APPLICANT SPECIFIC TEST PLAN
Stationary BlueMAX™ 300D SCR
At Environment Canada

Rev 2.1 February 14, 2013

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1.0 Applicant:

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2.0 Introduction:

Environment Canada (EC) will conduct verification testing to measure the emissions reductions for Nett Technologies Inc.'s **BlueMAX™ 300D** urea-based selective catalytic reduction (SCR) system for off road diesel engines operating in stationary or mobile configurations (generator sets, pumps and compressors) that use commercial ultralow sulfur diesel fuel (ULSD) conforming to 40 CFR 86.1313-2007 and/or 40 CFR 89.330.

3.0 Description of Technology System to be Verified

Nett Technologies is responsible for delivering to EC the following for verification testing:

1. Degreened BlueMAX™ 300D system with documented degreening history of 25-125 hours.
2. Aged BlueMAX™ 300D system with documented aging history of at least 1000 hours.

Prior to testing Nett Technologies Inc. will provide the documentation for both the aged and degreened BlueMAX™ 300D systems. Documentation will include model and serial numbers, ageing and degreening histories, dates of manufacture, hours of service, service description summaries, maintenance and performance summaries, and the written instructions typically provided with BlueMAX™ 300D.

3.1 Durability (Ageing of the System)

The BlueMAX™ 300D system will be aged for 1000 hours using a 176 kW MQ Power Corporation generator set powered by a Komatsu engine (Generator set details are provided in Table 1).

Table 1 - Durability Equipment and Engine Description

Generator-set description	Make	MQ Power Corporation
	Model	DCA220SSK
	Year	1998
	Power rating	176kWe/220kVA – prime 3
	Trailer mounted	
Engine description	Engine Make	Komatsu
	Engine Model	S6D125E-2
	Year	1996
	Engine Family	TKL11.RXDARB
	Cylinders	6
	Displacement (L)	11
	Aspiration	Turbo Charge Air Cooled
	Prime power (hp)	273 @ 1800 rpm
	Certified THC (g/bhp-hr)	0.3
	Certified CO (g/bhp-hr)	0.4
	Certified NOx (g/bhp-hr)	6.2
	Certified PM (g/bhp-hr)	0.2

The generator will be subject to varying electrical loads using a 200 kW Avtron Load Bank model K675AD24974-7 according to the 8 hour schedule shown in Table 2 on the following page. Performing this schedule will provide an average durability loading of 47%.

Table 2 - Generator Durability Loading Schedule

Desired Loading Schedule		Actual Loading Schedule Based on Loadbank load steps			
Load (%)	**Power [kW]**	**Actual Load (kW)**	**Actual Load (%)**	**Duration (min)**	**Duration (hours)**
0	0.0	0	0	12	0.20
25	44.0	45	25.6	72	1.20
45	79.2	80	45.5	48	0.80
65	114.4	115	65.3	84	1.40
80	140.8	140	79.5	48	0.80
65	114.4	115	65.3	84	1.40
45	79.2	80	45.5	48	0.80
25	44.0	45	25.6	72	1.20
0	0.0	0	0	12	0.20
			Total	480	8.0

A datalogger will be installed recording the required parameters including temperature (before and after DOC and after SCR), back-pressure, NOx (before and after DOC and after SCR), urea flow, urea level as well as diagnostics codes. In addition, functionality testing will be performed at intervals of 250, 500 and 750 hours according to the procedure defined in APPENDIX A – FUNCTIONAL TEST PLAN. A copy of data will be provided at a later date. Routine engine maintenance will be performed throughout the durability period.

3.2 Durability (Degreening of the System)

The aged system will be removed and a second system will be installed on the MQ Power generator set for degreening purposes. The system will be degreened for 25-125 hours under the same operating conditions as that of the aged durability system.

4.0 Testing:
The verification testing will be performed at the Emissions Research and Measurement Section (ERMS) of Environment Canada (EC), located at 335 River Road in Ottawa, Ontario, Canada. The ERMS is responsible for emissions testing of vehicles, engines and equipment, under the Canadian Environmental Protection Act, 1999 (CEPA 1999), which assigned EC full authority for both fuel quality standards and mobile source emission regulations for light-duty and heavy-duty on-road vehicles/engines, motorcycles, small marine engines, and utility engines. CEPA 1999 regulations follow the US CFR, Title 40 Part 1065. Extensive correlations with EPA have been performed to verify procedures and methods for heavy duty engine testing. Furthermore, Environment Canada's Heavy Duty Cell is ISO-17025 accredited.

Testing will be performed in accordance with the approved technology specific test/QA plan, as specified in the *Generic Verification Protocol for Determination of Emissions Reductions from Selective Catalytic Reduction Control Technologies for Highway, Nonroad, and Stationary Use Diesel Engines*. Under the referenced protocol, the ISO 8178 D2 steady state will be run. Emissions of HC, CO, CO2, NOx, NO, PM, SOF and ammonia slip will be measured over the 3 hot 5-mode steady-state cycle sequences using ULSD fuel for the baseline, aged and degreened system testing. NO2 will be reported as the difference between NOx and NO. BSFC will be reported using the method of carbon balance. During the runs, backpressure and SCR catalyst inlet and outlet temperatures will be recorded on a second-by-second basis.

4.1 Test Engine
This testing will consist of the measurement of exhaust emissions using a rebuilt 2001 Caterpillar 3406 engine serial number 41Z19318, engine family 1CPXL14.6MRJ (reference Table 3 for complete details). The engine was rebuilt using original Caterpillar parts and was been broken in on a dynamometer for 32 hours. A list of the parts that were changed, a dynamometer report to confirm the engine performance and a confirmation letter stating the engine was broken in can be found in Appendix B.

Table 3 - Engine Details

Engine Make and Model	Caterpillar 3406
Serial Number	41Z19318
Engine Year	2001
Engine Family	1CPXL14.6MRJ carried over from YCPXL14.6MRJ
Cylinders	6
Displacement (L)	14.6
Fuel System	Mechanical Direct Injection
Aspiration	Turbo Air to Water
Certified Emissions NMHC (g/bhp-hr)	0.04
Certified Emissions CO (g/bhp-hr)	2.7
Certified Emissions NOx (g/bhp-hr)	6.6
Certified Emissions PM (g/bhp-hr)	0.25

4.2 Test Fuel
Fuel used for this testing will be commercially available Type 2-D ULSD (<15ppm) conforming to 40 CFR 86.1313.

4.3 Test Requirements and Instruments

CEPA 1999 regulations follow the US CFR, Title 40 Part 89 and 1065. Extensive correlations with the EPA have been performed to verify procedures and methods for heavy duty engine testing.

The instruments to be used in emissions testing are show in Table 4.

