

January 11, 2007

Engines

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 - Durability
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Emissions

- Research
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- Certification
- Audit
- Compliance

Services

- Support
- Consulting

Stephen Norris
 Manager, Business Development
 Environmental Control Corporation
 2501-1020 Harwood St.
 Vancouver, BC V6E 4R1

Subject: Report 288a, "Catalytic Development and Performance Validation"


Dear Mr. Norris,

Thank you for the opportunity to perform catalyst testing for Environmental Control Corporation here at Carnot Emission Services' (♠CES) engine emission testing facility. This report and test sheets detail the recent testing of a Honda GX160, 163cc small offroad engine (SORE) with serial number GCAFT-1372446 and installed with a ECC catalytic muffler. Testing was conducted to determine zero hour certification emissions values and 125 hour durability in order to calculate a deterioration factor (DF). The table below shows the tasks associated with this effort.

Task	Description
1	Install, instrument, verify performance, calibrate, and prepare for ISO 8178 G2 (6-mode) test cycle using UTG 96 EPA protocol gasoline.
2	ISO 8178 G2 (6 mode) zero (low) hour test Engine tested with ECC Catalyst Muffler
3	ISO 8178 G2 (6 mode) 62 hour test Engine tested with ECC Catalyst Muffler
4	ISO 8178 G2 (6 mode) 125 hour test Engine tested with ECC Catalyst Muffler

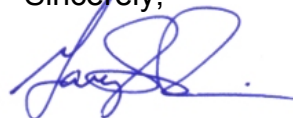
If there are any questions, I can be reached at (210) 928-2230 ext. 205, or via FAX at (210) 928-1233, or via email at gprice@sore-aces.com.

Approved by:



Timothy J. Griffin
 Lab Operations Manager
 Carnot Emissions Services

Sincerely,



Gary L. Price
 Sr. Engineer
 Carnot Emission Services

INSTALLATION & PERFORMANCE VERIFICATION

The engine was installed on Stand B in Test Cell #1. After installation and before CES began zero hour testing and service accumulation, two power curves were performed: the first in torque control and the second in speed control. Figure 1a & 1b shows the torque control data while Figures 2a & 2b represent speed control data. Overall results from both power and torque curves are in Table 2.

