100.53	1.88	29.4	27.3	22.6	39.2	3.3	12.5	2594.2	30.4	0.9	41.3	70.4	309.7	140	0.998	0.03	0.25	26.6	25.8	53.6	72.0	298	365	67	276	229	349
10/21/10	44:32	0.2	0.0	964	100.53	1.86	29.4	27.3	22.6	38.9	3.3	12.5	2423.5	30.8	0.9	41.2	70.2	310.7	140	0.998	0.03	0.25	26.6	25.9	53.5	71.4	283	330	67	291	226	351

**Table A.III.10. Engine Dynamometer Data, E15 Fuel, 79% of Expected Engine Life (be4\_e15\_22b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/5/10	17:36	0.3	0.0	918	100.24	1.72	35.3	22.4	20.5	40.0	0.0	0.1	1.3	-0.3	257.4	41.7	76.3	304.1	179	0.989	0.03	0.31	21.4	20.3	52.1	70.8	209	72	64	64	82	71
11/5/10	26:06	308.9	100.0	4399	100.23	44.93	34.4	22.6	20.0	41.3	3.7	12.5	444.0	1565.9	0.9	32.1	37.4	316.1	179	0.994	141.44	306.97	24.6	20.9	64.1	135.2	724	702	696	716	697	669
11/5/10	27:06	308.8	100.0	4400	100.23	44.79	34.6	22.6	19.9	41.4	3.8	12.5	442.1	1542.3	0.9	32.8	38.0	315.0	179	0.994	141.46	307.00	23.3	20.6	64.7	136.0	726	698	692	718	694	662
11/5/10	28:06	309.0	100.0	4401	100.23	44.92	34.9	22.6	19.9	41.4	3.8	12.5	442.8	1541.2	0.9	33.3	38.1	314.6	179	0.993	141.38	306.83	23	21.1	64.8	136.6	721	701	695	716	694	664
11/5/10	36:36	220.6	33.2	3519	100.24	23.00	33.0	22.9	19.7	42.2	0.3	13.9	238.3	2123.6	1.1	33.8	46.9	349.4	179	0.993	80.75	219.07	23.3	20.8	61.0	111.4	709	717	666	683	687	674
11/5/10	37:36	220.6	34.1	3519	100.23	23.24	33.0	23.1	19.6	42.3	0.3	13.9	240.4	2164.4	1.1	33.5	46.9	350.3	179	0.994	80.82	219.26	23.7	20.8	60.8	111.0	711	717	664	682	682	678
11/5/10	38:36	220.3	33.3	3519	100.24	22.95	32.7	22.9	19.6	42.5	0.3	13.9	238.0	2152.3	1.1	33.8	46.9	350.8	179	0.993	80.62	218.70	22.8	20.8	60.7	110.5	709	715	665	681	684	685
11/5/10	47:06	143.1	20.0	2645	100.24	12.44	32.6	23.0	19.5	42.8	0.1	13.6	188.7	1189.4	1.1	36.0	56.2	358.0	179	0.992	39.24	141.92	22.6	20.6	58.0	96.4	673	670	616	639	653	648
11/5/10	48:06	143.4	20.0	2640	100.23	12.43	32.3	23.1	19.5	42.8	0.1	13.6	188.1	1185.4	1.1	36.1	56.1	358.3	179	0.991	39.31	142.20	22.5	20.9	57.8	95.9	675	671	619	639	651	648
11/5/10	49:06	143.0	20.3	2641	100.24	12.57	32.0	23.0	19.5	42.8	0.1	13.6	185.0	1171.8	1.1	35.4	56.1	358.8	179	0.990	39.16	141.65	22.3	20.8	57.7	95.5	674	671	619	639	651	649
11/5/10	57:36	77.3	10.3	1759	100.25	5.80	30.5	23.1	19.5	43.1	1.3	13.9	489.0	423.6	1.0	37.1	67.5	346.3	180	0.990	14.09	76.47	21.9	20.6	55.3	84.2	575	612	500	561	587	588
11/5/10	58:36	76.9	10.4	1759	100.25	5.51	30.8	23.2	19.5	43.1	1.3	14.0	493.0	414.3	1.0	38.4	67.4	347.3	180	0.989	14.02	76.08	22.2	21.0	55.3	83.6	575	609	498	562	587	587
11/5/10	59:36	76.6	10.9	1758	100.25	6.04	30.6	23.2	19.5	43.2	1.3	14.0	478.5	414.7	1.0	34.6	67.4	347.7	180	0.989	13.97	75.83	21.9	20.5	55.1	83.2	573	613	501	563	588	586
11/5/10	07:41	0.3	0.0	939	100.26	1.69	33.4	21.8	19.5	43.0	3.3	12.3	2832.1	28.4	0.9	40.6	76.1	302.1	180	0.988	0.03	0.26	21.4	20.6	52.7	72.6	245	113	66	181	111	155
11/5/10	08:41	0.3	0.0	942	100.26	1.68	34.0	21.9	19.5	43.0	3.2	12.4	2678.8	28.5	0.9	39.9	76.0	302.8	180	0.989	0.03	0.27	21.7	20.9	52.5	71.7	261	184	66	191	162	148
11/5/10	09:41	0.2	0.0	913	100.27	1.69	33.5	21.8	19.5	42.9	3.1	12.4	2795.3	28.3	0.9	39.4	76.2	302.5	180	0.989	0.02	0.24	21.4	20.6	52.4	71.1	242	208	59	172	96	135

**Table A.III.11. Engine Dynamometer Data, E15 Fuel, 79% of Expected Engine Life (be4\_e15\_23b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/5/10	10:15	0.3	0.0	923	100.26	1.84	34.4	21.9	19.5	42.8	0.0	0.2	4.6	1.0	58.5	32.8	76.3	302.0	180	0.989	0.03	0.26	21.6	21.0	52.4	70.8	251	171	146	173	128	127
11/5/10	18:45	310.0	100.0	4400	100.28	44.68	29.9	23.3	19.5	42.9	3.6	12.6	436.7	1594.8	0.9	32.0	37.7	315.2	180	0.992	141.67	307.47	23.4	21.1	64.4	135.2	724	703	696	716	701	666
11/5/10	19:45	309.5	100.0	4398	100.28	44.87	30.8	23.2	19.5	42.9	3.7	12.5	439.8	1532.4	0.9	32.4	37.6	314.1	180	0.992	141.49	307.08	24	21.0	64.5	136.2	723	703	697	715	696	662
11/5/10	20:45	309.6	100.0	4401	100.28	44.76	30.4	23.3	19.5	42.9	3.8	12.5	436.9	1538.2	0.9	33.0	36.7	313.5	180	0.994	141.72	307.58	23.6	21.3	64.9	136.9	724	703	695	717	696	660
11/5/10	29:15	221.8	33.5	3519	100.27	23.04	30.4	23.2	19.5	42.6	0.3	13.8	248.4	2241.3	1.1	33.7	46.6	348.3	180	0.992	81.12	220.07	24.1	21.0	60.8	111.6	710	714	668	674	691	673
11/5/10	30:15	221.8	33.9	3519	100.28	23.11	30.6	23.3	19.5	42.6	0.3	13.8	244.2	2243.3	1.1	33.7	46.7	349.1	180	0.991	81.05	219.88	22.5	20.8	60.8	111.1	709	716	665	675	687	667
11/5/10	31:15	221.8	33.8	3520	100.28	23.03	30.3	23.5	19.5	42.5	0.3	13.8	250.2	2263.5	1.1	33.7	46.8	349.4	180	0.991	81.04	219.85	22.8	21.1	61.0	110.7	708	714	667	677	686	667
11/5/10	39:45	143.8	20.0	2637	100.30	12.38	28.7	23.8	19.5	42.2	0.1	13.6	195.3	1221.4	1.1	35.9	56.0	357.0	180	0.989	39.32	142.21	22.5	21.0	58.0	96.4	676	670	621	634	647	641
11/5/10	40:45	144.0	20.5	2637	100.31	12.41	28.5	23.8	19.5	42.1	0.1	13.6	196.9	1229.8	1.1	36.0	56.0	357.4	180	0.989	39.34	142.31	21.5	20.8	58.0	95.9	676	671	621	634	648	639
11/5/10	41:45	144.3	20.3	2636	100.31	12.41	28.3	23.9	19.7	42.1	0.1	13.6	197.8	1238.2	1.1	35.5	56.0	358.0	180	0.988	39.42	142.59	22	21.0	58.0	95.5	675	670	621	634	647	639
11/5/10	50:15	77.7	10.2	1760	100.34	6.05	29.6	23.8	20.0	37.1	1.3	14.0	499.6	449.7	1.0	34.8	67.4	345.5	180	0.988	14.14	76.73	21.7	20.6	55.3	84.2	580	610	500	557	583	584
11/5/10	51:15	77.4	10.5	1760	100.35	5.50	28.2	23.9	20.6	37.3	1.3	14.0	500.8	444.9	1.0	38.7	67.4	346.4	180	0.987	14.07	76.36	21.7	21.1	55.4	83.6	579	612	499	557	584	584
11/5/10	52:15	77.5	10.6	1759	100.33	6.03	27.4	23.8	19.9	37.5	1.3	14.0	492.7	452.6	1.0	34.5	67.5	347.2	180	0.987	14.10	76.52	21.6	20.6	55.3	83.2	580	611	500	558	582	585
11/5/10	00:20	0.3	0.0	962	100.32	1.71	31.3	22.1	19.8	40.2	3.3	12.4	2659.9	29.7	0.9	40.5	75.6	303.4	181	0.988	0.03	0.27	21.9	21.0	52.9	72.6	249	199	64	208	132	115
11/5/10	01:20	0.3	0.0	953	100.33	1.69	31.1	22.0	19.8	40.4	3.1	12.3	3217.0	28.3	0.9	39.9	76.0	302.7	181	0.988	0.03	0.28	21.6	20.8	52.8	71.8	178	205	65	206	154	159
11/5/10	01:20	0.3	0.0	953	100.33	1.69	31.1	22.0	19.8	40.4	3.1	12.3	3217.0	28.3	0.9	39.9	76.0	302.7	181	0.988	0.03	0.28	21.6	20.8	52.8	71.8	178	205	65	206	154	159

**Table A.III.12. Engine Dynamometer Data, E15 Fuel, 79% of Expected Engine Life (be4\_e15\_24b)**

Date	Time	Observed Torque	Throttle angle	Speed	Baro_p_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/5/10	03:10	0.3	0.0	960	100.33	1.73	31.7	21.8	19.9	40.5	0.0	0.1	3.5	0.8	126.4	39.2	75.5	305.1	181	0.987	0.03	0.25	21.4	20.6	52.5	70.7	286	218	144	169	140	114
11/5/10	11:40	310.1	100.0	4400	100.30	44.78	30.7	23.0	19.7	41.2	3.7	12.5	430.9	1572.0	0.9	32.1	37.7	314.5	181	0.992	141.81	307.77	23.14	20.9	64.1	134.9	724	707	699	715	695	664
11/5/10	12:40	310.1	100.0	4400	100.30	44.90	29.4	23.0	19.7	41.3	3.7	12.5	432.1	1597.6	0.9	32.3	37.0	313.8	181	0.992	141.79	307.73	24.4	20.9	64.5	135.8	726	703	696	713	693	667
11/5/10	13:40	310.3	100.0	4401	100.30	44.50	30.2	23.0	19.7	41.3	3.8	12.5	432.0	1568.1	0.9	32.4	36.9	313.4	181	0.994	142.06	308.32	23.78	20.9	64.8	136.5	728	704	694	713	692	658
11/5/10	22:10	221.8	33.3	3521	100.31	22.91	27.6	23.5	19.7	40.9	0.3	13.8	249.8	2243.5	1.1	33.4	46.8	349.3	181	0.990	80.90	219.47	23.05	20.8	61.1	111.1	711	713	667	676	681	676
11/5/10	23:10	221.9	33.7	3518	100.32	23.01	27.8	23.6	19.7	40.8	0.3	13.8	245.2	2238.0	1.1	33.5	46.6	350.3	181	0.990	80.92	219.53	23.18	21.1	61.0	110.5	712	715	668	676	682	678
11/5/10	24:10	222.2	33.9	3520	100.32	23.20	27.6	23.5	19.7	40.7	0.3	13.8	245.6	2234.6	1.1	33.1	46.5	350.9	181	0.990	81.06	219.90	22.79	20.8	61.0	110.1	710	712	665	674	685	670
11/5/10	32:40	144.1	20.6	2638	100.31	12.31	26.5	23.7	19.7	40.4	0.1	13.6	197.5	1258.8	1.1	35.5	56.1	356.6	181	0.988	39.36	142.39	22.3	21.0	58.3	96.4	674	667	621	634	647	633
11/5/10	33:40	144.2	20.4	2640	100.32	12.39	26.8	23.6	19.7	40.4	0.1	13.6	201.2	1241.3	1.1	35.8	56.1	357.0	181	0.989	39.40	142.53	22.74	20.8	58.0	95.8	674	671	621	636	648	634
11/5/10	34:40	143.9	20.4	2639	100.31	12.53	27.1	23.7	19.8	40.3	0.1	13.6	198.1	1242.7	1.1	35.6	56.1	357.3	181	0.988	39.33	142.27	22.6	21.1	58.1	95.5	674	670	621	635	646	636
11/5/10	43:10	77.2	10.8	1761	100.33	5.39	27.2	23.6	19.8	39.9	1.3	14.0	513.1	487.3	1.0	39.1	67.4	346.0	181	0.987	14.05	76.22	22	20.6	55.1	84.1	580	611	496	554	581	568
11/5/10	44:10	77.5	10.6	1760	100.33	5.97	27.3	23.7	19.8	39.9	1.3	14.0	509.1	483.5	1.0	33.9	67.3	346.6	181	0.987	14.09	76.45	21.7	20.9	55.1	83.5	580	612	497	553	580	568
11/5/10	45:10	77.3	10.8	1760	100.32	5.84	27.2	23.7	19.8	39.9	1.3	14.0	506.0	489.7	1.0	35.7	67.4	347.2	181	0.987	14.07	76.34	21.9	20.6	55.1	83.1	580	606	497	554	582	569
11/5/10	53:15	0.3	0.0	946	100.32	1.71	31.0	22.1	19.9	39.5	3.3	12.4	2754.5	29.7	0.9	40.0	75.9	301.5	181	0.987	0.03	0.30	21.6	21.0	52.6	72.4	282	119	65	199	182	137
11/5/10	54:15	0.3	0.0	957	100.32	1.69	30.4	21.9	19.9	39.5	3.3	12.5	2534.7	29.6	0.9	39.4	75.9	302.3	181	0.987	0.03	0.31	21.6	20.6	52.4	71.7	238	237	65	197	206	121
11/5/10	55:15	0.3	0.0	947	100.31	1.72	31.3	22.0	19.9	39.4	3.2	12.5	2606.8	29.2	0.9	39.1	75.9	302.4	182	0.987	0.03	0.28	21.6	20.9	52.4	71.1	212	180	66	155	178	111