Table 4 - Emissions Analyzer Instruments

Pollutant	Analysis Method	Instrument	Sample Collection
Carbon Monoxide (CO)	Non-Dispersive Infrared Detection (NDIR)	HORIBA Model AIA-210 LE	Continuous Collection
Carbon Dioxide (CO_2)	Non-Dispersive Infrared Detection (NDIR)	HORIBA Model OPE-115	Continuous Collection
Oxides of Nitrogen (NO_x/NO_2)	Heated Chemiluminescence Detection	California Analytical Instruments Model 400-HCLD	Continuous Collection
Total Hydrocarbons (THC)	Heated Flame Ionization Detection (FID)	California Analytical Instruments Model 300M-HFID	Continuous Collection
Particulate Matter (PM)	Gravimetric Procedure	Sartorius M5P-00V001	70mm Emfab Filters
Carbonyl Compounds (i.e., Formaldehyde, Acetaldehyde)	High Performance Liquid Chromatography	Agilent 1100 Series	2,4-DNPH coated-Silica Gel Cartridges
Volatile Organic Compounds	Gas Chromatography-Flame Ionization Detection	Entech Model 7000 Pre-Concentrator HP 6890 GC	Tedlar™ Bag
Methane	Gas Chromatography	HP 6890	Tedlar™ Bag
Nitrous Oxide (N_20)	Gas Chromatography with Electron Capture Detection	HP 5890A Series II GC with ECD	Tedlar™ Bag
Organic Carbon/ Elemental Carbon (OC&EC)	Modified NIOSH 5040 – thermal optical method	DRI Model 2001 Thermal/Optical OC/EC Carbon Analyzer from Atmoslytic Inc	47 mm quartz fired filters
Polycyclic Aromatic Hydrocarbons (PAH)	Low-Resolution Chromatography and mass spectrometry	-	Pre-cleaned filters and polyurethane foam plugs
Particle Number Size Distribution	Particle charging and detection	TSI 3090 EEPS	Continuous collection (Dilute Exhaust)
Ammonia	NH3 Slip – FTIR	MKS Multigas 2030	Raw Gas

The instruments listed above are calibrated in accordance with 40CFR, Part 89, Subpart D and copies of all results will be submitted with the final verification report. These reports will also include appropriate

documentation on all calibration equipment, all instrument certifications, and any calibration gas traceability documents.

Diluted exhaust gases from the dilution tunnel will be continuously collected and routed to the gaseous analyzers for analysis by corrected volume and for final calculation of corrected mass concentrations using temperature, barometric pressure and humidity. All engine test related variables are automatically integrated from the second by second raw dilution data and automatically corrected in accordance with the applicable EPA CFR 40 Part 89 for dilution ratio, temperature, humidity and mass and automatically calculated by the computer program to provide the final results.

The emission collection apparatus will utilize a CVS system that dilutes engine exhaust during the test with filtered ambient air from the test cell. A schematic of Heavy-Duty Test Cell is shown in the Figure below. This system allows measurement of true mass of the gaseous and particulate matter emissions from the engine during operation. The design of this sampling and analytical system for engine emissions follows the protocol of 40 CFR 89.

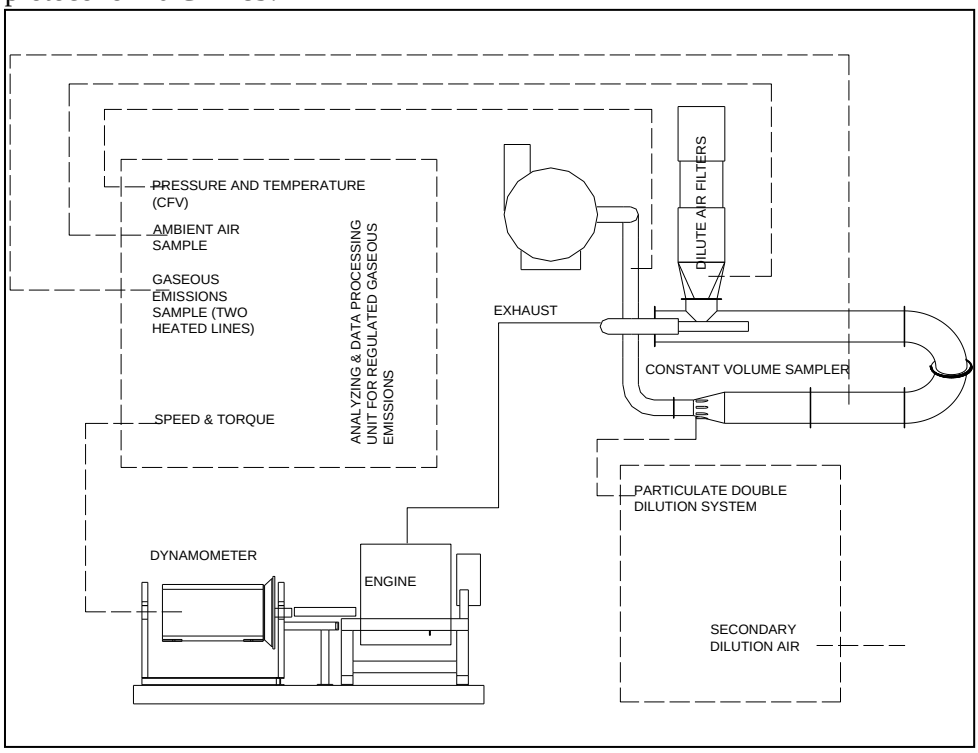

Figure 1 - Heavy Duty Test Cell Schematic

The total volume of raw exhaust is transferred from the engine's exhaust manifold to the CVS through a 13 cm diameter steel exhaust pipe. The exhaust is then diluted with high efficiency particulate air, HEPA filtered ambient air, within the dilution tunnel, which is 46 cm (18 inches) in diameter and 12 meters (40 feet) in length. The dilute exhaust is passed through a critical flow venture (CFV), which maintains the flow at 84.96 cubic meters per minute (3000 standard cubic feet per minute). Data obtained from temperature and pressure sensors located upstream of the venturi and downstream of the sampling zone allow for correction of the volumetric flow rate to standard conditions (i.e., 70° F, 101.325 kPa).

During emissions testing, a continuous flow of diluted exhaust is collected through in-line sampling probes and is directed to the particulate matter sampling system and gas analyzers. In each case, data is corrected for background air concentrations, prior to the determination of the mass emissions.

