



Team Results for Clean Snowmobile Challenge 2013 Team 9



2012 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

Test Date : 2013/03/08 10:45:08
Team Name : ETS
Team Number : 9
Model : Rotax
Engine : 600 ACE
Displacement[cc] : 594.00
100% Speed : 6144
100% Torque : 71.9
No of Strokes : 4
Fuel : GASOLINE H/C: 2.50 O/C: 0.28

ModeNum	:	1	2	3	4	5
Weighting	:	0.12	0.27	0.25	0.31	0.05
Power kW	:	46.0	20.4	11.5	6.0	0.0
HC_m g/hr	:	246.04	57.53	4.63	2.20	0.59
CO_m g/hr	:	14310.19	4023.50	91.22	20.93	0.70
NOx_m g/hr	:	34.66	17.32	7.01	1.73	0.17
Soot_m mg/hr	:	230.24	28.84	0.68	0.87	0.12
N2O_m mg/hr	:	0.00	0.00	0.02	0.01	0.00
CO2_m g/hr	:	34229.23	19044.66	14388.88	9379.03	3307.97
CH4_m g/hr	:	52.26	11.81	1.99	1.13	0.36
W_HC g/hr	:	29.53	15.53	1.16	0.68	0.03
W_CO g/hr	:	1717.22	1086.34	22.80	6.49	0.04
W_NOx g/hr	:	4.16	4.68	1.75	0.54	0.01
W_HCNOx g/hr	:	33.68	20.21	2.91	1.22	0.04
W_Soot mg/hr	:	27.63	7.79	0.17	0.27	0.01
W_N2O g/hr	:	0.00	0.00	0.01	0.00	0.00
W_CO2 g/hr	:	4107.51	5142.06	3597.22	2907.50	165.40
W_CH4 g/hr	:	6.27	3.19	0.50	0.35	0.02

Total Weighted Power [kW] 15.766

Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	46.93	2832.90	11.13	58.06
Specific Mass [g/kW-hr]	2.98	179.68	0.71	3.68
BSFC [g/kW-hr]	426.6			

Total Soot [mg/hr] 35.86 Specific Soot [mg/kW-hr] 2.27

Not Used for Competition

Total N2O [mg/hr]	0.01	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	15919.68	Specific CO2 [g/kW-hr]	1009.74
Total CH4 [g/hr]	10.33	Specific CH4 [g/kW-hr]	0.65

EMISSION TESTS:

	Value	Limit	Result
Power	46.29	<96.94 kW	PASS
Soot	2.27	<100 mg/kW-hr	PASS
CO	179.68	<275 g/kW-hr	PASS
HC + NOX	3.68	<90 g/kW-hr	PASS
E-Score	162.62	>100	PASS
Valid Data for All 5 Modes			PASS

LAB EMISSION TEST PASS



Team Results for Clean Snowmobile Challenge 2013 Team 9



Modal Raw Data : Engine / Environmental

ModeNum		1	2	3	4	5
Total Points	points	1100	1200	1200	1200	919
PtsInMode	points	1200	1800	1800	1800	1519
Speed	rpm	6081.01	5222.22	4608.36	3993.19	2116.40
Torque	Nm	72.21	37.38	23.82	14.31	0.00
Power	kW	45.98	20.44	11.50	5.98	0.00
BSFC	g/kw-hr	412.71	412.67	417.89	520.01	**
Fuel	g/hr	18978.00	8435.81	4804.47	3110.86	1093.54
T_int	degC	14.73	14.84	14.31	14.57	15.43
RelHumid	%	21.54	19.44	18.97	18.80	18.75
Baro	in Hg	29.23	29.22	29.22	29.22	29.22
Baro	mmHg	742.35	742.29	742.26	742.26	742.20
Pvap_kPa	kPa	0.32	0.29	0.27	0.28	0.29
Pvap_inHg	inHg	0.09	0.09	0.08	0.08	0.09
AbsHumidity	grains/lb	14.07	12.77	12.09	12.16	12.74
SatPres	kPa	98.65	98.67	98.69	98.68	98.66
Hum Factor		0.78	0.77	0.77	0.77	0.77
F_fac		0.98	0.98	0.98	0.98	0.98
K_fac		1.00	1.00	1.00	1.00	1.00
Humidity	g/kg	2.01	1.82	1.73	1.74	1.82
H2		3.16	1.72	0.05	0.02	0.00
WetDry Factor		0.84	0.84	0.84	0.84	0.84