**Table A.III.13. Engine Dynamometer Data, E15 Fuel, 100% of Expected Engine Life (be4\_e15\_28b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fueflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/16/10	22:25	0.4	0.0	816	101.27	1.71	42.4	25.2	21.7	39.6	0.4	1.6	797.0	52.6	62.7	36.9	77.2	320.6	206	0.996	0.04	0.41	28.5	24.4	44.4	52.3	176	103	71	77	109	71
11/16/10	31:08	323.4	100.0	4398	101.23	44.58	42.3	25.7	21.0	42.2	3.7	12.4	481.3	1601.6	0.9	30.7	34.8	346.4	206	0.994	148.04	321.28	26.7	24.8	63.8	123.0	730	695	705	719	698	656
11/16/10	32:09	323.1	100.0	4400	101.23	44.61	42.0	25.9	20.9	42.1	3.8	12.4	487.9	1571.6	0.9	30.7	34.7	344.3	206	0.994	147.99	321.18	27.2	24.9	64.2	124.4	727	693	703	721	697	664
11/16/10	33:09	323.3	100.0	4399	101.23	45.06	41.4	26.0	20.8	42.5	3.8	12.4	489.8	1587.9	0.9	30.7	34.6	343.0	206	0.995	148.21	321.65	27.4	25.1	64.3	125.2	726	694	704	717	697	663
11/16/10	41:40	232.3	34.3	3520	101.21	23.49	39.6	26.7	20.4	45.7	0.5	13.8	317.0	2218.0	1.0	29.1	44.4	354.9	206	0.995	85.21	231.15	27.4	25.7	62.3	111.5	709	717	667	679	692	678
11/16/10	42:40	230.9	34.8	3521	101.22	23.80	39.7	26.7	20.4	45.9	0.5	13.9	314.3	2239.4	1.0	31.0	42.3	355.3	206	0.995	84.66	229.68	26.8	25.8	62.3	111.2	707	719	665	681	694	679
11/16/10	43:40	231.2	34.9	3521	101.21	23.82	39.5	26.8	20.4	46.3	0.5	13.9	315.1	2229.5	1.0	31.1	41.9	355.7	206	0.995	84.77	229.96	27.4	26.0	62.4	111.0	709	719	666	678	692	678
11/16/10	52:10	152.3	20.4	2643	101.21	12.73	38.6	27.3	20.1	46.0	0.1	13.5	250.6	1297.0	1.1	32.9	52.6	356.0	206	0.994	41.92	151.47	27.2	26.2	60.1	97.8	674	667	622	631	649	637
11/16/10	53:10	149.2	21.5	2640	101.20	12.86	38.4	27.3	20.1	46.6	0.1	13.5	234.9	1237.0	1.1	30.5	52.7	356.3	206	0.995	41.04	148.45	27.3	26.3	59.9	97.3	674	668	622	633	648	638
11/16/10	54:10	150.7	21.0	2641	101.20	12.81	38.3	27.4	20.1	46.8	0.1	13.5	244.9	1300.4	1.1	32.0	53.1	356.5	206	0.995	41.45	149.91	27.2	26.4	59.9	97.0	674	667	621	633	649	639
11/16/10	02:42	81.6	11.4	1761	101.20	5.95	37.7	27.6	20.0	48.9	1.2	13.9	542.7	434.7	1.0	31.4	65.3	335.5	206	0.994	14.97	81.14	27	26.4	57.2	85.4	580	615	510	560	586	585
11/16/10	03:42	82.2	11.1	1761	101.19	5.90	37.7	27.7	20.1	49.0	1.2	13.9	546.2	434.9	1.0	31.7	66.6	336.0	206	0.994	15.07	81.71	27	26.4	57.2	84.8	581	615	511	559	586	585
11/16/10	04:42	80.8	11.0	1760	101.19	5.89	37.7	27.7	20.1	49.0	1.2	13.8	544.2	445.3	1.0	31.8	66.3	337.3	206	0.995	14.81	80.35	27	26.4	57.2	84.4	581	615	510	560	587	582
11/16/10	12:47	0.5	0.0	949	101.18	1.74	41.7	26.2	20.0	49.2	2.7	12.3	3114.2	28.1	0.9	32.4	75.6	310.1	206	0.992	0.05	0.48	25.5	25.4	54.5	73.6	230	428	119	418	74	375
11/16/10	13:47	-0.2	0.0	943	101.19	1.73	42.0	26.1	20.0	49.1	2.8	12.3	3711.0	27.2	0.9	33.1	75.4	311.9	206	0.992	-0.02	-0.23	25.5	25.4	54.3	72.9	248	422	71	411	138	378
11/16/10	14:47	0.5	0.0	955	101.18	1.81	42.2	26.0	20.0	49.1	2.7	12.4	3141.1	28.1	0.9	31.0	75.0	312.6	206	0.992	0.05	0.47	25.5	25.3	53.9	72.2	206	406	70	416	171	367

**Table A.III.14. Engine Dynamometer Data, E15 Fuel, 100% of Expected Engine Life (be4\_e15\_30b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fueflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/16/10	08:36	0.5	0.0	925	101.01	1.90	40.0	27.4	20.1	50.7	0.0	0.1	4.5	1.1	120.4	29.2	76.2	311.6	207	0.997	0.05	0.48	26.7	26.8	54.5	71.8	222	439	268	423	180	387
11/16/10	17:06	323.1	100.0	4402	101.01	43.90	36.0	29.0	20.1	51.0	3.7	12.5	463.3	1640.0	0.9	31.2	29.3	344.6	208	1.002	149.16	323.60	29.4	27.6	64.7	124.4	731	699	704	720	701	662
11/16/10	18:06	321.9	100.0	4401	101.01	44.73	36.0	29.0	20.1	50.9	3.7	12.5	481.2	1639.3	0.9	30.3	33.5	344.2	208	1.002	148.66	322.64	29.3	27.6	65.1	125.4	730	697	705	717	697	657
11/16/10	19:06	322.0	100.0	4401	101.01	44.57	35.9	29.1	20.1	50.8	3.7	12.5	481.9	1605.5	0.9	30.9	33.2	343.4	208	1.003	148.78	322.90	29.9	27.7	65.3	126.2	730	697	704	722	697	660
11/16/10	27:36	230.3	34.2	3521	101.02	23.58	34.7	29.3	20.1	50.9	0.5	13.8	319.8	2203.0	1.0	30.7	42.1	354.5	208	1.001	84.93	230.39	29.2	27.4	62.9	112.2	715	720	667	673	694	675
11/16/10	28:36	229.7	33.9	3521	101.01	23.57	34.9	29.3	20.1	50.9	0.5	13.8	316.6	2211.1	1.0	30.7	42.1	355.0	208	1.000	84.64	229.63	28.5	27.3	62.6	111.7	712	719	664	672	694	679
11/16/10	29:36	229.6	35.2	3518	101.01	23.65	35.0	29.3	20.1	50.9	0.5	13.8	318.6	2236.4	1.0	30.4	42.1	355.5	208	1.001	84.71	229.82	29	27.3	62.6	111.4	711	719	664	672	693	679
11/16/10	38:06	147.9	20.7	2639	100.99	12.58	34.7	29.3	20.2	51.0	0.1	13.5	242.4	1287.0	1.1	32.6	52.6	354.6	208	1.000	40.89	147.95	28.5	27.2	60.1	97.7	675	669	622	625	653	643
11/16/10	39:07	148.9	21.0	2642	100.99	12.61	34.7	29.2	20.2	51.0	0.1	13.5	234.8	1281.9	1.1	31.8	52.7	354.7	208	0.999	41.12	148.74	27.9	27.2	60.0	97.2	676	670	622	625	653	643
11/16/10	40:07	149.5	20.9	2640	101.00	12.76	34.8	29.2	20.2	51.1	0.1	13.5	239.3	1281.7	1.1	31.5	52.8	355.1	208	0.999	41.28	149.32	28	27.2	60.2	96.9	675	668	622	626	650	644
11/16/10	48:37	80.2	11.6	1761	101.00	5.76	34.8	29.2	20.3	50.1	1.2	13.9	541.6	450.8	1.0	30.8	65.8	336.3	208	0.998	14.77	80.06	27.4	27.3	57.6	85.3	580	617	509	553	584	587
11/16/10	49:38	80.9	11.2	1759	101.00	5.83	34.9	29.1	20.3	50.1	1.2	13.9	555.2	461.3	1.0	30.8	66.3	334.3	208	0.998	14.86	80.67	27.4	27.2	57.4	84.8	579	614	508	554	585	588
11/16/10	50:38	80.0	0.0	1762	101.00	5.87	34.9	29.2	20.3	50.1	1.2	13.9	543.5	461.3	1.0	31.6	66.1	335.1	208	0.998	14.71	79.81	27.4	27.3	57.4	84.4	580	616	508	553	585	588
11/16/10	58:43	0.5	0.0	952	101.00	1.72	40.4	27.1	20.3	50.3	2.8	12.5	2563.6	28.7	0.9	32.5	75.2	310.2	208	0.996	0.05	0.48	26.2	26.5	54.7	73.7	419	445	108	418	314	414
11/16/10	59:43	0.5	0.0	943	101.00	1.67	40.6	27.0	20.3	50.1	2.8	12.4	2617.6	28.5	0.9	33.4	75.5	310.2	208	0.996	0.05	0.51	26.1	26.4	54.5	73.1	419	449	111	415	238	408
11/16/10	00:43	0.5	0.0	967	100.99	1.64	40.7	27.0	20.3	49.9	2.9	12.4	2703.8	28.5	0.9	33.5	75.6	310.5	208	0.996	0.05	0.50	26.2	26.5	54.4	72.4	397	449	84	416	213	409