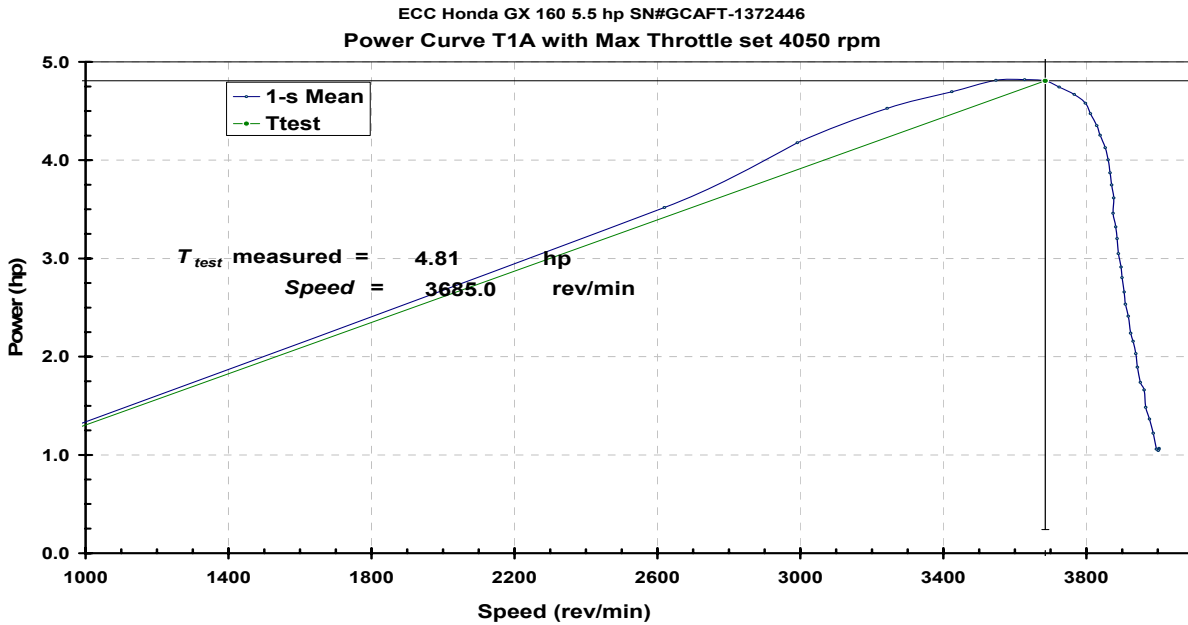


FIGURE 1a. Torque Control Power Curve

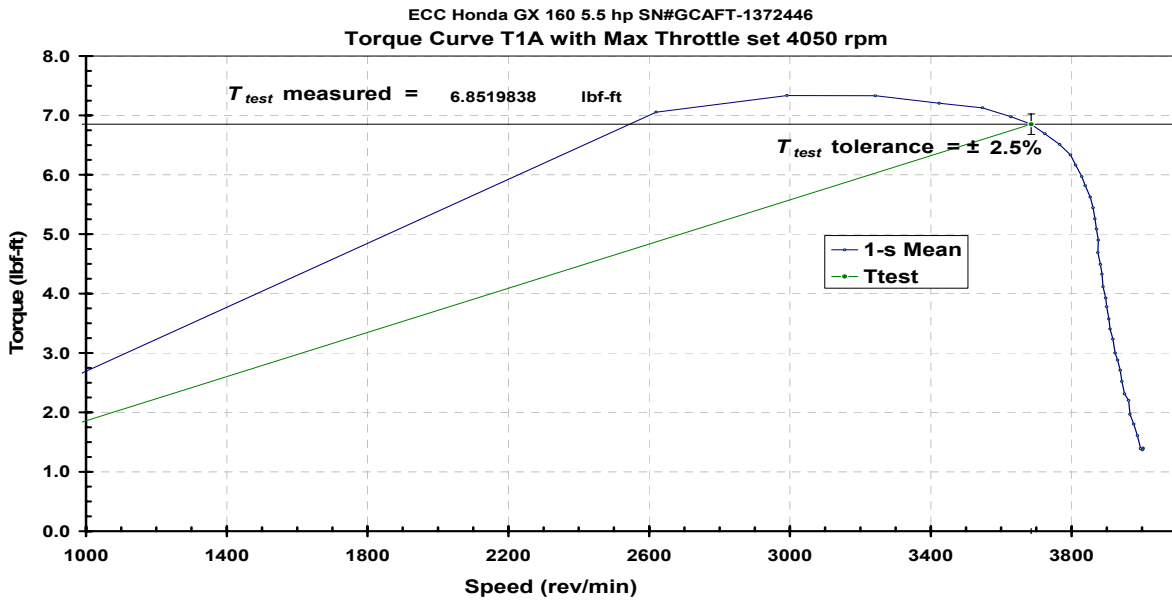


FIGURE 1b. Torque Control Torque Curve

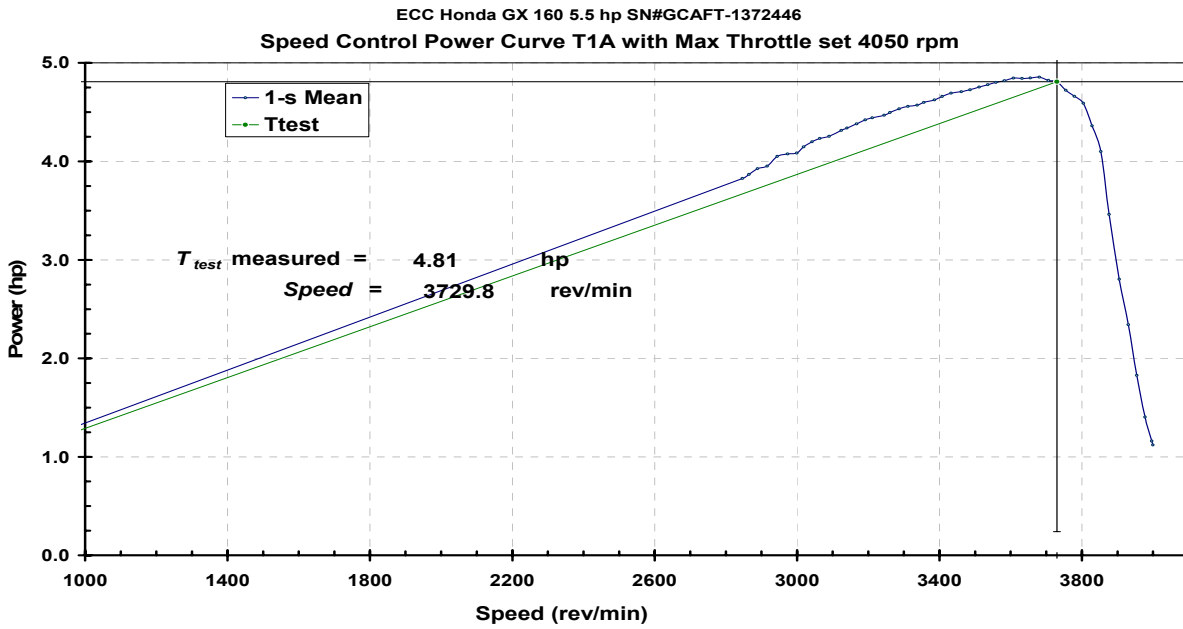


FIGURE 2a. Speed Control Power Curve

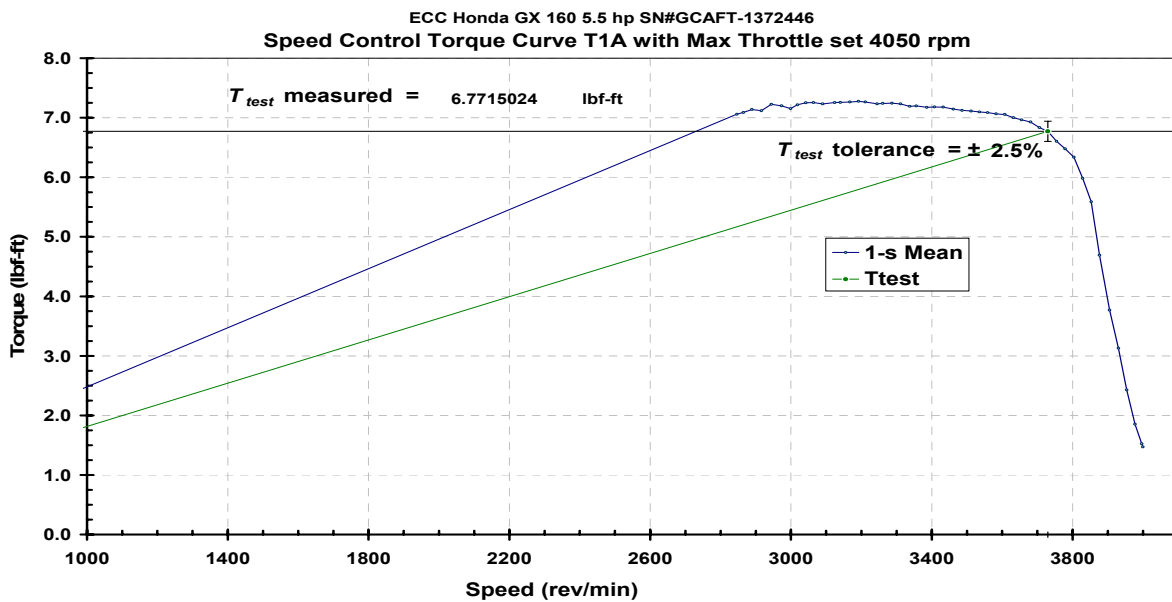


FIGURE 2b. Speed Control Torque Curve

TABLE 1. 163 cc Power Curve Results

Test	Rated Power	Rated Torque
Torque Control	4.81hp @ 3685 rpm	7.39 ft-lb @ 3150 rpm
Speed Control	4.81hp @ 3730 rpm	7.29 ft-lb @ 3200 rpm

TESTING

Emissions Testing

Testing for this engine included full EPA/CARB Modified B-Cycle (ISO 8178-G2) steady-state emissions at 0, 62.5, and 125 hours accumulation. The CARB approved ISO 8178-G2 is a 6-mode test cycle and is shown in Table 2.

TABLE 2. ISO 8178-G2 Test Cycle

Mode	1	2	3	4	5	6
Speed	Rated	Rated	Rated	Rated	Rated	Low Idle
Load (%)	100	75	50	25	10	N/A
Weight (%)	9	20	29	30	7	5

Service Hour Accumulation

Service hour accumulation between EPA/CARB B-Cycle (ISO 8178-G2) steady-state emissions testing was performed using the same weighting factors as those found in Table 3 above and cycled over 60 minute periods. For example, 100% load carries a weight of 9%, thus the engine is operated for 5.4 minutes using the following equation:

$$\text{Minutes} = \text{Mode Wt\%} / 100\% * 60 \text{ min}$$