Particulate matter emission rates are obtained by directing exhaust through a single dilution CVS (constant volume sampler), then a secondary dilution chamber, at which point the diluted sample is drawn into two separate cyclones, which are used to cut off the sizing of the particulate to be measured (e.g. 10 or 2.5 µm), for mixing. The uniform concentration is then passed through temperature controlled (47°C) filter holders (one for each of the two samples) allowing particles to be deposited on pre-weighed 45 mm Teflon® filters. Prior to the test, all filters are stored in a balance room where conditions are maintained at 40%±5% relative humidity and 23°C ±3°C. After this stabilization period, they are weighed on a Mettler Toledo® UMX2 balance readable to 0.1 microgram (µg). The filters are then stored in covered Petri dishes and remain in the balance room until needed for testing. The filters are then removed from the balance room just prior to commencing each test and then placed in the heated and sealed, stainless steel filter holder assembly located downstream of the secondary dilution chamber. After the test, the filters are re-stabilized in the balance room for 12-24 hours and re-weighed to determine the net mass of diesel particulate emissions. This mass, together with other emissions data, is then used to calculate the PM emission rate.

Fuel consumption values in g/hp-hr are calculated based on industry standard carbon balance equation.

Atmospheric conditions are known to affect engine exhaust emissions and cause variability in measured NO_x data. During each heavy-duty transient test, wet and dry bulb temperatures are recorded using a Bendix Psychometer and barometric pressure is measured using a Vaisala Pressure Transmitter. Based on these three parameters, a humidity value is calculated and a NO_x humidity correction factor (K_h), is derived.

4.4 Test Sequence and Matrix

A summary of the test cycles and sequence proposed to be used in this project are shown below in Table 5.

Table 5 - BlueMAX™ 300D Test Matrix

Step	Task Description	Test Cycle
1	Installation of Caterpillar 3406 engine/dyno/instruments all checked out.	N/A
2	Seasoning of fresh lubricating oil.	3 hours steady-state
3	Repetitive steady-state cycle runs.	2 hours steady state
4	Baseline Emission using ULSD Fuel to be compared to original engine certification	5-mode x3
5	Installation of BlueMAX™ 300D aged device.	
6	Repetitive steady-state cycle runs.	2 hours steady state
7	Aged emissions testing using ULSD fuel.	5-mode x3
8	Urea based functional testing. (Performed by Nett Technologies but supervised by Environment Canada)	
9	Installation of BlueMAX™ 300D degreened device.	
10	Repetitive steady-state cycle runs.	2 hours steady state
11	Degreened emissions testing using ULSD fuel.	5-mode x3

4.5 Baseline Engine Testing for Emissions Comparison

EC will set and record intake restrictions and exhaust backpressure to the engine manufacturer's specifications and will stabilize the engine on ULSD baseline fuel prior to conducting baseline verification tests. The engine will be set per the manufacturer's ratings, the command cycle will be generated, and engine preparations over the 5-mode steady-state FTP cycle will be performed. Prior to

the performance test, EC will run the engine for 2 hours of repetitive steady-state cycle operation using ULSD fuel.

Following this preparation, a test for engine-out emissions over the 3 5-mode steady-state cycle sequences will be conducted for HC, CO, CO_2, NO_x, NO, PM, SOF and ammonia slip. NO_2 will be reported as the difference between NO_x and NO. Brake specific fuel consumption (BSFC) over each steady-state, based on carbon balance, will also be reported. During the runs, backpressure and exhaust temperature will be recorded on a second-by-second basis. The results of the emissions testing will be compared against the original engine certification to ensure engine emissions compliance.

4.6 Installation and Inspection of the Aged BlueMAX™ 300D System

EC will visually inspect the aged BlueMAX™ 300D system for external signs of damage, record the condition and take digital photographs of the device. After inspection, the aged system will be installed per the manufacturer's written instructions.

4.7 Emissions Testing of Aged BlueMAX™ 300D Using ULSD Fuel

EC will operate the engine with the aged system installed, reset the backpressure and intake restriction to the engine manufacturer's desired level, and verify satisfactory engine operation. Exhaust backpressure will be recorded during the performance check

EC will stabilize the engine by running it on the ULSD baseline fuel for 2 hours of repetitive steady-state operation prior to conducting aged verification tests. The baseline command cycle will be recalled and used for preparations and testing.

Following this preparation, emissions of HC, CO, CO_2, NOx, NO, PM, SOF and ammonia slip with the aged system in place will be measured over the 3 hot 5-mode steady-state cycle sequence using ULSD fuel. NO_2 will be reported as the difference between NO_x and NO. BSFC will be reported. During the runs, backpressure and SCR catalyst inlet and outlet temperature will be recorded on a second-by-second basis.

4.8 Functional Testing of the Aged BlueMAX™ 300D System.

Functional testing of the reductant level monitoring and notification system, the reductant leak monitoring and notification system, and other SCR system malfunction monitoring systems are required for SCR systems. This will be performed by Nett Technologies and supervised by EC. See Appendix A for the written instructions that document how to conduct the functional testing on the BlueMAX™ 300D.

Upon completion of functional testing, EC will remove the system and restore the engine to its baseline configuration.

4.9 Installation and Inspection of the Degreened BlueMAX™ 300D System

EC will visually inspect the degreened BlueMAX™ 300D system for external signs of damage and record the condition and take digital photographs of the device. After inspection, the degreened system will be installed per the manufacturer's written instructions.

4.10 Emissions Testing of Degreened BlueMAX™ 300D Using ULSD Fuel

EC will operate the engine with the aged system installed, reset the backpressure and intake restriction to the engine manufacturer's desired level, and verify satisfactory engine operation. Exhaust backpressure will be recorded during the performance check.

EC will stabilize the engine by running it on the ULSD baseline fuel for 2 hours of repetitive steady-state operation prior to conducting degreened verification tests. The baseline command cycle will be recalled and used for preparations and testing.

Following this preparation, emissions of HC, CO, CO2, NOx, NO, PM, SOF and ammonia slip with the degreened system in place will be measured over the 3 hot 5-mode steady-state cycle sequence using ULSD fuel. NO_2 will be reported as the difference between NO_x and NO. BSFC will be reported. During the runs, backpressure and SCR catalyst inlet and outlet temperature will be recorded on a second-by-second basis.

5.0 Data Handling and Reporting:

Following completion of the verification testing, EC will prepare a report to summarize the data and testing process comparing the emissions from the baseline engine and the emissions with the BlueMAX™ 300D system installed. This will be forwarded to Nett Technologies.

6.0 Schedule:

This technology specific test/QA plan addendum for the verification will be finalized following receipt of EPA's approval. It may be again reviewed by the EPA prior to starting verification testing. Testing is anticipated to begin during in the February/March timeframe of 2013, but this will depend upon the laboratory test schedule.

APPENDIX A – FUNCTIONAL TEST PLAN

Functional testing of the reductant level monitoring and notification system, the reductant leak monitoring and notification system, and other SCR system malfunction monitoring systems are required for SCR systems. This will be performed by Nett Technologies and supervised by EC. These written instructions document the procedure to demonstrate the basic functionality of the Nett BlueMAX™ 300D SCR System.