**Table A.III.15. Engine Dynamometer Data, E15 Fuel, 100% of Expected Engine Life (be4\_e15\_31b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fueflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/16/10	01:33	0.4	0.0	947	100.99	1.82	40.8	27.0	20.3	49.7	0.0	0.1	4.3	1.0	120.9	27.2	75.5	311.4	208	0.996	0.04	0.45	26	26.5	54.4	71.8	397	456	79	425	235	413
11/16/10	10:03	322.1	100.0	4399	100.93	45.06	35.9	28.6	20.3	50.1	3.7	12.5	469.3	1565.1	0.9	30.3	32.4	346.9	208	1.002	148.75	322.84	29.5	27.3	64.7	123.9	731	700	706	723	696	660
11/16/10	11:03	322.0	100.0	4399	100.92	45.50	35.4	28.6	20.3	50.2	3.8	12.4	468.9	1676.0	0.9	31.8	32.4	345.0	208	1.002	148.59	322.57	29.3	27.3	64.8	125.0	730	702	706	720	696	664
11/16/10	12:03	322.3	100.0	4398	100.93	44.72	35.2	28.7	20.4	50.1	3.7	12.4	478.8	1581.9	0.9	30.7	32.5	344.4	208	1.003	148.92	323.19	29.2	27.3	64.9	125.7	728	697	704	719	698	664
11/16/10	20:34	228.4	33.8	3518	100.94	24.00	34.6	29.1	20.3	50.0	0.5	13.9	323.0	2279.0	1.0	31.7	42.3	355.0	209	1.000	84.10	228.28	28.1	27.2	62.6	111.7	711	720	667	679	692	679
11/16/10	21:34	230.6	34.9	3522	100.94	23.60	34.8	29.1	20.4	50.0	0.6	13.8	317.9	2221.7	1.0	30.8	42.5	355.1	209	1.001	85.07	230.77	29	27.2	62.5	111.3	709	718	665	676	691	677
11/16/10	22:34	230.7	34.9	3519	100.94	23.78	34.6	29.2	20.4	50.0	0.6	13.8	320.6	2163.9	1.0	30.4	42.4	355.3	209	1.001	85.09	230.84	28.6	27.2	62.4	111.1	713	723	665	678	692	675
11/16/10	31:05	149.4	21.6	2638	100.94	12.68	34.5	29.2	20.5	49.6	0.1	13.5	233.1	1257.8	1.1	32.5	53.6	354.0	209	1.000	41.30	149.38	28.4	26.9	59.9	97.4	675	669	622	634	649	639
11/16/10	32:06	147.4	20.8	2640	100.93	13.13	34.5	29.2	20.4	49.5	0.1	13.5	239.3	1254.0	1.1	32.3	53.2	354.3	209	1.001	40.78	147.55	28.7	26.8	59.8	96.9	676	671	623	635	649	639
11/16/10	33:06	149.7	21.2	2639	100.93	12.78	34.5	29.2	20.4	49.6	0.1	13.5	231.0	1255.4	1.1	31.8	53.6	354.7	209	1.000	41.40	149.75	28.2	26.9	59.6	96.6	675	670	621	633	650	638
11/16/10	41:37	80.5	11.2	1762	100.91	5.87	35.0	29.2	20.5	49.1	1.2	13.9	541.7	434.0	1.0	31.9	66.7	333.7	209	0.999	14.83	80.44	27.4	26.7	57.3	85.0	581	612	508	558	591	583
11/16/10	42:37	80.2	11.5	1760	100.91	5.82	35.3	29.2	20.5	49.2	1.2	13.9	524.8	413.4	1.0	31.1	66.3	334.1	209	0.999	14.77	80.17	27.5	26.7	57.0	84.5	580	613	507	559	589	586
11/16/10	43:37	80.5	11.4	1760	100.91	5.85	35.3	29.1	20.5	49.2	1.2	13.9	538.2	439.1	1.0	31.9	66.7	334.8	209	1.000	14.84	80.50	27.8	26.7	57.0	84.0	582	614	509	560	590	583
11/16/10	51:42	0.5	0.0	921	100.90	1.69	40.5	27.2	20.5	49.7	2.7	12.4	3129.3	28.3	0.9	32.4	76.0	308.0	209	0.997	0.05	0.49	26.3	25.9	54.4	73.4	163	410	71	422	78	376
11/16/10	52:42	-1.3	0.0	934	100.89	1.68	40.8	27.2	20.5	49.5	2.7	12.5	2100.0	29.9	0.9	32.9	76.4	309.7	209	0.997	-0.12	-1.27	26.1	25.8	54.3	72.7	253	424	72	412	88	370
11/16/10	53:43	0.5	0.0	946	100.89	1.69	40.9	27.1	20.5	49.4	2.7	12.4	3089.9	28.4	0.9	32.3	75.9	310.0	209	0.997	0.05	0.50	26.2	25.7	54.2	72.1	210	394	72	411	95	365

**Table A.III.16. Engine Dynamometer Data, Indolene (E0) Fuel, 2% of Expected Engine Life (be4\_ind\_002b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/8/10	42:10	0.1	0.0	905	101.63	1.85	41.9	23.9	23.6	37.6	0.0	0.1	3.8	1.7	39.6	49.4	73.6	281.3	8	0.982	0.01	0.14	24.3	26.9	55.4	408	440	355	414	430	406
10/8/10	50:40	325.7	100.0	4401	101.62	46.09	37.5	25.1	23.6	37.6	5.7	11.6	522.9	1072.7	0.9	38.9	23.1	335.7	8	0.986	147.97	321.15	26.7	29.7	62.6	716	673	695	733	689	658
10/8/10	51:40	325.6	100.0	4400	101.62	46.03	37.7	25.1	23.6	37.8	5.8	11.6	525.8	1064.7	0.9	39.2	23.3	334.6	8	0.987	148.02	321.24	26.6	30.2	62.8	714	674	693	733	688	657
10/8/10	52:40	325.5	100.0	4400	101.62	45.98	38.1	25.2	23.6	37.8	5.8	11.6	524.8	1053.2	0.9	39.4	23.1	333.9	8	0.986	147.86	320.90	26.1	30.7	63.0	717	676	695	733	688	656
10/8/10	01:10	233.3	31.8	3520	101.63	23.45	36.2	25.9	23.6	37.6	1.0	14.1	375.5	1937.9	1.0	41.8	33.3	345.7	8	0.985	84.71	229.81	26.0	33.4	60.4	729	736	682	686	708	709
10/8/10	02:10	232.6	32.3	3522	101.63	23.25	35.9	26.0	23.6	37.6	1.0	14.2	372.5	1960.0	1.0	41.8	33.3	346.4	8	0.985	84.44	229.08	25.7	33.8	60.3	731	737	682	686	709	712
10/8/10	03:10	233.2	32.6	3522	101.64	23.85	35.3	26.1	23.6	37.6	1.0	14.1	385.1	1977.1	1.0	40.6	33.3	346.6	8	0.985	84.65	229.65	25.9	34.1	60.6	730	737	682	686	710	710
10/8/10	11:40	151.6	17.5	2640	101.65	12.82	35.1	26.3	23.6	37.9	0.5	14.4	313.4	1246.6	1.0	42.5	45.6	344.9	8	0.984	41.23	149.12	25.8	35.6	57.8	703	701	652	654	680	681
10/8/10	12:40	151.7	18.1	2639	101.65	12.95	35.4	26.3	23.6	37.8	0.5	14.4	307.9	1242.9	1.0	43.8	45.6	345.7	8	0.984	41.27	149.28	25.6	35.8	57.8	702	700	651	655	681	681
10/8/10	13:40	151.0	18.4	2644	101.65	12.81	35.0	26.4	23.6	37.8	0.5	14.4	309.6	1234.7	1.0	42.6	45.5	346.3	8	0.984	41.07	148.55	25.9	36.0	58.0	704	699	652	653	681	681
10/8/10	22:10	81.8	8.8	1759	101.66	5.93	34.9	26.5	23.6	37.7	3.3	13.1	715.1	258.1	0.9	47.5	61.9	329.9	8	0.983	14.82	80.43	25.2	36.6	55.4	582	617	525	560	580	609
10/8/10	23:10	81.4	8.8	1761	101.66	6.43	34.9	26.5	23.6	37.8	3.2	13.1	704.8	251.8	0.9	41.9	61.9	330.8	8	0.983	14.75	80.03	25.2	36.7	55.3	582	617	526	560	580	613
10/8/10	24:10	81.3	9.2	1759	101.66	6.10	34.9	26.5	23.6	37.8	3.2	13.1	707.6	253.6	0.9	46.3	61.9	331.8	8	0.983	14.72	79.85	25.0	36.8	55.3	581	619	527	559	581	614
10/8/10	32:15	0.2	0.0	896	101.67	2.01	42.0	24.2	23.7	37.7	5.2	11.3	3026.2	24.8	0.9	43.3	73.7	302.1	8	0.983	0.02	0.17	24.9	36.3	52.8	436	460	350	414	426	422
10/8/10	33:15	0.2	0.0	889	101.67	1.96	41.8	24.2	23.7	37.7	5.1	11.4	2937.8	25.1	0.9	43.3	73.7	302.9	8	0.983	0.01	0.16	24.7	36.2	52.6	432	458	351	410	435	421
10/8/10	34:15	0.2	0.0	899	101.67	1.89	41.8	24.1	23.7	37.8	5.1	11.4	2917.0	25.0	0.9	44.7	73.8	303.6	8	0.983	0.02	0.17	24.9	36.4	52.4	431	453	351	410	433	424

**Table A.III.17. Engine Dynamometer Data, Indolene (E0) Fuel, 2% of Expected Engine Life (be4\_ind\_003b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/8/10	35:06	0.1	0.0	903	101.67	1.83	42.2	24.1	23.6	37.7	0.0	0.1	4.2	2.3	38.3	45.8	73.6	304.3	8	0.983	0.01	0.11	24.9	36.6	52.5	70.3	433	459	352	407	436	419	
10/8/10	43:36	323.7	100.0	4401	101.65	45.73	36.7	26.5	23.7	38.0	5.6	11.7	516.4	1083.2	0.9	37.9	20.9	336.6	9	0.990	147.63	320.39	28.5	39.7	62.8	122.5	724	678	698	735	686	662	
10/8/10	44:36	324.2	100.0	4400	101.65	45.80	35.7	26.7	23.7	38.0	5.6	11.7	527.7	1073.5	0.9	38.4	20.1	334.9	9	0.989	147.73	320.61	27.3	40.3	63.0	123.6	724	680	700	736	686	663	
10/8/10	45:36	323.8	100.0	4401	101.65	45.99	35.5	26.8	23.7	38.0	5.6	11.7	514.4	1056.8	0.9	38.2	19.6	333.7	9	0.989	147.60	320.34	29.0	40.7	63.3	124.3	723	679	698	734	687	664	
10/8/10	54:06	231.5	32.3	3519	101.66	22.35	34.4	27.6	23.7	38.1	1.0	14.2	366.2	1952.1	1.0	42.3	30.6	344.3	9	0.989	84.38	228.92	27.5	43.0	61.1	110.3	731	736	682	687	710	711	
10/8/10	55:06	232.1	32.5	3521	101.66	23.60	34.5	27.6	23.7	38.1	1.0	14.2	369.7	1950.6	1.0	40.1	30.5	345.1	9	0.989	84.59	229.48	28.0	43.3	61.2	110.0	733	736	684	690	709	711	
10/8/10	56:06	232.2	32.8	3520	101.66	23.62	34.1	27.7	23.7	38.1	1.0	14.2	368.3	1966.2	1.0	39.7	30.5	345.5	9	0.990	84.72	229.84	28.1	43.5	61.1	109.8	732	735	684	689	708	709	
10/8/10	04:36	151.0	18.1	2639	101.67	12.86	34.2	28.0	23.7	38.1	0.5	14.4	322.4	1233.4	1.0	42.7	44.1	344.3	9	0.988	41.22	149.10	27.2	44.6	58.5	96.8	700	698	652	652	683	679	
10/8/10	05:36	150.4	18.4	2641	101.67	12.78	34.1	28.0	23.8	38.1	0.6	14.4	320.0	1223.7	1.0	42.6	44.1	344.9	9	0.988	41.06	148.53	27.1	44.7	58.5	96.4	703	698	653	653	682	678	
10/8/10	06:36	151.0	18.0	2639	101.67	12.62	33.6	28.0	23.8	38.2	0.5	14.4	314.4	1232.7	1.0	43.0	44.1	345.5	9	0.987	41.21	149.06	27.2	45.0	58.4	96.0	701	698	654	654	680	679	
10/8/10	15:06	80.9	9.7	1759	101.68	6.23	33.2	28.2	23.8	38.1	3.2	13.2	696.2	246.6	0.9	44.3	61.0	328.4	9	0.987	14.72	79.89	27.1	45.2	56.1	84.7	580	618	531	561	585	614	
10/8/10	16:06	81.1	8.9	1760	101.68	6.37	33.0	28.3	23.8	38.1	3.1	13.2	689.8	248.2	0.9	42.0	61.1	329.0	9	0.987	14.75	80.04	27.2	45.3	56.0	84.2	581	618	531	563	587	614	
10/8/10	17:06	81.0	9.3	1760	101.68	6.24	32.2	28.4	23.8	38.2	3.1	13.2	685.2	251.2	0.9	43.5	61.1	329.4	9	0.987	14.72	79.88	27.0	45.4	56.1	83.8	580	618	529	560	586	617	
10/8/10	25:11	0.2	0.0	896	101.68	1.78	34.0	26.1	23.8	38.1	5.1	11.4	2891.6	26.0	0.9	46.6	73.1	301.3	9	0.985	0.02	0.21	26.6	44.3	53.6	72.7	428	459	359	412	430	427	
10/8/10	26:11	0.2	0.0	908	101.69	1.78	34.1	26.0	23.8	38.1	5.1	11.4	2774.6	26.1	0.9	46.1	73.1	301.9	9	0.985	0.02	0.24	26.7	44.4	53.6	72.0	422	473	358	412	432	425	
10/8/10	27:11	0.2	0.0	909	101.69	1.77	34.4	25.9	23.8	38.0	5.0	11.4	2896.6	26.2	0.9	45.7	73.1	302.5	9	0.985	0.02	0.23	26.7	44.5	53.5	71.3	425	462	354	414	430	426	