Using this equation, for the remaining modes yields the following cycle:

- 100% Load – 5.4 minutes (324 seconds)
- 75% Load – 12.0 minutes (720 seconds)
- 50% Load – 17.4 minutes (1044 seconds)
- 25% Load – 18.0 minutes (1080 seconds)
- 10% Load – 4.2 minutes (252 seconds)
- Low Idle – 3.0 minutes (180 seconds)
- Total – 60.0 minutes (3600 seconds)

Once the 60 minute long cycle is completed, the engine repeats the cycle for 7 more events for approximately 8 hrs. This process continues until either a scheduled emissions test or manufacturer’s recommended maintenance is required. Figure 3 depicts three hours (3 cycles) of actual service accumulation. The manufacturer’s recommended oil change interval is at 10 hours for initial break in and every 50 hours thereafter. ♣CES monitored and added oil as needed every 8 hr interval and changed oil at approximately 50 hour intervals. Looking at the cycle, it should be noted that ♣CES warms the engine for 2 minutes before beginning an 8 hr cycle. The engine then ramps to rated speed over 10 seconds followed by stabilization at 100% load for 314 seconds, then ramps to 10% load for 242, then ramps to 75% load for 720 seconds, then ramps to 25% load for 1080 seconds, then ramps to 50% load for 1044 seconds, and finally ramps back to rated to renew the cycle. The ramping process transitions over the first 10 seconds of each load change.