Functional testing will consist of triggering the sensors and system to register:

- Sensor error for the urea level
- Low levels in the urea tank
- Empty levels in the urea tank
- Engine No-Restart Interruption
- Low urea consumption
- Low urea pressure
- Urea tank leak detection
- High urea pressure
- Urea Quality

A.1 Equipment and Supplies Needed:

1. Set of wrenches to set-up system
2. Empty tank/container to hold the drained urea
3. Siphon or funnel to return drained urea tank
4. 24v battery supply
5. 32.5% urea solution
6. Water

A.2 NOx Sensor Failure

1. Disconnect the upstream NOx sensor from the harness.
2. Wait for a few seconds.
3. Watch for the operator display to indicate error code 3.
4. Reconnect the NOx sensor.
5. Watch the operator display for the error code to clear.

A.3 MAF Sensor Failure

1. Disconnect the MAF sensor from the harness.
2. Wait for a few seconds.
3. Watch for the operator display to indicate error code 4.
4. Reconnect the MAF sensor.
5. Watch the operator display for the error code to clear.

A.4 Inlet Thermocouple Failure

1. Disconnect the thermocouple from the harness.
2. Wait for a few seconds.
3. Watch for the operator display to indicate error code 5.
4. Reconnect the thermocouple.
5. Watch the operator display for the error code to clear.

A.5 Urea Level Sensor Failure

1. Disconnect the urea level sensor.
2. Wait 1 minute.
3. Watch for operator display to indicate error code 17.
4. Reconnect the urea level sensor.
5. Wait 30 seconds.
6. Watch the operator display for the error code to clear.

A.6 Low Levels in the Urea Tank

1. Fill the urea tank full.
2. Wait 30 seconds.
3. There should be no warning indicated on the display.
4. Open the drain valve of the urea tank and allow for urea to pour into a separate empty tank/container until the urea drops to a level below 20% in the tank, but above the empty level. Tank is marked for convenience.
5. Close the drain.
6. Wait 5 - 6 minutes.
7. Watch the operator display to ensure the level indicator has changed.

A.7 Empty Levels in the Urea Tank

1. Continue to drain the tank.
2. Close the drain.
3. Wait 5 - 6 minutes.
4. Watch the operator display to indicate code ‘E’.
5. Pour urea back into the tank to full.
6. Wait 1 - 2 minutes.
7. Watch operator display for the error code ‘E’ to clear.

A.8 Engine No-Restart Interruption

1. Turn on the engine.
2. Open the drain valve of the urea tank until the tank is empty.
3. Wait 5 minutes.
4. Watch the operator display to indicate error code ‘E’.
5. Turn the engine off.
6. Wait 45 seconds.
7. Restart the engine, wait 45 seconds and then turn it off.
8. Repeat engine restart and turn-off two more times (Note: Allow 45 seconds before each restart).
9. The engine should not start the fourth time.
10. Pour urea into the tank to full.
11. Wait 1 - 2 minutes.
12. Watch the operator display for error code ‘E’ to clear.
13. Turn the engine on.
14. Engine should re-start.

A.9 Urea Quality Sensor Interruption

1. Turn on the engine.
2. Open the drain valve of the urea tank until the tank is empty.
3. Close the drain.
4. Fill the tank with tap water.
5. Wait 5 minutes.
6. Watch the operator display to indicate error code 23.
7. Turn off engine.
8. Wait 45 seconds.
9. Restart the engine, wait 45 seconds.
10. Repeat steps 7 to 9 two more times.
11. The engine should not start the fourth time.
12. Drain water from the tank.
13. Refill tank with urea.
14. Wait 5 minutes.
15. Key switch on.
16. Watch for operator display for error code to clear.
17. Turn on engine, it should re-start.

A.10 Low Urea Pressure and Low Urea Consumption and Urea Tank Leak Detection

1. Start the engine and apply load.
2. Ensure that exhaust temperature is over 225°C (urea will not inject below 225°C).
3. Ensure that the temperature does not fall below 225°C during the test.
4. Watch the operator display, there should be no errors.
5. Unplug the urea tube from urea tank to urea dosing system (UDS) and the air tube from compressor to UDS.
6. Wait 10 minutes (unit should be operational; ensure temperature is above 225 degrees C)
7. Watch for the operator display to indicate error code 19.
8. Reconnect the urea tube and air tubes.
9. Watch the operator display for error code 19 to clear (this may take 1 - 2 minutes) (Note: If the error codes stays on after 2 minutes, ensure the urea and air tubes are properly connected.)

A.11 High Urea Pressure

1. Start engine and apply load.
2. Ensure that exhaust temperature is well over 225°C.
3. Watch the alarm box, there should be no errors.
4. Crimp the urea supply hose to nozzle with a set of vice grips (due to safety concerns, alternate means of cutting the urea supply to the exhaust stream are allowed).
5. Watch the operator display to indicate error code 16 (if the error code does not appear, ensure that the hose is crimped properly and repeat the procedure)
6. Remove the crimp in the hose.
7. Watch the operator display for error code 16 to clear (may take up to 2 minutes).
8. If error code 16 remains after 2 minutes; shut the engine, wait 2 - 3 minutes and restart.
9. Ensure the engine is operating above 225°C and watch the operator display for error code 16 to clear (may take 1 - 2 minutes).

Table A.1 - Functionality Test Pass/Fail 1

ERROR TYPE	EXPECTED RESULT	PASS/FAIL
NOx Sensor Failure	Error code 3	
MAF Sensor Failure	Error code 4	
Thermocouple Failure	Error code 5	
Urea Level Sensor Failure	Error code 17	
Low levels in the urea tank	Urea light	
Empty levels in the urea tank and high urea consumption	MIL light and error code 'E'	
Engine no-restart interruption	Urea light, error code 'E' and engine no-restart on the 4th attempt	
Engine no-restart interruption	Error code 25 and engine no-restart on 4th attempt	
Low urea pressure, low urea consumption, and urea tank leak detection	MIL light and error code 19	
High urea pressure	MIL light and error code 16	

APPENDIX B – TEST ENGINE DETAILS

B.1 Rebuilt Parts List

Nett Tech.