**Table A.III.18. Engine Dynamometer Data, Indolene (E0) Fuel, 2% of Expected Engine Life (be4\_ind\_004b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/8/10	28:01	0.2	0.0	910	101.69	2.16	34.6	25.9	23.8	37.9	0.0	0.1	4.2	2.6	37.8	38.9	73.0	303.4	9	0.985	0.02	0.24	26.7	44.4	53.3	70.9	425	464	356	416	428	428
10/8/10	36:31	323.0	100.0	4400	101.68	45.59	29.6	28.3	23.8	37.2	5.6	11.8	522.8	1097.6	0.9	37.5	17.5	335.3	9	0.990	147.33	319.75	29.4	47.8	63.7	122.9	724	681	698	735	688	664
10/8/10	37:31	322.7	100.0	4400	101.69	45.16	30.2	28.5	23.8	37.2	5.6	11.7	530.6	1070.8	0.9	37.9	17.4	333.9	9	0.992	147.46	320.02	30.3	47.4	63.8	123.9	723	683	696	737	685	667
10/8/10	38:31	322.7	100.0	4401	101.69	45.92	29.6	28.5	23.9	37.1	5.6	11.7	530.7	1073.6	0.9	38.2	17.2	332.9	10	0.991	147.39	319.88	29.3	47.8	64.0	124.6	723	683	698	736	686	663
10/8/10	47:01	232.0	32.0	3521	101.70	23.84	28.3	29.0	23.9	36.6	1.0	14.1	370.1	1995.8	1.0	39.3	30.2	344.0	10	0.990	84.62	229.55	29.3	39.1	60.6	110.0	732	734	684	687	707	708
10/8/10	48:01	230.6	32.6	3519	101.69	23.37	28.5	29.1	23.9	36.6	0.9	14.2	364.2	2005.9	1.0	40.1	30.4	344.7	10	0.990	84.16	228.32	29.4	38.1	60.6	109.6	735	734	683	688	708	710
10/8/10	49:01	231.5	32.6	3520	101.70	23.21	28.5	29.2	23.9	36.6	0.9	14.2	360.7	2008.2	1.0	39.5	30.7	345.3	10	0.990	84.48	229.17	29.2	37.4	60.6	109.2	733	735	683	686	706	707
10/8/10	57:31	149.8	18.3	2642	101.71	12.66	24.8	29.5	23.8	36.0	0.6	14.4	328.5	1259.5	1.0	42.2	45.1	344.2	10	0.986	40.84	147.71	28.1	31.3	58.4	96.5	701	699	652	654	680	682
10/8/10	58:31	149.7	18.6	2640	101.71	12.67	24.9	29.4	23.8	35.8	0.6	14.4	334.9	1258.6	1.0	42.7	45.2	344.9	10	0.986	40.82	147.65	28.2	30.7	58.5	96.1	702	699	652	654	679	679
10/8/10	59:31	150.8	18.1	2642	101.71	12.71	25.4	29.4	23.8	35.6	0.5	14.4	328.7	1274.1	1.0	42.6	45.3	345.5	10	0.986	41.11	148.70	28.2	30.3	58.4	95.6	701	698	651	654	678	679
10/8/10	08:01	80.8	8.8	1761	101.72	6.11	25.4	29.3	23.7	35.1	3.1	13.2	671.1	268.9	0.9	43.1	62.2	326.3	10	0.984	14.67	79.58	27.0	26.6	55.9	84.2	583	618	528	557	584	611
10/8/10	09:01	80.7	8.8	1760	101.72	6.22	25.9	29.3	23.7	35.1	3.0	13.2	686.0	266.3	0.9	42.6	62.3	327.7	10	0.984	14.64	79.43	27.1	26.2	55.9	83.6	583	616	528	555	580	611
10/8/10	10:01	80.8	8.4	1759	101.72	6.16	25.7	29.3	23.7	35.2	3.0	13.2	691.3	268.5	0.9	42.9	62.4	327.7	10	0.984	14.66	79.56	27.1	25.8	55.9	83.2	583	616	527	555	580	614
10/8/10	18:06	0.3	0.0	902	101.73	1.84	31.4	26.7	23.6	35.2	5.2	11.3	2954.7	25.6	0.9	47.4	74.1	301.2	10	0.983	0.03	0.27	26.3	24.1	53.4	72.1	422	452	165	410	274	390
10/8/10	19:06	0.3	0.0	906	101.73	1.81	31.5	26.6	23.5	35.3	5.2	11.3	2999.7	25.6	0.9	47.0	74.2	301.8	10	0.983	0.03	0.27	26.3	23.7	53.2	71.5	371	456	134	409	261	393
10/8/10	20:06	0.3	0.0	893	101.73	1.81	31.7	26.5	23.5	35.2	5.1	11.4	2952.4	25.9	0.9	46.6	74.2	302.4	10	0.983	0.02	0.26	26.0	23.3	53.1	70.8	391	458	95	408	294	390

**Table A.III.19. Engine Dynamometer Data, Indolene (E0) Fuel, 28% of Expected Engine Life (be4\_ind\_011b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/18/10	52:23	0.5	0.0	973	101.15	1.87	26.9	31.0	25.1	34.2	0.0	0.1	1.6	1.0	267.8	44.5	69.6	310.4	83	1.000	0.05	0.49	30.5	29.3	56.9	73.9	412	445	359	415	414	415
10/18/10	00:53	323.6	100.0	4401	101.11	45.18	25.4	32.1	25.2	34.6	5.7	11.6	530.6	1188.4	0.9	30.4	2.0	339.0	83	1.003	149.51	324.49	31.6	29.7	64.2	122.6	711	679	690	727	681	642
10/18/10	01:53	323.6	100.0	4400	101.11	44.54	25.1	32.2	25.2	34.6	5.7	11.5	533.8	1175.3	0.9	30.6	3.4	337.8	83	1.003	149.55	324.57	32.1	29.8	64.5	123.6	709	677	689	728	680	643
10/18/10	02:53	323.6	100.0	4400	101.11	44.84	24.9	32.3	25.2	34.6	5.7	11.5	532.5	1167.3	0.9	31.0	2.4	337.0	83	1.003	149.51	324.48	32.1	29.8	64.8	124.4	711	677	690	727	680	643
10/18/10	11:23	231.4	33.2	3520	101.10	23.29	24.4	32.8	25.3	34.9	1.1	14.0	374.5	2223.8	1.0	30.3	16.6	343.8	84	1.002	85.45	231.80	31.0	30.0	62.8	110.9	718	724	675	679	702	691
10/18/10	12:23	232.0	32.2	3522	101.10	22.96	24.2	32.8	25.3	34.8	1.1	14.0	377.9	2227.9	1.0	30.9	16.6	344.5	84	1.002	85.70	232.50	31.3	30.1	62.6	110.7	713	724	675	681	703	694
10/18/10	13:23	232.2	32.6	3517	101.10	23.12	24.5	32.8	25.3	34.8	1.2	14.0	373.7	2148.3	1.0	30.7	16.6	344.9	84	1.003	85.87	232.96	31.8	30.1	62.6	110.5	714	726	675	681	702	692
10/18/10	21:53	150.5	18.8	2642	101.09	12.30	25.3	33.0	25.4	34.8	0.5	14.3	351.9	1495.6	1.0	31.9	33.7	348.2	84	1.002	41.71	150.86	31.0	29.8	60.4	97.1	688	687	644	644	664	664
10/18/10	22:53	150.2	19.2	2640	101.10	12.28	25.6	33.0	25.4	34.9	0.5	14.3	351.4	1487.8	1.0	32.3	33.7	348.9	84	1.003	41.64	150.61	31.3	29.9	60.4	96.7	686	687	644	644	665	665
10/18/10	23:53	151.0	18.5	2640	101.10	12.36	26.1	33.0	25.4	34.9	0.5	14.2	350.6	1488.2	1.0	31.8	33.7	349.4	84	1.003	41.86	151.42	31.1	29.8	60.3	96.5	686	687	644	645	664	665
10/18/10	32:23	81.0	9.7	1759	101.09	5.89	27.7	32.8	25.5	35.3	2.9	13.3	646.9	331.7	0.9	32.6	55.7	334.4	84	1.002	14.96	81.15	30.2	29.2	57.8	84.9	570	600	504	550	576	586
10/18/10	33:23	81.0	9.4	1761	101.09	5.84	27.6	32.8	25.5	35.4	2.9	13.3	643.0	338.7	0.9	32.8	55.9	335.1	84	1.002	14.95	81.12	30.2	29.3	57.8	84.4	570	599	505	551	577	588
10/18/10	34:23	81.0	9.5	1760	101.09	5.86	27.6	32.8	25.5	35.5	2.8	13.3	643.7	336.3	0.9	32.6	56.1	335.1	84	1.002	14.96	81.14	30.2	29.3	57.7	84.0	572	599	504	550	575	587
10/18/10	42:28	0.5	0.0	931	101.09	1.65	32.0	30.4	25.5	35.9	4.3	11.6	4047.1	25.5	0.9	36.3	72.2	305.6	84	1.000	0.05	0.51	29.0	28.3	55.5	73.2	308	220	63	331	93	255
10/18/10	43:28	0.5	0.0	942	101.09	1.66	32.2	30.2	25.5	35.9	4.4	11.7	3535.2	25.8	0.9	35.7	72.1	306.2	84	1.000	0.05	0.52	29.1	28.1	55.1	72.5	286	222	63	335	229	238
10/18/10	44:28	0.5	0.0	923	101.09	1.78	32.5	30.1	25.6	35.9	4.4	11.8	3477.4	25.6	0.9	34.9	72.1	306.9	84	1.000	0.05	0.50	29.0	28.2	55.1	71.9	266	215	62	296	181	200

**Table A.III.20. Engine Dynamometer Data, Indolene (E0) Fuel, 28% of Expected Engine Life (be4\_ind\_012b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/18/10	45:18	0.5	0.0	930	101.09	1.76	32.6	30.1	25.6	35.9	0.0	0.1	3.1	1.3	37.8	34.6	72.2	307.2	84	1.000	0.05	0.52	29.2	28.3	55.1	71.5	210	217	62	297	212	150
10/18/10	53:48	321.7	100.0	4401	101.06	44.92	29.5	32.3	25.6	36.6	5.6	11.6	527.7	1151.9	0.9	29.3	4.3	339.3	84	1.006	149.08	323.55	31.1	29.5	64.1	122.5	714	677	695	726	684	644
10/18/10	54:48	321.6	100.0	4401	101.06	44.76	29.5	32.3	25.6	36.7	5.6	11.6	534.6	1152.2	0.9	29.5	5.2	338.1	84	1.006	149.13	323.64	32.6	29.7	64.5	123.4	712	674	697	728	686	642
10/18/10	55:48	321.6	100.0	4400	101.06	44.80	29.8	32.3	25.6	36.9	5.7	11.6	536.7	1148.5	0.9	29.4	4.8	337.1	84	1.006	149.05	323.49	31.7	29.7	64.6	124.1	713	675	695	728	682	640
10/18/10	04:18	230.4	32.2	3521	101.07	22.98	29.5	32.7	25.7	37.2	1.2	14.0	375.1	2110.3	1.0	31.0	18.9	344.9	85	1.005	85.36	231.57	31.7	29.5	62.3	110.6	721	727	678	682	702	694
10/18/10	05:18	230.6	32.3	3520	101.06	22.93	29.8	32.7	25.7	37.4	1.2	14.0	374.4	2126.3	1.0	31.0	19.0	345.2	85	1.005	85.44	231.79	31.1	29.5	62.3	110.3	722	729	681	683	702	694
10/18/10	06:18	229.7	32.9	3521	101.06	23.16	29.7	32.8	25.7	37.6	1.1	14.0	365.3	2146.0	1.0	30.4	19.0	345.6	85	1.005	85.07	230.79	31.2	29.6	62.3	110.0	724	730	676	684	703	692
10/18/10	14:48	149.2	18.9	2640	101.07	12.31	29.8	32.8	25.8	37.7	0.6	14.3	352.1	1389.9	1.0	32.8	33.6	349.0	85	1.005	41.46	149.97	30.9	29.6	60.1	97.0	691	690	646	647	668	664
10/18/10	15:48	149.7	18.8	2641	101.07	12.37	30.1	32.8	25.8	37.8	0.6	14.3	351.2	1400.0	1.0	32.1	33.7	349.7	85	1.004	41.57	150.38	30.4	29.6	60.3	96.6	695	690	648	649	666	667
10/18/10	16:48	149.4	18.9	2643	101.07	12.35	30.0	32.8	25.8	37.7	0.6	14.3	351.0	1392.9	1.0	32.6	33.7	350.2	85	1.005	41.49	150.06	30.7	29.4	60.1	96.3	692	690	649	649	668	666
10/18/10	25:18	80.8	9.5	1759	101.07	5.96	30.8	32.5	25.8	38.0	3.0	13.3	645.4	288.8	0.9	32.9	56.7	331.0	85	1.003	14.94	81.05	29.9	29.0	57.7	84.7	576	601	506	554	578	600
10/18/10	26:18	80.3	9.3	1760	101.07	5.95	31.0	32.5	25.8	38.1	2.9	13.3	643.1	287.9	0.9	33.2	56.8	331.8	85	1.003	14.84	80.52	29.7	28.9	57.5	84.2	576	603	506	552	578	599
10/18/10	27:18	80.2	10.0	1762	101.07	5.93	30.7	32.5	25.8	38.0	2.9	13.3	646.7	288.1	0.9	33.2	56.9	333.8	85	1.002	14.81	80.37	29.7	28.6	57.3	83.8	574	602	503	554	579	599
10/18/10	35:23	0.5	0.0	925	101.06	1.72	37.3	29.6	25.6	37.8	4.5	11.7	3556.8	24.7	0.9	36.7	73.4	304.7	85	1.000	0.05	0.49	28.4	27.6	55.0	72.9	294	342	64	404	106	203
10/18/10	36:23	0.5	0.0	930	101.06	1.85	37.4	29.5	25.6	37.8	4.4	11.7	3838.2	24.8	0.9	33.8	73.5	305.4	85	1.000	0.05	0.53	28.4	27.5	54.7	72.3	270	311	63	403	171	136
10/18/10	37:23	0.5	0.0	930	101.06	1.81	37.7	29.4	25.6	37.8	4.3	11.8	3906.0	24.9	0.9	34.9	73.5	306.0	85	1.000	0.05	0.52	28.2	27.4	54.5	71.7	277	312	62	404	132	189