Team Results for Clean Snowmobile Challenge 2013 Team 9



Modal Emissions Concentrations

ModeNum		1	2	3	4	5
THC	ppmC1	1846.46	944.45	122.80	89.88	68.18
CO	%	5.57	3.43	0.13	0.04	0.00
N2O	ppm	0.00	0.00	1.87	0.81	0.03
CH4	ppm	356.32	176.08	47.99	42.04	37.99
CO2	%	8.48	10.33	12.59	12.66	12.68
O2	%	0.00	0.00	0.00	0.00	0.06
CNOx	ppm	82.19	89.83	58.66	22.40	6.37
AHC	ppm	47.83	21.89	0.01	0.00	0.00
C2H2	ppm	19.25	3.58	2.06	2.01	1.74
C2H4	ppm	176.84	70.90	2.94	1.42	0.69
C3H6	ppm	24.99	3.57	0.03	0.04	0.01
C4H6	ppm	8.11	17.64	1.34	0.71	0.08
ETOH	ppm	110.86	65.05	7.40	3.92	2.01
H2O	%	15.91	16.27	16.30	16.19	16.02
HCHO	ppm	15.57	4.29	0.90	0.67	0.54
HCN	ppm	47.07	75.92	1.48	1.14	0.85
HNCO	ppm	2.13	17.94	1.94	1.34	0.47
MECHO	ppm	64.72	29.61	1.70	0.31	0.11
NC5	ppm	52.52	33.38	5.64	2.90	1.90
NH3	ppm	108.97	391.90	24.37	16.22	0.25
NO	ppm	105.67	116.43	76.47	29.52	8.78
NO2	ppm	0.05	0.01	0.00	0.00	0.00
Soot	mg/m3	1.08	0.28	0.01	0.02	0.01
AFR	:1	8.36	9.36	10.76	10.80	10.86



Team Results for Clean Snowmobile Challenge 2013 Team 9



Measurement Accuracy (SAE paper 961804)

	H2_XLS %	ModalHC_Dry %	ModalFTIR_H2O %	N2 %	Ar %	AFR :1	Tr_Eff -
1	3.761	0.220	15.905	79.466	0.919	12.452	1.000
2	2.050	0.113	16.274	83.791	0.969	13.645	1.000
3	0.063	0.015	16.297	86.570	1.001	15.357	1.000
4	0.022	0.011	16.194	86.431	0.999	15.400	1.000
5	0.002	0.008	16.024	86.277	0.997	15.470	0.997