USED TRUCK ENGINES
INVENTORY
C/O DOLORES DESTEFANO
{14} BENSALEM, PA

S/N REQIURED

WO 1841321 07-13-12 E14C820 C09088 14 E 2 1

6409615 07-02-12 20 20 20

AA 3406C 041Z19318 C09088 10.0 C09088

RECONDITION ENGINE

INSTALL PLATINUM KIT
RESEAL FRONT AND REAR COVERS
RESEAL OIL FILTER HOUSING AND FUEL PUMP
HAD TO PURCHASE MAIN BEARING BECAUSE THEY WERE
NOT PART OF THE PLATINUM KIT
THERE IS AN ADDITIONAL CHARGE FOR A BREATHER AND
DIP STICK TUBE AND GAUGE.
ENGINE IS TOTALLY RECONDITIONED
--

1	0R-1090	CARTRIDGE	S
1		CORE DEPOSIT	S
1-		CORE RETURN	S
1	0S-0509	CAP SCREW	S
2	0S-1587	CAP SCREW	S
2	0S-1594	CAP SCREW	S
7	1U-5517	DISC	S
1	2N-3350	SEAL-O-RING	S
1	2N-8109	CLAMP	S
1	4F-7390	RING	S
4	5M-2894	WASHER	S
2	5P-5846	SEAL O RING	S
2	5P-7813	SEAL	S
1	5P-8068	SEAL	S
3	5P-9709	DISC	S
1	6V-3319	SEAL O RING	S
1	6V-3830	SEAL O RING	S

CONT'D

USED TRUCK ENGINES
INVENTORY
C/O DOLORES DESTEFANO
{14} BENSALEM, PA

S/N REQIURED

WO 1841321 07-13-12 E14C820 C09088 14 E 2 2

6409615 07-02-12 20 20 20

AA 3406C 041Z19318 C09088 10.0 C09088

1	7C-0307	GASKET	S
2	8J-4351	SEAL-O-RING	S
1	8M-5260	SEAL O RIN	S
1	8N-8258	BEARING	S
1	9S-8001	PLUG	S
1	9S-8003	PLUG	S
2	9S-8007	PLUG	S
1	109-3206	SEAL O RING	S
1	109-9685	SEAL O RING	S
1	131-7123	BEARING	S
1	20R-1101	KIT ENG OVER	N — see attached Breakdown
1		CORE DEPOSIT	N
1-		CORE RETURN	N
3	222-3117	CLEANER-BRAK	S
1	259-7008	GLOVES	S
1	30540	CEMENT	S
2	40462	LOCTITE	S

F/R ALL *

SEGMENT 01 TOTAL : T

PROVIDE PARTS ONLY

ADDITIONAL PARTS NOT INCLUDED IN THE QUOTE WERE
APPROVED BY CHRIS GLADECK TO JOHN DEA
--

CONT'D

USED TRUCK ENGINES
INVENTORY
C/O DOLORES DESTEFANO
{14} BENSALEM, PA

S/N REQIURED

WO 1841321 07-13-12 E14C820 C09088 14 E 2 3

6409615 07-02-12 20 20 20

AA 3406C 041Z19318 C09088 10.0 C09088

1	4N-4668	BREATHER A	S	
1	7C-4024	GAGE OIL	S	
1	7E-1381	TUBE AS	N	
7	211-0592	BEARING - MA	N	
2	253-1752	PLATE-THRUST	S	

TOTAL PARTS SEG. 97 *

SEGMENT 97 TOTAL T

15328.36

Part No. Consists Breakdown

Page 1 of 1

PART CONSIST [20R1101]

AUGUST 13, 2012

For Help Desk Phone Numbers Click here

Part Number: 20R1101
Description: KIT-ENG OVERHAUL
Version Symbol: -
Change Level: 1

CLICK HERE TO VIEW NOTE INFORMATION

Part Number	QTY	Description	Svc Ind	Set-Type	Note	In Chg	Out Chg	Reason	New Part	Breakdown
0R9449	0001	PUMP GP-ENG OIL	Y	PTS-LIST		00				Breakdown...
0R9847	0006	CYLINDER PACK AS	Y	PTS-LIST		00				Breakdown...
0R9943	0006	NOZZLE AS-FUEL V	Y	PTS-LIST		00				Breakdown...
10R0482	0001	PUMP GP-WATER	Y	PTS-LIST		00				Breakdown...
10R7438	0001	HEAD GP-CYL BSC	Y	PTS-LIST		00				Breakdown...
1006889	0012	BRIDGE-VALVE	Y	PTS-LIST		00				Breakdown...
3799131	0001	KIT-OVERHAUL	Y	PTS-LIST	B	00				Breakdown...

Total rows: 7

Caterpillar Confidential: **Green**
Content Owner: Shane Gilles
Web Master(s): PSG Web Based Systems Support
Current Date: Monday, August 13, 2012 11:21:20 AM
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http://tmiwebclassic.cat.com/tmi/servlet/TMIDirector?Action=buildtab&refkind=RNTMI... 8/13/2012

B.2 Engine Dyno Report

Power Net

POWER TEST
Menomonee Falls, WI USA

Work Order Data

Work Order #: 5065823
Machine Model #: 980
Engine Model #: 3406
Engine Arrangment #: 192-7101
Rated Horsepower: 325 HP @ 2100 RPM
Tester ID: Karl 2681

Customer Name: Used Truck Engines
Machine Serial #: NA
Engine Serial #: 41Z19318
Engine Perf. Spec. #: 2T7424
Rated Torque: 1260 LBS @ 1200 RPM
E-Fuel Setting:

Dyno Report

Mins	Speed(RPM)	Torque(ft-lbs)	Corr.Gross Hp	OIL(lbs/hr*)	FUEL(lbs/hr*)	BOOST(in Hg)	FUEL BURN RATE (gals/hr.)	JAC.H2O. OUT #1(°F)
0.00	2330	105	47.9	73.2	45.1	10.4	5.55	181
1.23	2300	176	79.3	73.0	44.8	11.7	6.76	182
2.40	2250	514	226	72.1	40.3	25.8	12.7	186
2.98	2200	741	319	71.2	38.4	36.6	16.6	189
3.38	2150	796	334	70.5	37.7	38.6	17.5	190
3.67	2110	835	343	70.1	36.9	39.0	17.6	191
3.85	2060	886	356	69.6	36.9	39.6	18.0	191
3.93	2000	917	359	69.4	36.4	39.4	17.8	191
4.00	1880	974	357	68.8	37.0	37.4	17.5	191
4.10	1810	964	340	68.0	36.8	33.4	16.4	192
4.18	1660	1010	326	67.5	37.1	31.2	15.9	192
4.27	1590	1000	310	66.5	37.5	26.2	14.8	192
4.35	1460	1030	293	66.0	38.7	24.7	14.4	192
4.40	1380	1010	271	64.8	42.3	20.6	13.7	192
4.45	1290	1000	253	64.4	43.8	19.1	13.1	192
4.50	1180	992	228	63.1	42.7	15.5	12.1	192
6.58	790	33.2	5.13	37.9	52.9	.730	.700	183