**Table A.III.21. Engine Dynamometer Data, Indolene (E0) Fuel, 28% of Expected Engine Life (be4\_ind\_013b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/18/10	38:14	0.4	0.0	928	101.06	1.71	37.9	29.3	25.6	37.6	0.0	0.1	3.2	1.3	37.8	36.9	73.4	306.7	85	1.000	0.04	0.42	28.3	27.3	54.3	71.1	261	279	64	401	210	205
10/18/10	46:44	320.6	100.0	4400	101.05	44.84	33.3	31.2	25.4	38.8	5.6	11.6	533.7	1154.3	0.9	29.8	5.6	339.3	85	1.004	148.35	321.96	30.4	28.4	63.8	122.2	719	678	700	729	683	638
10/18/10	47:44	320.2	100.0	4400	101.05	44.80	32.9	31.4	25.4	38.8	5.7	11.6	533.4	1122.7	0.9	30.0	4.7	338.1	85	1.005	148.24	321.73	30.9	28.4	64.1	123.1	716	675	698	728	686	641
10/18/10	48:44	320.3	100.0	4401	101.05	44.88	33.0	31.3	25.4	38.8	5.7	11.6	528.9	1126.3	0.9	29.9	4.7	336.9	85	1.005	148.39	322.04	31.4	28.3	64.2	123.9	714	680	697	728	689	640
10/18/10	57:14	230.1	32.3	3519	101.06	22.98	33.2	31.6	25.1	39.2	1.1	14.0	378.4	2126.1	1.0	31.3	19.9	344.9	85	1.004	85.18	231.07	29.3	28.0	61.7	110.3	722	733	680	686	699	697
10/18/10	58:14	229.4	32.8	3521	101.06	22.90	33.4	31.5	25.1	39.2	1.1	14.1	375.2	2134.9	1.0	31.3	20.0	345.3	85	1.003	84.83	230.15	29.8	28.1	61.6	110.1	724	732	680	688	701	698
10/18/10	59:14	229.8	32.7	3519	101.06	23.11	33.5	31.5	25.1	39.2	1.1	14.1	375.4	2021.4	1.0	31.0	20.0	345.5	85	1.004	85.02	230.65	30.0	28.1	61.6	109.6	723	732	682	687	702	694
10/18/10	07:44	148.9	19.1	2638	101.06	12.34	34.1	31.4	25.0	39.8	0.6	14.3	348.6	1369.6	1.0	32.8	37.0	349.2	86	1.002	41.22	149.09	28.6	27.8	59.6	96.8	693	695	652	654	669	671
10/18/10	08:44	149.3	18.9	2640	101.06	12.22	33.9	31.4	25.0	39.9	0.5	14.3	351.8	1372.2	1.0	33.6	37.1	349.9	86	1.002	41.34	149.52	28.9	27.7	59.4	96.4	694	694	651	655	668	671
10/18/10	09:44	149.3	18.4	2642	101.06	12.41	34.5	31.3	25.0	40.0	0.6	14.3	348.8	1374.2	1.0	33.1	37.1	350.5	86	1.002	41.35	149.58	28.8	27.7	59.3	96.0	696	695	651	654	667	672
10/18/10	18:14	80.2	10.0	1761	101.07	6.12	35.3	31.0	24.9	40.4	3.0	13.3	658.0	283.8	0.9	32.9	59.1	331.4	86	1.000	14.78	80.20	28.0	27.1	56.9	84.3	578	602	504	554	572	597
10/18/10	19:14	80.2	9.7	1761	101.07	6.06	35.4	31.0	24.9	40.6	3.0	13.3	635.1	280.6	0.9	34.3	59.2	331.6	86	1.000	14.78	80.19	28.1	27.0	56.7	83.8	579	603	505	556	574	599
10/18/10	20:14	80.1	9.8	1760	101.07	5.93	35.4	31.0	24.9	40.6	3.0	13.2	640.1	276.8	0.9	34.5	59.3	333.0	86	1.000	14.76	80.11	27.8	26.9	56.5	83.4	578	601	506	556	573	600
10/18/10	28:19	0.5	0.0	899	101.06	1.70	44.3	27.8	24.8	40.9	4.8	11.4	3707.4	22.7	0.9	39.4	77.4	304.5	86	0.999	0.05	0.51	26.7	25.8	54.3	72.4	269	217	65	399	225	228
10/18/10	29:19	0.5	0.0	898	101.06	1.78	44.4	27.6	24.8	41.0	4.8	11.5	3902.4	23.1	0.9	36.9	77.4	305.3	86	0.998	0.05	0.50	26.5	25.7	54.0	71.6	239	230	64	406	216	190
10/18/10	30:19	0.5	0.0	902	101.06	1.85	44.7	27.5	24.7	41.1	4.7	11.6	3928.7	23.1	0.9	36.1	77.5	305.8	86	0.998	0.05	0.51	26.4	25.6	53.9	70.9	235	209	63	412	216	160

**Table A.III.22. Engine Dynamometer Data, Indolene (E0) Fuel, 50% of Expected Engine Life (be4\_ind\_017b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fueflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/21/10	38:14	0.4	0.0	928	101.06	1.71	37.9	29.3	25.6	37.6	0.0	0.1	3.2	1.3	37.8	36.9	73.4	306.7	85	1.000	0.04	0.42	28.3	27.3	54.3	71.1	261	279	64	401	210	205
10/21/10	46:44	320.6	100.0	4400	101.05	44.84	33.3	31.2	25.4	38.8	5.6	11.6	533.7	1154.3	0.9	29.8	5.6	339.3	85	1.004	148.35	321.96	30.4	28.4	63.8	122.2	719	678	700	729	683	638
10/21/10	47:44	320.2	100.0	4400	101.05	44.80	32.9	31.4	25.4	38.8	5.7	11.6	533.4	1122.7	0.9	30.0	4.7	338.1	85	1.005	148.24	321.73	30.9	28.4	64.1	123.1	716	675	698	728	686	641
10/21/10	48:44	320.3	100.0	4401	101.05	44.88	33.0	31.3	25.4	38.8	5.7	11.6	528.9	1126.3	0.9	29.9	4.7	336.9	85	1.005	148.39	322.04	31.4	28.3	64.2	123.9	714	680	697	728	689	640
10/21/10	57:14	230.1	32.3	3519	101.06	22.98	33.2	31.6	25.1	39.2	1.1	14.0	378.4	2126.1	1.0	31.3	19.9	344.9	85	1.004	85.18	231.07	29.3	28.0	61.7	110.3	722	733	680	686	699	697
10/21/10	58:14	229.4	32.8	3521	101.06	22.90	33.4	31.5	25.1	39.2	1.1	14.1	375.2	2134.9	1.0	31.3	20.0	345.3	85	1.003	84.83	230.15	29.8	28.1	61.6	110.1	724	732	680	688	701	698
10/21/10	59:14	229.8	32.7	3519	101.06	23.11	33.5	31.5	25.1	39.2	1.1	14.1	375.4	2021.4	1.0	31.0	20.0	345.5	85	1.004	85.02	230.65	30.0	28.1	61.6	109.6	723	732	682	687	702	694
10/21/10	07:44	148.9	19.1	2638	101.06	12.34	34.1	31.4	25.0	39.8	0.6	14.3	348.6	1369.6	1.0	32.8	37.0	349.2	86	1.002	41.22	149.09	28.6	27.8	59.6	96.8	693	695	652	654	669	671
10/21/10	08:44	149.3	18.9	2640	101.06	12.22	33.9	31.4	25.0	39.9	0.5	14.3	351.8	1372.2	1.0	33.6	37.1	349.9	86	1.002	41.34	149.52	28.9	27.7	59.4	96.4	694	694	651	655	668	671
10/21/10	09:44	149.3	18.4	2642	101.06	12.41	34.5	31.3	25.0	40.0	0.6	14.3	348.8	1374.2	1.0	33.1	37.1	350.5	86	1.002	41.35	149.58	28.8	27.7	59.3	96.0	696	695	651	654	667	672
10/21/10	18:14	80.2	10.0	1761	101.07	6.12	35.3	31.0	24.9	40.4	3.0	13.3	658.0	283.8	0.9	32.9	59.1	331.4	86	1.000	14.78	80.20	28.0	27.1	56.9	84.3	578	602	504	554	572	597
10/21/10	19:14	80.2	9.7	1761	101.07	6.06	35.4	31.0	24.9	40.6	3.0	13.3	635.1	280.6	0.9	34.3	59.2	331.6	86	1.000	14.78	80.19	28.1	27.0	56.7	83.8	579	603	505	556	574	599
10/21/10	20:14	80.1	9.8	1760	101.07	5.93	35.4	31.0	24.9	40.6	3.0	13.2	640.1	276.8	0.9	34.5	59.3	333.0	86	1.000	14.76	80.11	27.8	26.9	56.5	83.4	578	601	506	556	573	600
10/21/10	28:19	0.5	0.0	899	101.06	1.70	44.3	27.8	24.8	40.9	4.8	11.4	3707.4	22.7	0.9	39.4	77.4	304.5	86	0.999	0.05	0.51	26.7	25.8	54.3	72.4	269	217	65	399	225	228
10/21/10	29:19	0.5	0.0	898	101.06	1.78	44.4	27.6	24.8	41.0	4.8	11.5	3902.4	23.1	0.9	36.9	77.4	305.3	86	0.998	0.05	0.50	26.5	25.7	54.0	71.6	239	230	64	406	216	190
10/21/10	30:19	0.5	0.0	902	101.06	1.85	44.7	27.5	24.7	41.1	4.7	11.6	3928.7	23.1	0.9	36.1	77.5	305.8	86	0.998	0.05	0.51	26.4	25.6	53.9	70.9	235	209	63	412	216	160