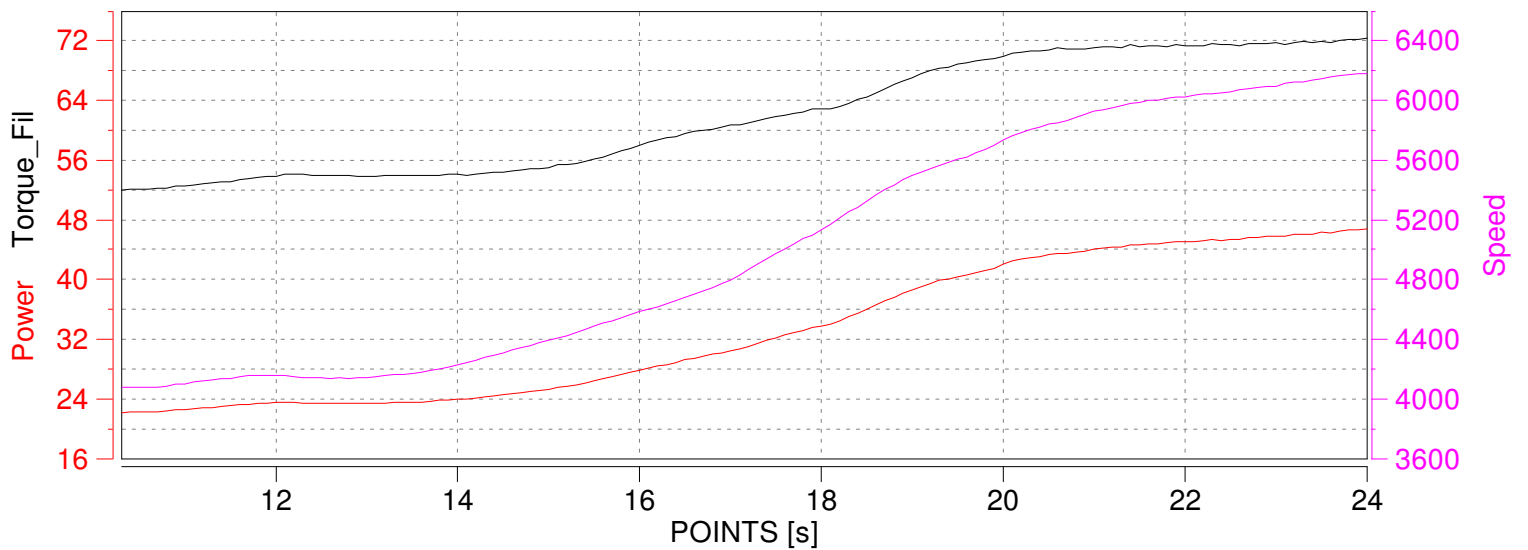
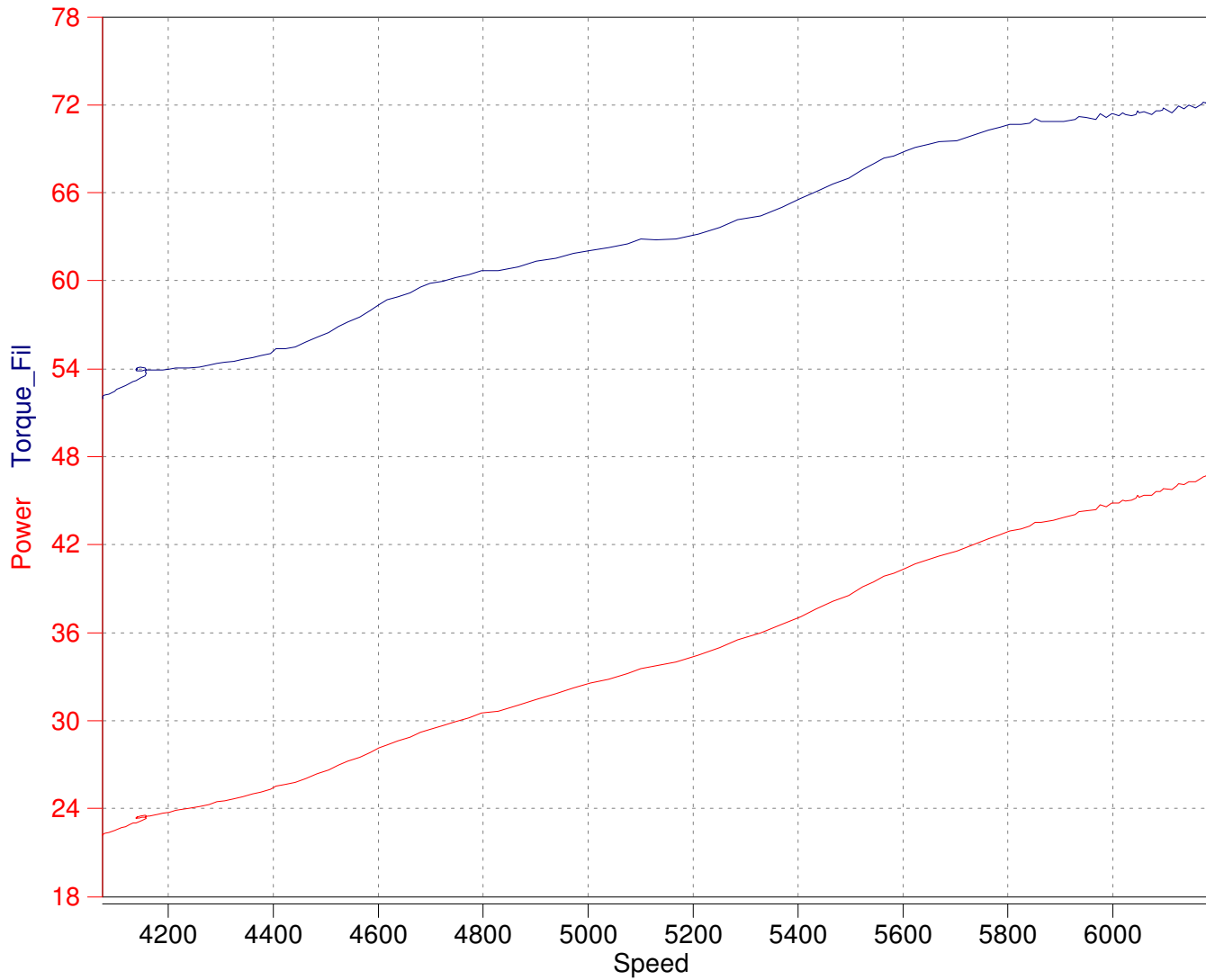
ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
246.044	0.220	0.027	0.247	101.121	1.121
57.530	0.113	0.014	0.127	103.378	3.378
4.635	0.015	0.002	0.017	102.853	2.853
2.199	0.011	0.001	0.012	102.630	2.630
0.587	-0.041	-0.005	-0.046	102.414	2.414