Performance Spreadsheet

Mins	Speed(RPM)	Torque(ft-lbs)	Power(Hp)	Corr.Gross Hp
0.00	2330	105	46.8	47.9
1.23	2300	176	77.3	79.3
2.40	2250	514	220	226
2.98	2200	741	311	319
3.38	2150	796	326	334
3.67	2110	835	335	343
3.85	2060	886	347	356
3.93	2000	917	350	359
4.00	1880	974	348	357
4.10	1810	964	331	340
4.18	1660	1010	318	326
4.27	1590	1000	303	310
4.35	1460	1030	286	293
4.40	1380	1010	264	271
4.45	1290	1000	247	253
4.50	1180	992	222	228
6.58	790	33.2	4.99	5.13

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Temperature Spreadsheet

Mins	JAC H2O IN(°F)	JAC H2O OUT #1(°F)	OIL(°F)	FUEL IN(°F)	FUEL OUT(°F)	INTAKE AIR(°F)	AMBIENT AIR(°F)
0.00	160	181	195	95.9	141	178	86.2
1.23	161	182	195	97.6	144	178	85.7
2.40	163	186	196	98.4	146	184	85.5
2.98	167	189	197	97.7	146	190	85.8
3.38	169	190	198	97.2	147	193	86.1
3.67	171	191	199	96.8	148	195	86.3
3.85	171	191	199	96.6	148	195	87.8
3.93	171	191	200	96.4	148	196	86.9
4.00	170	191	200	96.4	148	196	87.0
4.10	170	192	200	96.3	148	195	86.7
4.18	170	192	200	96.4	148	194	86.5
4.27	170	192	200	96.3	148	193	86.7
4.35	170	192	200	96.3	148	192	87.0
4.40	170	192	200	96.3	148	191	87.6
4.45	170	192	199	96.2	148	190	88.0
4.50	169	192	199	96.2	148	189	89.1
6.58	158	183	192	97.1	149	179	89.5

Pressure Spreadsheet

Mins	BAROMETRIC(in Hg)	OIL(lbs/in²)	FUEL(lbs/in²)	BOOST(in Hg)
0.00	29.9	73.2	45.1	10.4
1.23	29.9	73.0	44.8	11.7
2.40	29.9	72.1	40.3	25.8
2.98	29.9	71.2	38.4	36.6
3.38	29.9	70.5	37.7	38.6
3.67	29.9	70.1	36.9	39.0
3.85	29.9	69.6	36.9	39.6
3.93	29.9	69.4	36.4	39.4
4.00	29.9	68.8	37.0	37.4
4.10	29.9	68.0	36.8	33.4
4.18	29.9	67.5	37.1	31.2
4.27	29.9	66.5	37.5	26.2
4.35	29.9	66.0	38.7	24.7
4.40	29.9	64.8	42.3	20.6
4.45	29.9	64.4	43.8	19.1
4.50	29.9	63.1	42.7	15.5
6.58	29.9	37.9	52.9	.730

Fuel Burn Spreadsheet

Mins	FUEL BURN RATE (gals./hr.)
0.00	5.55
1.23	6.76
2.40	12.7
2.98	16.6
3.38	17.5
3.67	17.6
3.85	18.0
3.93	17.8
4.00	17.5
4.10	16.4
4.18	15.9
4.27	14.8
4.35	14.4
4.40	13.7
4.45	13.1
4.50	12.1

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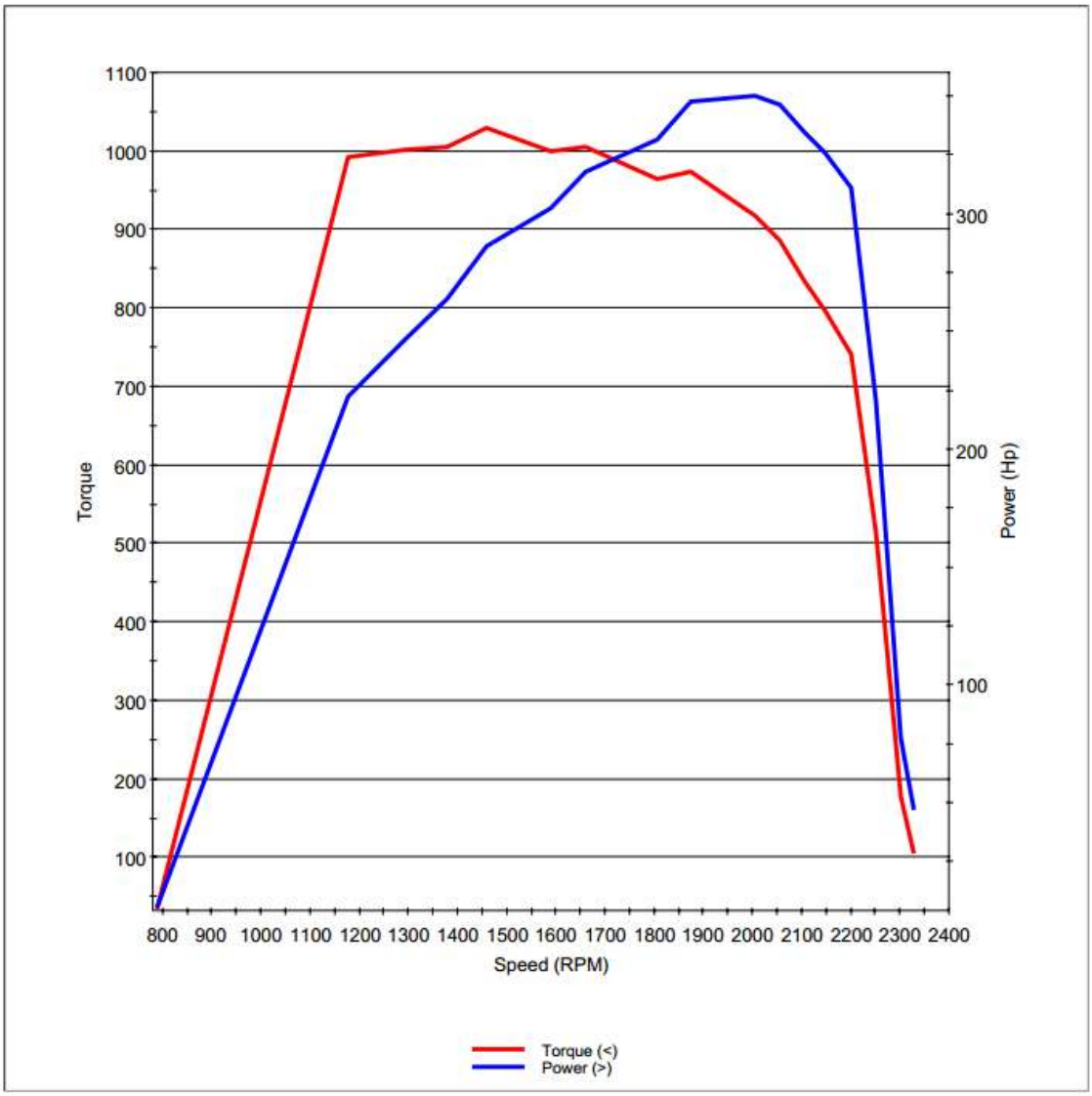
6.58	.700