**Table A.III.23. Engine Dynamometer Data, Indolene (E0) Fuel, 50% of Expected Engine Life (be4\_ind\_018b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/22/10	26:27	0.2	0.0	955	101.68	1.98	34.9	23.8	22.4	33.2	0.0	0.1	-0.6	6.5	1.0	49.9	72.0	319.1	142	0.975	0.02	0.22	22.4	21.2	51.2	67.2	405	423	352	394	410	394	
10/22/10	34:57	328.1	100.0	4400	101.68	45.61	33.8	23.3	22.0	34.0	5.5	11.6	536.9	1237.4	0.9	33.2	6.3	347.9	142	0.978	147.80	320.77	23.7	21.0	61.2	121.0	706	687	693	737	690	644	
10/22/10	35:57	328.3	100.0	4399	101.68	45.43	33.7	23.4	21.9	34.1	5.5	11.6	532.9	1238.3	0.9	33.4	5.2	346.2	142	0.978	147.98	321.15	24.5	21.0	61.6	122.2	705	682	695	737	693	649	
10/22/10	36:57	328.1	100.0	4401	101.68	45.57	33.5	23.5	21.9	34.1	5.5	11.6	526.6	1252.3	0.9	33.3	6.6	345.0	142	0.978	147.78	320.73	23.7	21.2	61.9	123.0	707	685	693	735	689	644	
10/22/10	45:27	235.5	33.2	3520	101.69	23.10	32.9	23.6	21.6	34.8	0.7	14.1	332.6	2442.8	1.0	35.6	17.4	353.2	142	0.976	84.77	229.98	23.7	21.1	59.7	110.0	721	738	680	691	706	691	
10/22/10	46:27	234.4	34.3	3521	101.70	22.84	31.3	23.6	21.6	34.6	0.7	14.0	327.2	2506.6	1.0	35.4	17.4	353.7	142	0.976	84.30	228.70	24.2	21.2	59.8	109.7	721	737	674	692	705	688	
10/22/10	47:27	234.7	33.8	3522	101.69	22.90	29.2	23.7	21.6	34.6	0.7	14.0	325.5	2551.1	1.0	35.5	17.3	354.1	142	0.976	84.44	229.08	24.0	21.2	59.6	109.4	718	737	679	691	706	691	
10/22/10	55:57	152.8	20.0	2639	101.71	12.41	28.2	23.8	21.5	35.0	0.4	14.2	313.8	1666.1	1.0	38.7	34.1	353.3	142	0.974	41.11	148.71	22.6	21.2	57.4	96.2	682	694	643	648	671	655	
10/22/10	56:57	152.3	20.0	2641	101.72	12.40	27.5	23.8	21.5	35.0	0.4	14.2	310.2	1665.7	1.0	37.2	34.1	353.9	142	0.973	40.97	148.20	22.6	21.1	57.2	95.8	683	693	643	648	672	656	
10/22/10	57:57	152.6	20.0	2642	101.72	12.35	27.8	23.8	21.5	34.9	0.4	14.2	312.0	1636.1	1.0	38.7	34.1	354.4	142	0.973	41.08	148.58	22.8	21.1	57.1	95.4	683	693	642	648	673	653	
10/22/10	06:27	82.3	10.5	1761	101.73	6.55	28.2	23.7	21.3	34.9	2.9	13.2	651.2	421.8	0.9	36.6	55.0	333.0	142	0.972	14.76	80.04	22.3	20.9	54.7	83.7	564	607	506	545	579	579	
10/22/10	07:27	81.5	10.9	1760	101.73	6.27	28.1	23.7	21.3	34.8	3.0	13.2	656.1	412.9	0.9	37.0	54.7	333.6	142	0.972	14.59	79.16	22.3	20.9	54.5	83.2	565	607	505	544	579	578	
10/22/10	08:27	82.4	10.4	1760	101.73	5.68	28.3	23.7	21.3	34.5	3.1	13.2	662.2	415.2	0.9	41.3	54.7	334.2	142	0.972	14.76	80.08	22.3	21.1	54.5	82.8	565	606	507	545	577	578	
10/22/10	16:32	-0.3	0.0	975	101.75	1.85	31.3	21.7	21.3	34.5	5.2	11.3	3166.0	24.9	0.9	43.1	69.5	310.8	143	0.970	-0.03	-0.31	21.4	20.2	51.8	71.7	255	265	64	399	205	273	
10/22/10	17:32	0.1	0.0	975	101.74	1.84	31.4	21.7	21.3	34.5	5.2	11.3	3599.9	24.8	0.9	42.9	70.3	311.3	143	0.970	0.01	0.11	21.4	20.2	51.6	70.9	241	257	64	390	176	264	
10/22/10	18:32	0.1	0.0	973	101.74	1.83	31.8	21.6	21.3	34.3	5.1	11.2	3486.1	24.7	0.9	42.5	70.4	311.6	143	0.970	0.01	0.09	21.6	20.3	51.6	70.4	278	247	64	333	126	212	

**Table A.III.24. Engine Dynamometer Data, Indolene (E0) Fuel, 50% of Expected Engine Life (be4\_ind\_019b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
10/22/10	19:23	0.1	0.0	977	101.75	1.82	31.8	21.6	21.3	34.2	5.1	11.3	3499.7	24.5	0.9	39.9	70.1	312.2	143	0.971	0.01	0.09	21.7	20.2	51.3	70.0	230	227	63	264	223	173
10/22/10	27:53	328.9	100.0	4399	101.74	45.50	27.7	23.8	21.1	34.0	5.3	11.7	515.8	1252.0	0.9	34.6	-0.5	346.2	143	0.978	148.15	321.58	25.5	21.7	62.0	122.3	710	685	696	737	694	646
10/22/10	28:53	330.2	100.0	4401	101.75	44.88	28.1	23.8	21.1	33.8	5.3	11.7	525.4	1360.0	0.9	37.1	12.3	344.8	143	0.978	148.85	322.95	25.4	21.8	62.1	123.2	710	686	698	738	693	644
10/22/10	29:53	329.1	100.0	4400	101.74	45.00	28.0	23.9	21.1	33.9	5.4	11.7	533.2	1298.8	0.9	34.5	4.6	344.2	143	0.978	148.28	321.82	24.9	21.9	62.3	124.1	713	683	697	736	694	642
10/22/10	38:23	236.2	33.3	3520	101.76	23.16	25.1	24.5	21.1	33.3	0.8	14.1	338.3	2583.0	1.0	34.7	18.5	352.4	143	0.976	85.01	230.59	24.9	22.0	60.2	110.5	722	736	680	690	705	685
10/22/10	39:23	235.0	34.3	3520	101.75	22.69	25.1	24.5	21.1	33.1	0.8	14.0	335.0	2536.0	1.0	35.5	18.5	353.0	143	0.976	84.51	229.27	24.4	22.0	60.2	110.3	726	738	675	689	711	687
10/22/10	40:23	235.2	33.6	3522	101.75	22.96	25.1	24.7	21.1	33.1	0.8	14.1	334.8	2535.6	1.0	35.0	18.5	353.1	143	0.976	84.59	229.48	24.6	22.0	60.0	110.0	721	736	679	692	711	687
10/22/10	48:53	150.7	20.0	2639	101.77	12.55	24.5	24.8	21.2	32.8	0.5	14.2	311.6	1634.0	1.0	34.6	34.2	353.5	143	0.974	40.56	146.79	23.8	22.0	57.7	96.5	684	693	643	649	667	660
10/22/10	49:53	153.7	19.4	2640	101.76	12.28	24.6	24.7	21.2	32.6	0.4	14.2	340.9	1677.0	1.0	41.0	34.1	353.7	143	0.974	41.40	149.75	23.9	22.0	57.5	96.1	684	693	642	649	667	657
10/22/10	50:53	152.4	20.1	2643	101.78	12.37	24.6	24.7	21.1	32.6	0.4	14.2	326.5	1663.0	1.0	37.2	34.4	353.9	143	0.974	41.01	148.36	23.9	21.9	57.5	95.7	684	693	644	650	668	656
10/22/10	59:23	82.0	10.7	1759	101.80	6.12	25.4	24.7	21.2	32.3	2.9	13.2	658.0	417.2	0.9	36.9	54.6	332.1	143	0.972	14.69	79.76	22.9	21.8	55.0	83.9	565	609	510	543	579	585
10/22/10	00:23	82.9	10.6	1761	101.80	5.81	24.9	24.7	21.2	32.3	2.9	13.2	663.6	402.7	0.9	38.3	54.6	333.1	143	0.972	14.86	80.58	23.1	21.7	54.9	83.4	567	610	510	544	579	587
10/22/10	01:23	82.0	10.8	1761	101.79	5.85	24.9	24.6	21.2	32.3	2.9	13.2	653.9	406.0	0.9	40.0	54.7	333.5	143	0.972	14.70	79.74	23.0	21.7	55.0	82.8	567	611	511	545	580	588
10/22/10	09:28	0.6	0.0	942	101.80	1.85	29.8	22.1	21.3	31.8	5.3	11.2	3587.0	24.6	0.9	42.5	71.1	308.8	143	0.970	0.05	0.55	21.7	20.5	51.9	71.7	279	251	64	335	201	217
10/22/10	10:28	0.1	0.0	939	101.80	1.87	30.1	22.0	21.3	31.8	5.3	11.2	3648.7	24.3	0.9	42.6	71.0	309.1	143	0.970	0.01	0.13	22.0	20.5	51.7	70.9	256	175	63	353	175	234
10/22/10	11:28	0.1	0.0	933	101.80	1.86	30.2	22.0	21.3	31.7	5.2	11.2	3776.2	24.1	0.9	42.3	71.1	309.4	144	0.970	0.01	0.11	22.2	20.5	51.5	70.4	247	178	63	331	128	225

**Table A.III.25. Engine Dynamometer Data, Indolene (E0) Fuel, 79% of Expected Engine Life (be4\_ind\_025b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/5/10	58:19	0.2	0.0	910	100.31	1.60	30.6	22.3	19.9	39.0	0.0	0.1	2.5	0.7	85.5	36.3	75.5	300.9	182	0.988	0.02	0.23	22.2	21.7	53.8	69.3	204	189	71	150	139	100
11/5/10	06:49	310.3	100.0	4397	100.30	44.98	27.4	23.1	19.9	39.2	5.5	11.8	537.3	1212.9	0.9	32.6	37.7	315.5	182	0.991	141.75	307.65	24.1	21.0	64.1	133.8	703	680	681	734	681	647
11/5/10	07:49	310.1	100.0	4400	100.30	44.92	28.0	23.1	19.9	39.2	5.6	11.7	547.4	1195.6	0.9	32.2	36.6	314.4	182	0.992	141.82	307.78	24.4	20.9	64.4	134.7	703	681	681	732	676	644
11/5/10	08:49	310.2	100.0	4399	100.30	45.10	28.0	23.1	19.9	39.2	5.6	11.7	547.7	1182.4	0.9	32.6	37.5	314.1	182	0.992	141.79	307.73	24.5	20.9	64.5	135.3	702	679	679	736	676	636
11/5/10	17:19	222.9	32.8	3521	100.29	22.29	27.1	23.2	19.9	39.0	0.7	14.2	348.5	2247.2	1.0	34.3	46.5	348.7	182	0.991	81.43	220.91	23.5	20.8	60.9	111.4	713	727	670	680	700	692
11/5/10	18:19	222.6	32.7	3519	100.29	22.54	26.9	23.3	19.9	39.0	0.7	14.2	344.5	2325.0	1.0	33.9	46.5	349.5	182	0.991	81.35	220.68	24.2	21.0	60.8	111.0	712	727	670	678	700	686
11/5/10	19:19	222.8	32.6	3522	100.30	22.01	28.0	23.3	19.9	39.0	0.7	14.2	342.6	2353.3	1.0	34.6	46.5	350.2	182	0.990	81.33	220.64	22.5	20.7	60.5	110.6	712	727	670	679	699	684
11/5/10	27:49	144.9	18.8	2641	100.30	11.97	26.0	23.7	20.0	38.6	0.5	14.4	350.7	1534.7	1.0	37.0	55.9	356.1	182	0.989	39.61	143.28	22.7	20.9	57.8	97.0	675	687	628	638	668	649
11/5/10	28:49	144.1	19.3	2639	100.29	11.87	26.7	23.6	20.0	38.6	0.5	14.4	352.2	1516.1	1.0	36.4	56.0	356.4	182	0.989	39.39	142.47	22.9	20.8	57.7	96.5	676	688	631	640	668	650
11/5/10	29:49	145.1	18.8	2643	100.29	11.95	27.1	23.6	20.0	38.6	0.5	14.4	347.5	1502.5	1.0	36.4	56.0	356.8	182	0.989	39.68	143.54	22.8	21.0	57.9	96.1	675	688	630	641	667	650
11/5/10	38:19	77.9	10.5	1759	100.29	6.09	26.2	24.0	20.1	37.6	3.1	13.3	717.4	373.0	0.9	35.4	67.3	345.2	182	0.987	14.18	76.92	21.9	20.8	55.6	84.3	560	592	482	532	569	585
11/5/10	39:19	77.7	10.8	1759	100.30	5.41	27.2	24.0	20.2	37.6	3.1	13.3	718.5	367.2	0.9	40.4	67.3	345.9	182	0.987	14.13	76.66	21.6	20.6	55.3	83.8	558	594	483	533	570	586
11/5/10	40:19	77.4	11.0	1761	100.30	6.09	26.2	24.2	20.7	35.1	3.1	13.3	708.3	359.3	0.9	34.9	67.3	346.3	182	0.987	14.08	76.40	21.9	20.9	55.5	83.3	557	595	483	532	569	587
11/5/10	48:24	0.3	0.0	971	100.30	1.77	28.7	22.1	20.4	35.1	5.2	11.3	4157.3	24.6	0.9	42.0	75.7	302.6	182	0.988	0.03	0.27	21.9	20.6	53.4	72.7	351	163	64	201	72	238
11/5/10	49:24	0.3	0.0	976	100.32	1.77	29.5	22.0	21.4	32.7	5.2	11.4	3705.8	24.9	0.9	41.4	75.8	303.0	182	0.988	0.03	0.28	22.2	20.9	53.6	72.0	249	168	63	151	76	231
11/5/10	50:24	0.3	0.0	967	100.31	1.76	28.9	21.9	20.9	31.2	5.1	11.3	4121.1	24.9	0.9	41.1	75.8	303.5	182	0.988	0.03	0.28	22.0	20.6	53.3	71.3	253	156	63	141	105	174