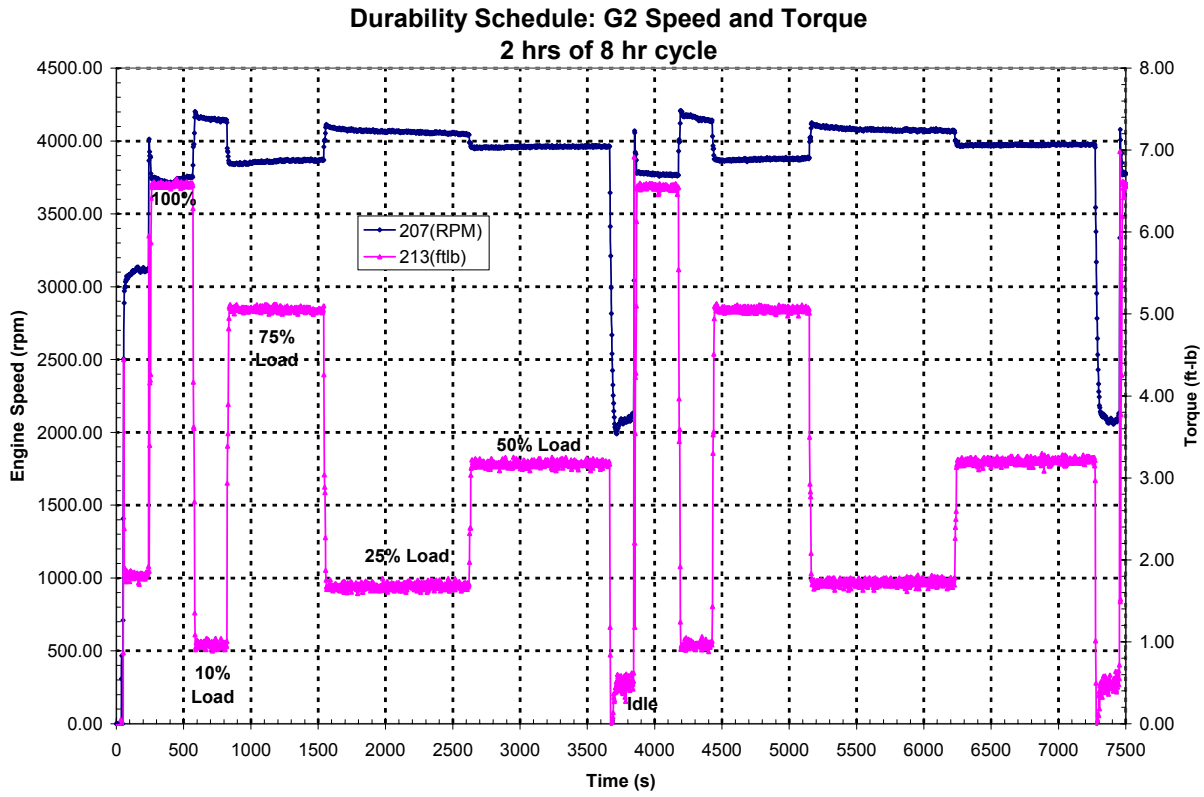


FIGURE 3. Two Hours of Actual Service Accumulation



RESULTS

Emissions Test Results

The EPA/CARB B-Cycle (ISO 8178-G2) weighted steady-state emissions results for 0, 62.5, and 125 hours accumulation are shown in Table 3, along with the date tested and the maximum average power achieved. Complete data sheets for these results are included in Appendix A.

TABLE 3. EPA/CARB B-Cycle (ISO 8178-G2) Steady-State Emissions Results

Test No.	Test Hours	Test Date	Power [Bhp]	BSCO [g/kW-h]	BSHC [g/kW-h]	BSNOx [g/kW-h]	BS(HC+NOx) [g/kW-h]
T1B	4.61	12/13/06	4.76	215.68	3.66	0.43	4.09
T62A	61.9	12/19/06	4.89	246.62	3.02	0.45	3.47
T125A	124.37	12/22/06	4.76	293.15	3.35	0.44	3.79

The emission results are summarized in Figure 4, which shows the emissions as a function of time along with the linear regression curve fit used to determine the deterioration factor (DF) for the engine assuming a 125 hour useful life (UL).

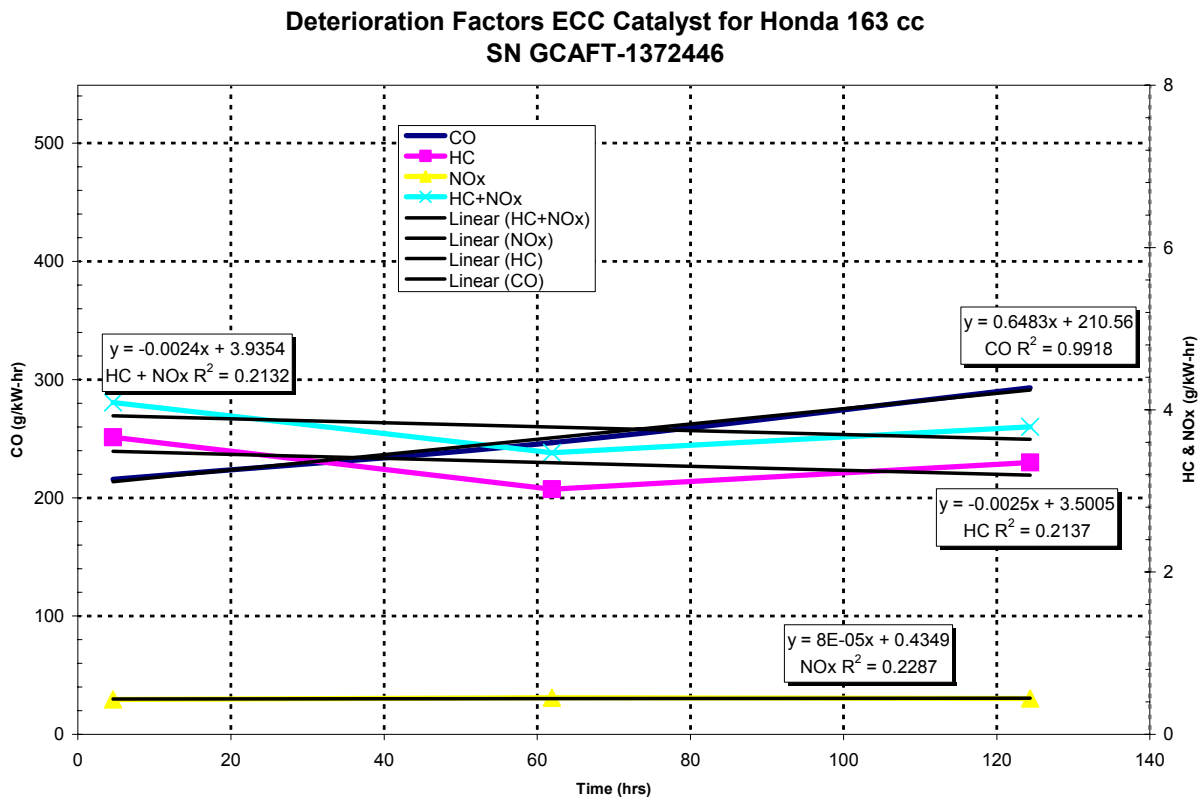


FIGURE 4. Emissions Results as a Function of Service Hour Accumulation

The actual multiplicative deterioration factors (DF) calculated from the data are shown below in Table 4.

TABLE 4. Deterioration Factors Assuming 125 Hour Useful Life

Emissions	BSCO	BSHC	BSNOx	BS(HC+NOx)
DF	1.3849	1.0000	1.0229	1.0000

Applying the DFs in table 4 to the zero hour emissions in table 3 yields the certification levels shown in Table 5. The EPA and CARB standards for a Class I engine for calendar years 2007 and later are shown in Table 6. Based on these results, the Honda GX160 163cc with the ECC catalytic muffler has demonstrated that the emissions meet EPA and CARB requirements.