Performance Graph



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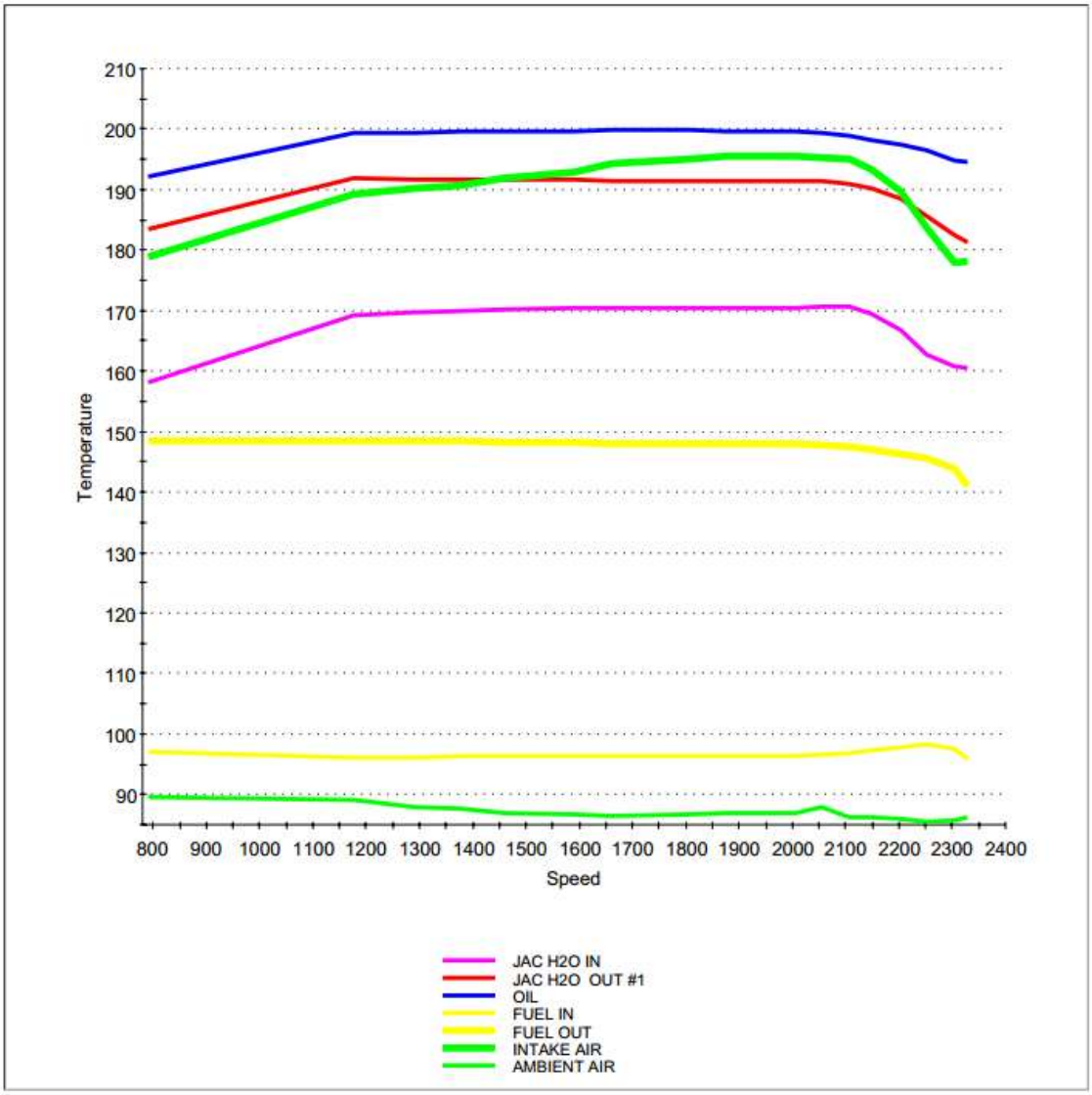
Temperature Graph



File: Used Truck Engines 3406, 5065823.pnd Tested : 7/19/2012 1:54:34 PM Page 4

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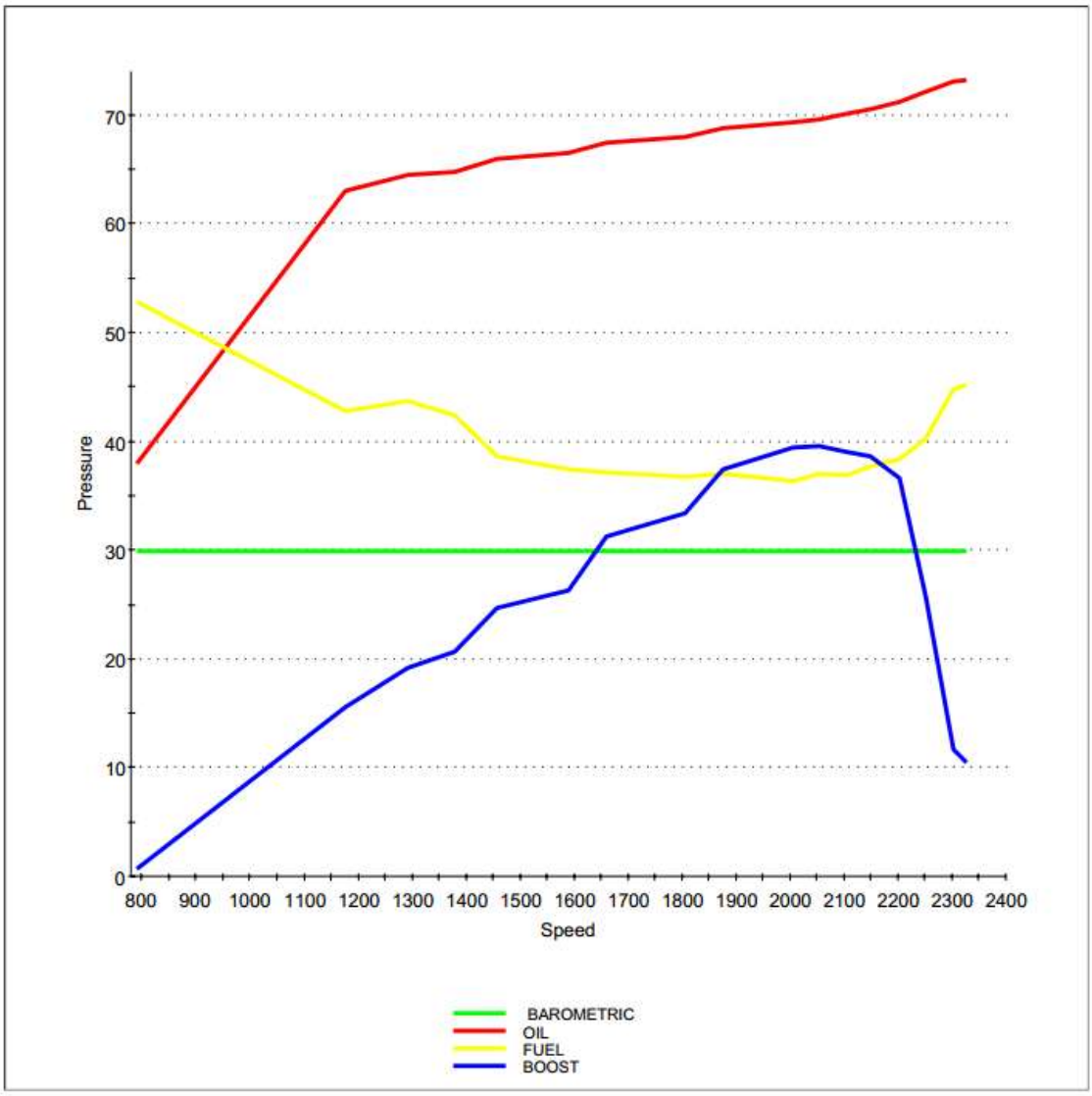
Pressure Graph