**Table A.III.26. Engine Dynamometer Data, Indolene (E0) Fuel, 79% of Expected Engine Life (be4\_ind\_026b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/5/10	59:44	311.7	100.0	4401	100.26	45.13	27.5	23.5	20.2	37.0	5.5	11.8	552.9	1193.0	0.9	32.3	37.7	316.3	183	0.993	142.65	309.58	24.4	21.4	63.9	133.1	706	678	683	732	683	648	
11/5/10	00:44	311.3	100.0	4400	100.27	44.91	27.8	23.5	20.2	37.1	5.6	11.7	555.4	1174.5	0.9	32.7	36.7	315.0	183	0.993	142.38	309.01	24.3	21.2	64.2	134.2	706	676	684	734	679	646	
11/5/10	01:44	311.3	100.0	4400	100.27	45.09	28.4	23.4	20.2	37.0	5.6	11.7	558.8	1176.0	0.9	33.0	37.7	314.8	183	0.993	142.40	309.04	23.5	21.1	64.4	134.6	705	674	681	732	677	645	
11/5/10	10:14	223.2	33.3	3518	100.28	22.14	26.7	23.8	20.1	37.5	0.7	14.2	349.9	2293.0	1.0	34.6	46.0	349.9	183	0.992	81.63	221.46	24.6	21.7	61.1	111.2	710	726	664	688	699	692	
11/5/10	11:14	223.3	33.0	3522	100.28	22.24	27.4	23.9	20.2	37.6	0.7	14.2	348.5	2287.5	1.0	34.6	46.2	350.8	183	0.993	81.76	221.79	25.2	21.7	61.2	110.6	713	727	665	687	702	686	
11/5/10	12:14	223.6	33.3	3520	100.28	22.10	27.7	23.9	20.2	37.6	0.8	14.2	349.5	2291.2	1.0	34.6	46.1	351.6	183	0.994	81.88	222.13	24.7	21.8	61.1	110.3	713	726	669	684	701	686	
11/5/10	20:44	144.9	19.6	2642	100.29	12.02	24.9	24.3	20.2	37.2	0.5	14.4	353.2	1490.0	1.0	36.4	55.6	355.6	183	0.990	39.64	143.40	23.2	21.7	58.3	97.0	678	686	632	646	664	658	
11/5/10	21:44	145.0	19.3	2638	100.30	11.88	25.1	24.3	20.3	37.2	0.5	14.4	353.5	1472.2	1.0	36.9	55.6	355.9	183	0.991	39.71	143.63	23.6	21.7	58.3	96.5	677	686	630	646	666	658	
11/5/10	22:44	144.8	19.3	2640	100.30	12.01	25.2	24.2	20.3	37.1	0.5	14.4	347.4	1482.3	1.0	36.7	55.6	356.3	183	0.991	39.66	143.45	23.5	21.7	58.2	96.2	677	685	629	645	667	656	
11/5/10	31:14	77.6	10.8	1759	100.31	6.00	24.0	24.2	20.3	36.6	3.0	13.4	695.1	366.6	0.9	35.4	67.1	343.5	183	0.988	14.13	76.69	22.3	21.4	55.5	84.4	558	596	486	537	561	594	
11/5/10	32:14	78.0	10.6	1760	100.31	5.58	24.5	24.2	20.3	36.6	3.0	13.3	704.5	362.9	0.9	39.8	67.0	344.2	183	0.988	14.20	77.05	22.6	21.4	55.3	83.8	555	596	486	536	561	593	
11/5/10	33:14	78.0	10.7	1758	100.31	5.86	24.3	24.2	20.3	36.5	3.0	13.3	699.1	363.2	0.9	36.1	67.3	345.2	183	0.988	14.20	77.03	22.6	21.3	55.3	83.4	556	596	487	536	561	593	
11/5/10	41:19	0.3	0.0	987	100.33	1.76	30.2	22.1	20.4	36.2	5.3	11.3	3763.1	24.5	0.9	42.1	75.3	302.8	183	0.987	0.04	0.35	21.8	21.0	52.7	72.5	378	262	66	377	74	279	
11/5/10	42:19	0.3	0.0	984	100.32	1.75	30.8	22.1	20.4	36.2	5.3	11.3	3706.9	24.5	0.9	41.6	75.3	303.7	183	0.988	0.03	0.32	22.0	21.1	52.7	71.7	376	190	63	387	78	128	
11/5/10	43:19	0.3	0.0	973	100.33	1.73	30.3	22.0	20.4	36.1	5.2	11.4	3729.0	24.9	0.9	41.2	75.3	304.2	183	0.988	0.03	0.32	21.9	21.0	52.4	71.1	384	191	64	388	77	222	

**Table A.III.27. Engine Dynamometer Data, Indolene (E0) Fuel, 79% of Expected Engine Life (be4\_ind\_027b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/5/10	44:10	0.3	0.0	961	100.32	1.77	29.7	22.1	20.4	36.0	0.0	0.1	3.8	1.0	31.8	41.0	75.5	304.3	183	0.988	0.03	0.30	22.0	21.1	52.4	70.6	312	164	62	336	73	227
11/5/10	52:40	313.1	100.0	4402	100.32	45.02	26.7	23.7	20.4	36.2	5.5	11.8	563.6	1205.2	0.9	32.2	36.6	319.8	183	0.993	143.30	311.01	24.5	22.1	63.8	131.6	706	682	685	732	683	637
11/5/10	53:40	313.0	100.0	4400	100.31	44.87	26.0	23.8	20.4	36.2	5.5	11.8	551.9	1207.7	0.9	32.6	37.0	317.7	183	0.994	143.33	311.06	24.3	22.1	64.2	132.9	707	681	686	733	681	638
11/5/10	54:40	312.9	100.0	4399	100.31	44.99	25.4	23.9	20.4	36.1	5.6	11.7	561.5	1196.3	0.9	32.6	36.6	316.9	183	0.993	143.22	310.83	25.0	22.3	64.7	133.6	704	679	686	733	683	642
11/5/10	03:10	225.4	32.5	3518	100.33	22.18	24.7	24.5	20.5	35.4	0.8	14.2	370.6	2399.0	1.0	34.4	45.4	351.1	184	0.993	82.51	223.84	25.0	22.3	61.3	111.2	714	727	663	682	696	682
11/5/10	04:10	224.3	33.3	3521	100.33	22.08	24.1	24.5	20.5	35.4	0.8	14.2	368.3	2413.0	1.0	34.2	45.4	351.8	184	0.993	82.10	222.72	25.2	22.1	61.1	110.7	716	727	662	680	698	687
11/5/10	05:10	224.9	32.9	3521	100.34	22.50	24.0	24.4	20.5	35.4	0.7	14.2	362.4	2374.3	1.0	34.4	45.3	352.4	184	0.992	82.24	223.10	25.2	22.0	61.1	110.3	717	728	668	680	695	691
11/5/10	13:40	146.3	18.6	2641	100.34	12.00	22.6	24.8	20.5	34.9	0.5	14.4	361.5	1514.1	1.0	36.6	54.8	355.3	184	0.990	40.05	144.86	23.6	22.3	58.5	97.2	681	688	631	648	665	660
11/5/10	14:40	145.9	19.5	2642	100.35	12.01	22.2	24.8	20.6	34.8	0.5	14.4	348.7	1505.1	1.0	36.4	54.8	355.4	184	0.990	39.91	144.37	23.8	22.3	58.4	96.7	682	688	633	648	663	657
11/5/10	15:40	146.2	19.2	2641	100.35	12.07	23.2	24.8	20.6	34.7	0.5	14.4	350.7	1485.8	1.0	36.9	54.7	355.8	184	0.990	40.02	144.77	23.7	22.5	58.4	96.3	681	687	633	648	666	657
11/5/10	24:10	78.5	11.1	1760	100.35	5.81	23.3	24.6	20.6	34.5	3.0	13.3	680.7	357.8	0.9	37.1	66.7	343.2	184	0.989	14.31	77.64	23.3	22.4	55.8	84.3	564	597	490	540	571	594
11/5/10	25:10	78.7	10.7	1760	100.35	5.67	23.0	24.6	20.6	34.5	3.0	13.3	683.8	356.4	0.9	39.2	66.4	343.7	184	0.989	14.34	77.80	23.3	22.4	55.7	83.8	563	596	490	540	570	592
11/5/10	26:10	78.4	10.8	1759	100.35	5.86	22.7	24.6	20.6	34.4	3.0	13.3	694.4	358.1	0.9	36.6	66.3	345.1	184	0.989	14.28	77.50	23.5	22.3	55.5	83.3	562	595	491	539	569	594
11/5/10	34:15	0.3	0.0	974	100.35	1.76	26.2	22.4	20.7	33.9	5.4	11.3	3575.1	24.8	0.9	41.8	74.8	303.5	184	0.986	0.03	0.32	22.0	21.3	52.8	72.4	406	425	81	359	83	353
11/5/10	35:15	0.3	0.0	975	100.35	1.76	26.0	22.3	20.7	33.7	5.4	11.4	3490.2	24.9	0.9	41.3	74.8	303.9	184	0.986	0.03	0.33	21.8	21.3	52.6	71.6	401	195	70	357	82	353
11/5/10	36:15	0.3	0.0	967	100.35	1.75	26.0	22.3	20.7	33.6	5.2	11.4	3767.3	24.9	0.9	40.9	75.2	303.7	184	0.986	0.03	0.33	21.9	21.4	52.6	71.0	407	237	65	366	205	354

**Table A.III.28. Engine Dynamometer Data, Indolene (E0) Fuel, 100% of Expected Engine Life (be4\_ind\_032b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/16/10	54:36	0.5	0.0	938	100.88	1.65	41.1	27.0	20.5	49.3	0.0	0.1	4.7	1.0	32.9	32.7	75.6	311.2	209	0.997	0.05	0.52	26.1	25.8	54.0	71.5	272	401	72	408	145	368
11/16/10	03:09	321.4	100.0	4400	100.86	44.48	35.4	29.0	20.5	49.5	5.6	11.6	584.6	1163.0	0.9	29.9	36.3	348.0	209	1.001	148.25	321.71	28.2	27.3	64.5	123.6	705	678	687	735	679	641
11/16/10	04:09	320.9	100.0	4400	100.86	44.44	35.6	29.0	20.5	49.6	5.6	11.6	619.2	1130.4	0.9	29.8	33.9	346.4	209	1.003	148.29	321.84	28.6	27.3	65.1	124.5	705	675	684	731	679	646
11/16/10	05:09	320.6	100.0	4400	100.86	44.46	35.8	29.1	20.5	49.6	5.6	11.5	614.6	1120.3	0.9	29.6	33.2	345.5	209	1.004	148.34	321.93	29.6	27.4	65.3	125.2	705	676	688	732	678	644
11/16/10	13:39	229.5	34.5	3519	100.86	22.79	35.7	29.3	20.5	49.1	1.1	14.0	437.4	2163.8	1.0	31.3	42.3	352.9	209	1.003	84.86	230.21	29.1	27.4	62.8	112.4	708	728	662	683	699	682
11/16/10	14:39	230.1	33.4	3521	100.85	22.85	35.2	29.5	20.5	49.1	1.2	14.0	441.7	2106.0	1.0	31.1	42.2	353.4	209	1.003	85.07	230.77	28.7	27.5	62.9	112.0	706	731	659	679	698	685
11/16/10	15:39	229.5	33.5	3520	100.85	23.16	35.3	29.4	20.5	49.0	1.2	14.0	438.4	2100.9	1.0	31.3	42.1	353.9	209	1.004	84.90	230.32	28.7	27.4	63.0	111.7	706	730	665	678	700	687
11/16/10	24:10	149.4	20.2	2641	100.85	12.17	35.5	29.6	20.6	48.8	0.5	14.2	412.3	1414.8	1.0	32.9	53.3	353.0	210	1.002	41.38	149.69	27.9	27.2	60.0	97.9	677	688	629	642	661	656
11/16/10	25:10	148.9	20.3	2640	100.85	12.15	35.2	29.6	20.6	48.9	0.5	14.2	411.5	1426.1	1.0	33.0	53.3	353.4	210	1.001	41.21	149.05	27.6	27.2	59.9	97.4	676	688	628	642	660	652
11/16/10	26:10	149.3	19.9	2641	100.85	12.27	35.0	29.6	20.6	49.0	0.5	14.2	408.8	1421.9	1.0	32.6	53.4	353.7	210	1.001	41.30	149.39	27.7	27.1	59.8	97.1	675	687	628	643	661	654
11/16/10	34:40	81.1	11.2	1761	100.85	5.89	35.7	29.4	20.5	49.0	2.9	13.2	772.9	288.9	0.9	33.1	66.6	335.6	210	1.000	14.95	81.08	27.5	26.8	57.4	85.1	562	605	492	547	571	595
11/16/10	35:40	80.7	11.2	1761	100.84	5.89	36.0	29.3	20.6	49.0	2.9	13.2	781.4	306.7	0.9	34.0	66.5	334.0	210	1.002	14.90	80.82	28.1	26.7	57.1	84.6	561	603	491	547	570	594
11/16/10	36:40	80.4	10.7	1760	100.83	5.88	36.0	29.3	20.6	49.0	2.9	13.2	774.8	303.7	0.9	33.4	66.6	334.6	210	1.001	14.83	80.49	27.4	26.7	57.0	84.1	561	605	492	546	570	594
11/16/10	44:45	1.3	0.0	965	100.83	1.69	42.8	26.9	20.6	48.5	4.7	11.5	3248.0	25.3	0.9	36.9	74.7	310.8	210	0.998	0.13	1.26	25.8	25.6	54.3	73.3	391	447	76	409	125	391
11/16/10	45:45	-0.5	0.0	953	100.83	1.73	43.2	26.8	20.6	48.8	4.7	11.6	2956.0	25.4	0.9	36.4	75.9	310.9	210	0.998	-0.05	-0.45	25.7	25.6	54.1	72.7	386	449	70	407	120	392
11/16/10	46:45	0.5	0.0	964	100.82	1.88	43.3	26.7	20.6	49.0	4.5	11.6	3371.5	26.0	0.9	33.2	75.7	311.3	210	0.998	0.05	0.52	25.6	25.4	54.1	72.0	375	422	68	399	77	385