TABLE 5. CERTIFICATION VALUES FOR 125 hr MODERATE USE

Test	BS Emissions, [g/kW-hr]		Deterioration Factors		Certification Values, [g/kW-hr] (DFs Applied)	
	CO	HC+NOx	CO	HC+NOx	CO	HC+NOx
T1B	215.7	4.09	1.385	1.000	298.7	4.09

TABLE 6. EMISSION STANDARDS 2007+ (CLASS I)

Standard	Displacement	Emission Standards, [g/kW-hr]	
		CO	HC+NOx
EPA	>100 to <225cc	610	16.1
CARB	>80 to <225cc	549	10.0

Should ECC decide to continue durability to 250 hr useful life at a later date, the Certification values are extrapolated to those found in Table 7. All emission values appear to still meet 2007+ emission standards.

TABLE 7. EST. CERTIFICATION VALUES FOR 125 hr INTERMEDIATE USE

Test	BS Emissions, [g/kW-hr]		Deterioration Factors		Certification Values, [g/kW-hr] (DFs Applied)	
	CO	HC+NOx	CO	HC+NOx	CO	HC+NOx
T1B	215.7	4.09	1.780	1.000	383.8	4.09

CARNOT EMISSION SERVICES

APPENDIX A

ECC Honda 160GX Emissions Test Results

163cc Model



CARNOT EMISSION SERVICES
EPA/CARB B-Cycle (ISO 8178 - G2) EMISSION TEST RESULTS
CES PROJECT: P-288
Environmental Control Corp.

ENGINE IDENTIFICATION			FUEL/OIL INFORMATION			TEST CELL INFORMATION		
Engine Manufacturer:	Honda		Fuel ID:	UTG 96 EPA Protocol Cert Fuel		Test Cell/Stand:	1A	
Engine Model Number:	GX160		H/C Ratio:	1.835		Test Operator:	TG	
Engine Serial Number:	GCAFT-1372446		Engine Cycle:	Otto - 4-stroke		Test Date:	12/13/06	
Engine Displacement [cc/in^3]:	163	9.9	Oil Type:	Havoline: SAE 10W-30		Start Test:	14:26:04	
Emission Ctrl System:	EM		Comments:			Test No:	T1A	
Rated/Idle Speed:	3600	1800	Comments:			Engine Start Hr./Duration:	4.61	1.17

MODE	TARGET			MEASURED				FUEL FLOW [lb/hr]	INLET AIR CONDITIONS			TEST FACTORS			
	Speed [rpm]	Load [%]	Torque [ft-lb]	Time [sec]	Speed [rpm]	Torque [ft-lb]	Torque [% Target]		Temp [deg F]	Dew Point [deg F]	Baro [in-hg]	Dry-Wet Correction	NOx Correction	Humidity	Particulate F Factor
1	3600	100	6.94	120.0	3600	6.94	0.00	2.77	72.7	33.3	29.239	0.995	0.892	4.08	1.000
2	3600	75	5.21	120.0	3879	5.22	0.15	2.22	72.7	33.7	29.235	0.983	0.893	4.13	1.001
3	3600	50	3.47	120.0	3906	3.48	0.17	1.82	72.7	33.9	29.229	0.996	0.894	4.17	1.001
4	3600	25	1.74	120.0	3943	1.75	0.84	1.34	72.7	34.1	29.226	0.995	0.894	4.20	1.001
5	3600	10	0.69	120.0	3954	0.66	-4.96	1.08	72.7	34.2	29.223	0.986	0.894	4.23	1.001
6	1800	0	na	120.0	1465	0.41	na	0.49	72.7	33.9	29.223	1.002	0.894	4.17	1.001

MODE	BHP from Work [hp]	DILUTE SAMPLE EMISSIONS				
		CO [ppm]	CO2 [%]	HC [ppm]	NOx [ppm]	PM [mg]
1	4.76	3174.9	0.76	25.3	3.9	0.000
2	3.85	2276.9	0.91	23.2	8.0	0.000
3	2.59	2303.1	0.70	24.1	2.2	0.000
4	1.31	2479.6	0.74	27.0	0.9	0.000
5	0.50	1487.8	0.65	16.3	0.5	0.000
6	0.11	3474.7	0.25	186.2	0.7	0.000

DILUTION RATIO
12.09
11.42
13.82
13.04
15.97
20.57

MODE	DILUTE SAMPLE MASS FLOW					
	PDP Flow [scfm]	CO [g/hr]	CO2 [g/hr]	HC [g/hr]	NOx [g/hr]	PM [g/hr]
1	118.8	746.0	2787.9	8.81	1.33	#DIV/0!
2	89.8	404.4	2534.8	6.12	2.08	#DIV/0!
3	89.9	409.5	1954.0	6.35	0.58	#DIV/0!
4	62.4	305.9	1437.3	4.95	0.17	#DIV/0!
5	62.4	183.6	1262.6	2.98	0.09	#DIV/0!
6	34.8	239.1	265.8	19.02	0.07	#DIV/0!

MODE	WEIGHT FACTOR	WEIGHTED SAMPLE MASS FLOW				
		CO [g/hr]	CO2 [g/hr]	HC [g/hr]	NOx [g/hr]	PM [g/hr]
1	0.09	67.14	250.9	0.79	0.12	#DIV/0!
2	0.20	80.89	507.0	1.22	0.42	#DIV/0!
3	0.29	118.75	566.7	1.84	0.17	#DIV/0!
4	0.30	91.76	431.2	1.48	0.05	#DIV/0!
5	0.07	12.86	88.38	0.21	0.01	#DIV/0!
6	0.05	11.95	13.29	0.95	0.00	#DIV/0!
SUM	1.00	383.35	1857.4	6.50	0.77	#DIV/0!