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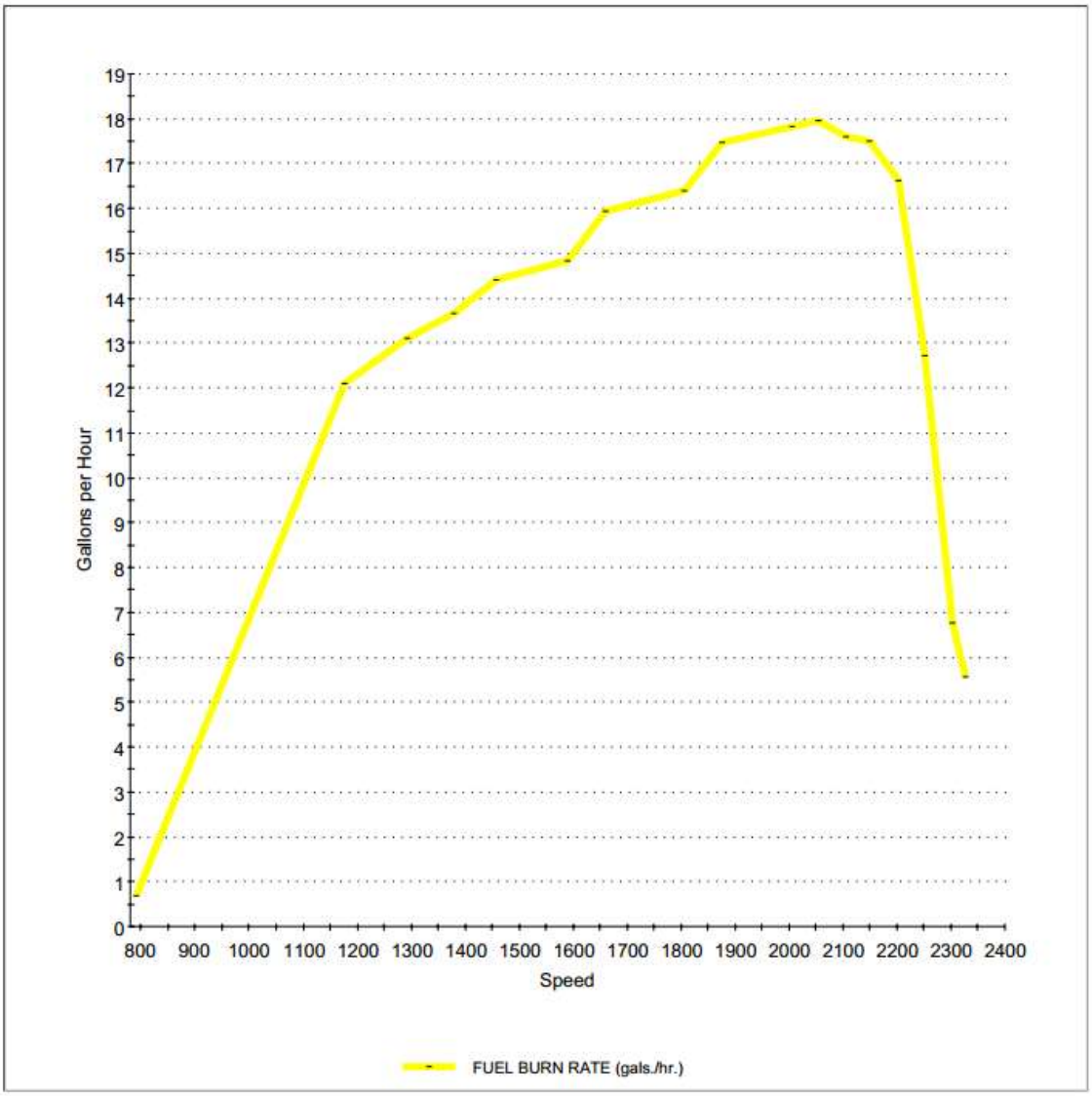
Fuel Burn Graph



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B.3 Rebuild Dealer Letter

Ransome Engine

CAT Power Systems

7/30/12

Mr. Wayne Moffat
NETT Technologies
2-6707 Goreway Drive
Mississauga ON L4V 1P7
Canada

RE: Dyno/Engine Break in

Dear Mr. Moffat,

Per our conversation the Machine engine listed below has successfully completed its 30hour break in on our dyno. It ran a total of 32 hours.

Engine Model 3406 Serial Number 41Z19318 Machine model 980

Your engine has been skidded and packaged for shipment please contact us when your carrier is ready to make a pick up.

Thank you for considering Ransome Engine for your service needs. We shall be most pleased to service your account.

Sincerely,

Christopher P Gladeck

2975 Galloway Road
P.O. Box 8522
Bensalem, PA 19020-8522
(215) 244-0600
Fax (215) 245-2779

600 S. Egg Harbor Road
Hammonton, NJ 08037
(609) 561-5267
Fax (609) 561-5479

720 Pulaski Hwy.
P.O. Box 66
Bear, DE 19701
(302) 328-8021
Fax (302) 328-8017