**Table A.III.29. Engine Dynamometer Data, Indolene (E0) Fuel, 100% of Expected Engine Life (be4\_ind\_033b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6	
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/16/10	47:35	0.6	0.0	962	100.82	2.05	43.6	26.6	20.6	49.5	0.0	0.1	4.7	1.1	31.8	31.1	75.7	311.9	210	0.998	0.06	0.56	25.6	25.4	54.0	71.6	276	423	67	401	124	382	
11/16/10	56:05	321.1	100.0	4400	100.80	44.65	38.4	28.2	20.6	51.3	5.5	11.6	619.6	1147.7	0.9	29.5	33.8	347.9	210	1.003	148.38	322.04	28.2	26.5	64.4	123.3	708	678	691	731	682	642	
11/16/10	57:05	321.2	100.0	4401	100.80	45.09	37.7	28.4	20.6	51.3	5.6	11.6	610.4	1096.0	0.9	29.8	30.1	345.7	210	1.004	148.57	322.39	29.2	26.5	64.7	124.3	708	674	688	732	679	641	
11/16/10	58:05	320.7	100.0	4401	100.79	44.92	37.9	28.4	20.6	51.3	5.6	11.6	624.4	1115.0	0.9	29.9	34.1	345.9	210	1.004	148.41	322.10	30.4	26.5	64.8	125.1	708	675	688	734	679	641	
11/16/10	06:35	229.7	33.5	3520	100.78	22.91	37.6	28.8	20.6	51.1	1.1	14.0	432.7	2143.2	1.0	31.8	43.3	353.5	210	1.003	84.91	230.36	28.2	26.4	62.7	111.7	710	731	663	677	700	685	
11/16/10	07:35	229.6	33.9	3520	100.78	22.74	37.3	28.8	20.6	51.0	1.1	14.0	432.4	2073.7	1.0	31.9	43.3	354.1	210	1.003	84.85	230.20	28.1	26.5	62.6	111.4	711	729	664	677	700	687	
11/16/10	08:35	229.6	34.5	3521	100.78	22.74	37.5	28.8	20.6	50.8	1.1	14.0	431.0	2086.6	1.0	31.9	43.1	354.7	210	1.003	84.92	230.37	27.9	26.4	62.4	111.1	710	732	662	677	699	686	
11/16/10	17:05	148.3	20.0	2638	100.79	12.37	37.7	28.8	20.6	50.1	0.5	14.2	412.2	1452.0	1.0	32.2	52.5	352.7	211	1.002	41.04	148.53	27.8	26.1	59.6	97.7	677	687	628	635	664	653	
11/16/10	18:05	149.6	20.1	2641	100.80	11.90	37.6	28.8	20.5	50.3	0.6	14.2	406.5	1407.0	1.0	33.4	53.4	353.8	211	1.001	41.41	149.72	27.2	26.0	59.5	97.3	677	688	629	635	663	655	
11/16/10	19:05	149.2	20.0	2640	100.80	12.28	37.3	28.8	20.6	50.3	0.5	14.2	416.1	1451.7	1.0	33.1	53.1	353.8	211	1.001	41.27	149.29	27.3	26.0	59.5	96.9	679	688	628	636	664	654	
11/16/10	27:35	80.5	11.2	1761	100.83	5.43	38.7	28.6	20.6	49.5	3.0	13.2	810.8	321.7	0.9	38.8	66.5	333.5	211	0.999	14.83	80.40	26.6	25.9	57.2	85.1	562	603	492	534	570	587	
11/16/10	28:35	80.4	11.4	1760	100.83	6.00	39.0	28.5	20.6	49.4	3.0	13.2	805.9	335.5	0.9	33.4	66.5	334.0	211	1.000	14.82	80.41	27.1	25.9	57.0	84.5	562	601	492	535	572	587	
11/16/10	29:35	80.5	11.3	1761	100.83	5.81	38.9	28.5	20.6	49.3	3.0	13.2	798.6	324.5	0.9	34.5	66.5	334.7	211	1.000	14.83	80.48	26.8	26.0	56.9	84.1	561	602	491	534	568	587	
11/16/10	37:41	1.9	0.0	960	100.83	1.74	46.2	26.0	20.6	49.1	4.9	11.6	4025.0	25.4	0.9	37.4	75.9	310.4	211	0.997	0.19	1.86	25.2	25.0	54.2	73.2	410	432	80	392	137	398	
11/16/10	38:40	0.5	0.0	965	100.83	1.73	46.3	25.9	20.7	49.2	4.8	11.5	3484.8	25.4	0.9	37.8	75.2	311.2	211	0.997	0.05	0.54	25.2	25.1	54.0	72.5	410	421	74	386	114	397	
11/16/10	39:40	0.5	0.0	971	100.83	1.79	46.5	25.8	20.7	49.2	4.7	11.5	3471.9	25.5	0.9	36.5	75.4	312.0	211	0.997	0.05	0.53	25.1	24.8	53.8	71.9	412	421	77	383	92	399	

**Table A.III.30. Engine Dynamometer Data, Indolene (E0) Fuel, 100% of Expected Engine Life (be4\_ind\_034b)**

Date	Time	Observed Torque	Throttle angle	speed	Baro_P_TestCell	Fuelflow_kgh	RH_TestCell	Temp_TestCell	Actual_Temp_Intake_Air	Actual_Humidity_Intake_Air	CO_H_precat	CO2_precat	THC_precat	NOx_precat	Emissions_Lambda	P_FuelRail	P_Supply_Water	Oil_Press	Eng_Counter_Hour	Correction_Factor_1228	Corrected Power	Corrected Torque	T7_Intake	T_Supply_Water	T_Water_Block	Oil_T	EGT_Cyl_1	EGT_Cyl_2	EGT_Cyl_3	EGT_Cyl_4	EGT_Cyl_5	EGT_Cyl_6
		Nm	%	rpm	kPa	kg/h	%	°C	°C	%	%	%	ppm	ppm		kPa	kPa	kPa	h		kW	Nm	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
11/16/10	40:31	0.6	0.0	967	100.83	1.73	46.8	25.7	20.6	49.1	0.0	0.1	4.3	1.0	32.8	37.5	75.5	312.5	211	0.996	0.06	0.56	24.7	24.7	53.5	71.4	408	433	70	387	158	396
11/16/10	49:01	321.1	100.0	4401	100.80	44.85	41.5	27.4	20.6	49.4	5.5	11.6	616.1	1148.8	0.9	29.9	33.7	348.0	211	1.002	148.31	321.88	28.1	25.6	64.0	123.2	709	678	688	732	683	641
11/16/10	50:01	321.3	100.0	4400	100.81	44.82	41.3	27.5	20.6	49.6	5.5	11.6	628.8	1146.6	0.9	30.1	34.9	346.9	211	1.001	148.26	321.76	28.0	25.6	64.3	124.1	708	675	689	732	679	636
11/16/10	51:01	321.4	100.0	4399	100.81	44.72	41.0	27.6	20.6	49.8	5.6	11.6	633.0	1129.8	0.9	30.2	33.7	345.9	211	1.002	148.38	322.04	27.7	25.7	64.2	124.9	707	675	689	734	682	644
11/16/10	59:31	230.5	33.5	3520	100.80	23.06	40.8	27.8	20.6	51.5	1.1	14.0	439.3	2157.8	1.0	31.9	43.2	353.1	211	1.001	85.08	230.82	27.5	25.3	62.2	111.7	709	732	663	678	701	683
11/16/10	00:31	228.9	33.8	3519	100.78	22.58	41.3	27.9	20.6	52.0	0.9	14.1	435.8	2120.0	1.0	31.5	43.1	353.9	211	1.001	84.42	229.09	26.9	25.2	62.1	111.4	713	731	665	678	699	682
11/16/10	01:31	230.6	34.0	3518	100.78	22.79	42.0	27.7	20.6	52.1	1.1	14.0	438.3	2123.4	1.0	32.2	43.2	354.3	211	1.001	85.08	230.81	26.9	25.1	62.0	111.0	709	733	665	680	696	684
11/16/10	10:01	149.2	20.6	2640	100.78	12.09	43.4	27.5	20.6	51.0	0.5	14.2	435.0	1440.4	1.0	34.1	53.7	352.8	211	0.999	41.21	149.08	25.6	24.5	59.1	97.4	674	688	628	637	662	651
11/16/10	11:01	150.2	19.6	2641	100.77	12.26	43.7	27.5	20.6	51.0	0.5	14.2	435.1	1414.4	1.0	34.3	53.7	353.2	211	0.999	41.49	150.08	25.6	24.5	59.0	96.9	674	689	629	636	662	651
11/16/10	12:01	148.9	20.1	2638	100.76	12.18	43.4	27.5	20.6	51.1	0.5	14.2	437.7	1426.1	1.0	34.6	53.7	353.6	211	0.999	41.12	148.73	25.5	24.4	58.9	96.6	675	690	629	638	662	651
11/16/10	20:31	78.2	11.1	1759	100.79	5.89	47.0	26.8	20.6	51.5	3.0	13.2	821.5	330.9	0.9	34.9	67.4	333.2	212	0.999	14.39	78.13	25.1	23.8	56.4	84.6	550	601	490	537	563	576
11/16/10	21:31	80.0	11.5	1761	100.78	5.17	46.5	26.8	20.6	51.4	3.0	13.2	829.5	344.4	0.9	38.0	67.0	333.6	212	0.999	14.74	79.94	25.3	23.8	56.3	84.1	548	601	488	537	562	576
11/16/10	22:31	80.7	10.7	1760	100.78	5.97	46.6	26.8	20.6	51.3	3.0	13.2	821.0	343.7	0.9	33.1	66.7	334.2	212	0.998	14.86	80.61	24.9	23.6	56.1	83.7	550	602	491	538	563	576
11/16/10	30:36	1.2	0.0	973	100.78	1.72	57.6	24.0	20.5	51.6	5.2	11.3	3340.0	23.2	0.9	39.4	74.3	311.7	212	0.995	0.13	1.23	22.9	22.3	53.2	72.8	385	336	66	390	74	147
11/16/10	31:36	0.5	0.0	944	100.77	1.75	57.9	23.8	20.6	51.6	5.0	11.2	3014.8	23.4	0.9	39.1	75.7	311.3	212	0.995	0.05	0.47	22.8	22.3	53.1	72.0	377	359	66	380	75	97
11/16/10	32:36	0.5	0.0	955	100.77	1.76	58.3	23.7	20.6	51.7	5.0	11.2	3814.6	22.9	0.9	39.1	75.5	312.0	212	0.995	0.05	0.50	22.8	22.2	52.9	71.4	366	347	64	352	157	83