WEIGHTED POWER [hp]
0.43
0.77
0.75
0.39
0.03
0.01
2.38

COMPOSITE BRAKE EMISSIONS			
BSCO	= 160.83	g/hp-hr	= 215.68 g/kW-hr
BSCO2	= 779.3	g/hp-hr	= 1045.02 g/kW-hr
BSHC	= 2.73	g/hp-hr	= 3.66 g/kW-hr
BSNOx	= 0.32	g/hp-hr	= 0.43 g/kW-hr
BS(HC+NOx)	= 3.05	g/hp-hr	= 4.09 g/kW-hr
BSPM	= #DIV/0!	g/hp-hr	= #DIV/0! g/kW-hr
BSFC	= 0.723	lb/hp-hr	= 0.440 kg/kW-hr

MODE	PERCENT CONTRIBUTION					
	CO [%]	CO2 [%]	HC [%]	NOx [%]	HC+NOx [%]	PM [%]
1	17.5%	13.5%	12.2%	15.7%	12.6%	#DIV/0!
2	21.1%	27.3%	18.8%	54.5%	22.6%	#DIV/0!
3	31.0%	30.5%	28.3%	22.1%	27.7%	#DIV/0!
4	23.9%	23.2%	22.8%	6.5%	21.1%	#DIV/0!
5	3.4%	4.8%	3.2%	0.9%	3.0%	#DIV/0!
6	3.1%	0.7%	14.6%	0.5%	13.1%	#DIV/0!

MODE	CORR. FACTOR	CORR. POWER [bhp]	WATER VAPOR [°Hg]	TEMPERATURES		
				EXH. [deg F]	CELL [deg F]	OIL [deg F]
1	1.0028	4.77	0.190	#DIV/0!	73.7	251.6
2	1.0031	3.86	0.193	#DIV/0!	73.2	243.8
3	1.0034	2.60	0.194	#DIV/0!	72.5	214.7
4	1.0036	1.32	0.196	#DIV/0!	72.1	197.3
5	1.0037	0.50	0.197	#DIV/0!	71.7	186.3
6	1.0037	0.11	0.194	#DIV/0!	70.8	153.9

Equivalent Zero Hour Test Report

CARNOT EMISSION SERVICES

ECC Honda 160GX Emissions Test Results

163cc Model



CARNOT EMISSION SERVICES
EPA/CARB B-Cycle (ISO 8178 - G2) EMISSION TEST RESULTS
CES PROJECT: P-288
Environmental Control Corp.

ENGINE IDENTIFICATION				FUEL/OIL INFORMATION				TEST CELL INFORMATION			
Engine Manufacturer:	Honda			Fuel ID:	UTG 96 EPA Protocol Cert Fuel			Test Cell/Stand:	1A		
Engine Model Number:	GX160			H/C Ratio:	1.835			Test Operator:	TG/MC		
Engine Serial Number:	GCAFT-1372446			Engine Cycle:	Otto - 4-stroke			Test Date:	12/19/06		
Engine Displacement [cc/in³]:	163	9.9		Oil Type:	Havoline: SAE 10W-30			Start Test:	8:43:46		
Emission Ctrl System:	EM			Comments:				Test No:	T62A		
Rated/Idle Speed:	3600	1800		Comments:				Engine Start Hr./Duration:	61.90	0.97	

TARGET				MEASURED				FUEL FLOW	INLET AIR CONDITIONS			TEST FACTORS			
MODE	Speed [rpm]	Load [%]	Torque [ft-lb]	Time [sec]	Speed [rpm]	Torque [ft-lb]	Torque [% Target]	[lb/hr]	Temp [deg F]	Dew Point [deg F]	Baro [in-hg]	Correction	Correction	Humidity	N/A
1	3600	100	7.13	120.0	3601	7.13	0.00	2.53	69.7	56.8	29.347	0.996	0.988	10.02	1.002
2	3600	75	5.35	120.0	3836	5.39	0.85	2.04	71.9	57.1	29.349	0.974	0.989	10.11	1.005
3	3600	50	3.57	120.0	3941	3.50	-1.70	1.77	70.5	57.0	29.349	0.997	0.989	10.09	1.003
4	3600	25	1.78	120.0	4033	1.81	1.46	1.40	68.1	57.1	29.351	0.996	0.990	10.13	1.000
5	3600	10	0.71	120.0	4166	0.74	3.50	1.18	67.9	57.1	29.343	0.976	0.990	10.13	1.000
6	1800	0	na	120.0	2097	0.59	na	0.66	77.9	59.9	29.350	1.000	1.009	11.20	1.015

MODE	BHP	DILUTE SAMPLE EMISSIONS				
	from Work [hp]	CO [ppm]	CO2 [%]	HC [ppm]	NOx [ppm]	PM [mg]
1	4.89	3225.1	0.65	23.1	3.9	0.000
2	3.94	2466.8	0.79	20.5	7.8	0.000
3	2.63	2624.7	0.63	20.2	2.0	0.000
4	1.39	3298.5	0.70	24.2	0.9	0.000
5	0.59	2300.9	0.64	17.4	0.5	0.000
6	0.23	4534.3	0.37	116.9	0.7	0.000

DILUTION RATIO
13.31
12.41
14.32
12.55
14.84
15.36

DILUTE SAMPLE MASS FLOW					
PDP Flow [scfm]	CO [g/hr]	CO2 [g/hr]	HC [g/hr]	NOx [g/hr]	PM [g/hr]
120.1	766.2	2409.1	8.15	1.50	#DIV/0!
90.5	441.7	2230.4	5.44	2.27	#DIV/0!
90.8	471.3	1786.6	5.38	0.59	#DIV/0!
62.6	408.6	1363.2	4.45	0.17	#DIV/0!
62.8	285.9	1242.6	3.20	0.10	#DIV/0!
35.4	317.1	409.9	12.13	0.08	#DIV/0!

MODE	WEIGHT FACTOR	WEIGHTED SAMPLE MASS FLOW				
		CO [g/hr]	CO2 [g/hr]	HC [g/hr]	NOx [g/hr]	PM [g/hr]
1	0.09	68.96	216.8	0.73	0.14	#DIV/0!
2	0.20	88.33	446.1	1.09	0.45	#DIV/0!
3	0.29	136.67	518.1	1.56	0.17	#DIV/0!
4	0.30	122.58	409.0	1.34	0.05	#DIV/0!
5	0.07	20.01	86.98	0.22	0.01	#DIV/0!
6	0.05	15.85	20.49	0.61	0.00	#DIV/0!
SUM	1.00	452.41	1697.5	5.55	0.82	#DIV/0!

WEIGHTED POWER
0.44
0.79
0.76
0.42
0.04
0.01
2.46

COMPOSITE BRAKE EMISSIONS			
BSCO	= 183.90	g/hp-hr	= 246.62 g/kW-hr
BSCO2	= 690.0	g/hp-hr	= 925.33 g/kW-hr
BSHC	= 2.26	g/hp-hr	= 3.02 g/kW-hr
BSNOx	= 0.33	g/hp-hr	= 0.45 g/kW-hr
BS(HC+NOx)	= 2.59	g/hp-hr	= 3.47 g/kW-hr
BSPM	= #DIV/0!	g/hp-hr	= #DIV/0! g/kW-hr
BSFC	= 0.685	lb/hp-hr	= 0.417 kg/kW-hr

MODE	PERCENT CONTRIBUTION					
	CO %	CO2 %	HC %	NOx %	HC+NOx %	PM %
1	15.2%	12.8%	13.2%	16.5%	13.6%	#DIV/0!
2	19.5%	26.3%	19.6%	55.2%	24.2%	#DIV/0!
3	30.2%	30.5%	28.1%	20.7%	27.2%	#DIV/0!
4	27.1%	24.1%	24.1%	6.3%	21.8%	#DIV/0!
5	4.4%	5.1%	4.0%	0.9%	3.6%	#DIV/0!
6	3.5%	1.2%	10.9%	0.5%	9.6%	#DIV/0!

MODE	CORR. FACTOR	CORR. POWER [bhp]	WATER VAPOR [°Hg]	TEMPERATURES EXH. [deg F]	TEMPERATURES CELL [deg F]	TEMPERATURES OIL [deg F]
	1	1.0063	4.92	0.465	1104.6	75.3
2	1.0089	3.97	0.469	1039.0	75.3	232.9
3	1.0073	2.65	0.468	930.7	75.4	216.3
4	1.0045	1.40	0.470	836.7	75.4	197.2
5	1.0047	0.59	0.470	814.6	75.4	187.8
6	1.0177	0.24	0.519	545.6	76.0	167.3

MANUFACTURER DECLARATIONS			
RATED POWER	=	4.0	kW @ 3600 rpm
PEAK TORQUE	=		N-m @ 2500 rpm
DECLARED IDLE	=	N/A	@ N/A rpm

	EMISSION STANDARDS (g/kW-hr)			Honda Cert Values
	EPA 2004 +	CARB 2002-2006	CARB 2007 +	2006
BSCO	610	549.0	549.0	403.27
BS(HC+NOx)	16.1	16.1	10.0	11.58
BSPM				

Equivalent Mid-Hour (62.5 hr) Test Report

CARNOT EMISSION SERVICES

ECC Honda 160GX Emissions Test Results

163cc Model



CARNOT EMISSION SERVICES
 EPA/CARB B-Cycle (ISO 8178 - G2) EMISSION TEST RESULTS
 CES PROJECT: P-288
 Environmental Control Corp.

ENGINE IDENTIFICATION				FUEL/OIL INFORMATION				TEST CELL INFORMATION			
Engine Manufacturer:	Honda			Fuel ID:	UTG 96 EPA Protocol Cert Fuel			Test Cell/Stand:	1A		
Engine Model Number:	GX160			H/C Ratio:	1.835			Test Operator:	TG		
Engine Serial Number:	GCAFT-1372446			Engine Cycle:	Otto - 4-stroke			Test Date:	12/22/06		
Engine Displacement [cc/in³]:	163	9.9		Oil Type:	Havoline: SAE 10W-30			Start Test:	8:49:12		
Emission Ctrl System:	EM			Comments:				Test No:	T125A		
Rated/Idle Speed:	3600	1800		Comments:				Engine Start Hr./Duration:	124.14	1.40	

TARGET				MEASURED				FUEL FLOW	INLET AIR CONDITIONS			TEST FACTORS				
MODE	Speed [rpm]	Load [%]	Torque [ft-lb]	Time [sec]	Speed [rpm]	Torque [ft-lb]	Torque [% Target]	[lb/hr]	Temp [deg F]	Dew Point [deg F]	Baro [in-hg]	Correction	Correction	Humidity	Particulate	F Factor
1	3600	100	6.94	120.0	3600	6.94	0.00	2.74	94.6	32.3	29.288	0.996	0.890	3.90	1.027	
2	3600	75	5.20	120.0	3736	5.27	1.28	2.08	61.4	32.1	29.297	0.984	0.889	3.87	0.983	
3	3600	50	3.47	120.0	3861	3.51	1.24	1.83	82.8	32.5	29.298	0.997	0.890	3.94	1.011	
4	3600	25	1.73	120.0	3979	1.69	-2.32	1.40	88.8	32.1	29.302	0.996	0.889	3.86	1.019	
5	3600	10	0.69	120.0	4278	0.81	16.68	1.26	72.5	32.0	29.304	0.985	0.889	3.86	0.998	
6	1800	0	na	120.0	2567	0.59	na	0.74	56.5	32.0	29.304	0.998	0.889	3.86	0.976	

MODE	BHP from Work [hp]	DILUTE SAMPLE EMISSIONS				
		CO [ppm]	CO2 [%]	HC [ppm]	NOx [ppm]	PM [mg]
1	4.76	3951.1	0.66	26.6	3.8	0.000
2	3.75	2709.2	0.79	23.0	8.5	0.000
3	2.58	3048.9	0.62	23.5	2.2	0.000
4	1.28	3655.1	0.64	25.6	0.8	0.000
5	0.66	2760.9	0.62	18.2	0.5	0.000
6	0.29	4409.3	0.50	68.4	0.6	0.000

DILUTION RATIO
12.19
12.18
13.86
12.74
14.23
13.63

DILUTE SAMPLE MASS FLOW					
PDP Flow [scfm]	CO [g/hr]	CO2 [g/hr]	HC [g/hr]	NOx [g/hr]	PM [g/hr]
119.5	934.1	2445.2	9.34	1.33	#DIV/0!
90.4	484.3	2218.1	6.10	2.21	#DIV/0!
91.0	548.8	1744.7	6.29	0.58	#DIV/0!
63.8	461.0	1276.8	4.80	0.15	#DIV/0!
64.2	350.7	1245.3	3.43	0.10	#DIV/0!
35.8	312.1	551.5	7.19	0.06	#DIV/0!

MODE	WEIGHT FACTOR	WEIGHTED SAMPLE MASS FLOW				
		CO [g/hr]	CO2 [g/hr]	HC [g/hr]	NOx [g/hr]	PM [g/hr]
1	0.09	84.07	220.1	0.84	0.12	#DIV/0!
2	0.20	96.87	443.6	1.22	0.44	#DIV/0!
3	0.29	159.16	506.0	1.82	0.17	#DIV/0!
4	0.30	138.29	383.0	1.44	0.05	#DIV/0!
5	0.07	24.55	87.17	0.24	0.01	#DIV/0!
6	0.05	15.60	27.57	0.36	0.00	#DIV/0!
SUM	1.00	518.53	1667.4	5.92	0.79	#DIV/0!

WEIGHTED POWER [hp]
0.43
0.75
0.75
0.39
0.05
0.01
2.37

COMPOSITE BRAKE EMISSIONS			
BSCO	= 218.60	g/hp-hr	= 293.15 g/kW-hr
BSCO2	= 703.0	g/hp-hr	= 942.68 g/kW-hr
BSHC	= 2.50	g/hp-hr	= 3.35 g/kW-hr
BSNOx	= 0.33	g/hp-hr	= 0.44 g/kW-hr
BS(HC+NOx)	= 2.83	g/hp-hr	= 3.79 g/kW-hr
BSPM	= #DIV/0!	g/hp-hr	= #DIV/0! g/kW-hr
BSFC	= 0.733	lb/hp-hr	= 0.446 kg/kW-hr

MODE	PERCENT CONTRIBUTION					
	CO %	CO2 %	HC %	NOx %	HC+NOx %	PM %
1	16.2%	13.2%	14.2%	15.2%	14.3%	#DIV/0!
2	18.7%	26.6%	20.6%	56.3%	24.8%	#DIV/0!
3	30.7%	30.3%	30.8%	21.4%	29.7%	#DIV/0!
4	26.7%	23.0%	24.3%	5.8%	22.1%	#DIV/0!
5	4.7%	5.2%	4.1%	0.9%	3.7%	#DIV/0!
6	3.0%	1.7%	6.1%	0.4%	5.4%	#DIV/0!

MODE	CORR. FACTOR	CORR. POWER [bhp]	WATER VAPOR [°Hg]	TEMPERATURES		
				EXH. [deg F]	CELL [deg F]	OIL [deg F]
1	1.0249	4.87	0.183	1029.0	76.5	242.5
2	0.9872	3.70	0.181	979.7	73.9	227.7
3	1.0114	2.61	0.184	883.3	74.7	212.8
4	1.0178	1.31	0.181	804.5	77.5	193.3
5	0.9995	0.66	0.181	792.0	77.7	189.7
6	0.9813	0.28	0.181	576.3	75.0	170.3

MANUFACTURER DECLARATIONS			
RATED POWER	=	4.0	kW @ 3600 rpm
PEAK TORQUE	=		N-m @ 2500 rpm
DECLARED IDLE	=	N/A	@ N/A rpm

	EMISSION STANDARDS (g/kW-hr)			Honda Cert Values
	EPA 2004 +	CARB 2002-2006	CARB 2007 +	2006
BSCO	610	549.0	549.0	403.27
BS(HC+NOx)	16.1	16.1	10.0	11.58
BSPM				

Equivalent Final-Hour (125 hr) Test Report

APPENDIX B

Additional Power Curve performed with Reduced Throttle

Do to the nature of the catalyst, the engine runs at a higher no-load speed than with the manufacturer's supplied muffler. Consequently, the Power Map was shifted from the declared Maximum output of 4.0 kW (5.5 bhp) at 3,600 rpm. Therefore, it was determined that no-load (high idle) engine conditions would be set by reducing the throttle lever to conditions typically seen on engines of this displacement. A power curve was run under these conditions and the power maps are shown below.