Power Run

Team 9

TeamNumber	9
TeamName	ETS
Model	Rotax
Engine	600 ACE

Displacement cc	594.00
RatedSpeed	6144
RatedTorque	71.9





Team Results for Clean Snowmobile Challenge 2013 Team 9 ECO



2012 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

Test Date : 2013/03/08 09:58:54
Team Name : ETS
Team Number : 9
Model : Rotax
Engine : 600 ACE
Displacement[cc] : 594.00
100% Speed : 6159
100% Torque : 70.6
No of Strokes : 4
Fuel : GASOLINE H/C: 2.50 O/C: 0.28

ModeNum	:	1	2	3	4	5
Weighting	:	0.12	0.27	0.25	0.31	0.05
Power kW	:	41.5	19.8	11.5	5.5	0.0
HC_m g/hr	:	161.67	72.99	11.81	4.91	1.43
CO_m g/hr	:	11573.93	3919.45	495.16	24.19	0.46
NOx_m g/hr	:	54.03	24.60	8.76	1.08	0.42
Soot_m mg/hr	:	134.65	21.42	2.35	0.53	0.09
N2O_m mg/hr	:	0.00	0.00	0.08	0.01	0.00
CO2_m g/hr	:	32605.25	18871.14	14026.67	9080.93	2839.71
CH4_m g/hr	:	39.78	11.27	3.55	1.31	0.73
W_HC g/hr	:	19.40	19.71	2.95	1.52	0.07
W_CO g/hr	:	1388.87	1058.25	123.79	7.50	0.02
W_NOx g/hr	:	6.48	6.64	2.19	0.34	0.02
W_HCNOx g/hr	:	25.88	26.35	5.14	1.86	0.09
W_Soot mg/hr	:	16.16	5.78	0.59	0.16	0.00
W_N2O g/hr	:	0.00	0.00	0.02	0.00	0.00
W_CO2 g/hr	:	3912.63	5095.21	3506.67	2815.09	141.99
W_CH4 g/hr	:	4.77	3.04	0.89	0.40	0.04

Total Weighted Power [kW] 14.882

Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	43.66	2578.43	15.67	59.33
Specific Mass [g/kW-hr]	2.93	173.26	1.05	3.99
BSFC [g/kW-hr]	440.6			

Total Soot [mg/hr] 22.70 Specific Soot [mg/kW-hr] 1.53

Not Used for Competition

Total N2O [mg/hr]	0.02	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	15471.58	Specific CO2 [g/kW-hr]	1039.60
Total CH4 [g/hr]	9.14	Specific CH4 [g/kW-hr]	0.61

EMISSION TESTS:

	Value	Limit	Result
Power	45.56	<96.94 kW	PASS
Soot	1.53	<100 mg/kW-hr	PASS
CO	173.26	<275 g/kW-hr	PASS
HC + NOX	3.99	<90 g/kW-hr	PASS
E-Score	164.03	>100	PASS
Valid Data for All 5 Modes			PASS

LAB EMISSION TEST PASS



Team Results for Clean Snowmobile Challenge 2013 Team 9 ECO



Modal Raw Data : Engine / Environmental

ModeNum		1	2	3	4	5
Total Points	points	418	1200	1200	1200	1200
PtsInMode	points	791	1800	1800	1800	1800
Speed	rpm	6026.64	5234.04	4619.41	4003.87	1836.80
Torque	Nm	65.71	36.04	23.81	13.03	0.00
Power	kW	41.47	19.75	11.52	5.46	0.00
BSFC	g/kw-hr	408.40	422.21	425.64	552.33	**
Fuel	g/hr	16937.23	8339.97	4901.64	3016.80	939.60
T_int	degC	11.13	9.71	11.07	10.17	10.21
RelHumid	%	22.29	21.88	22.24	21.35	21.62
Baro	in Hg	29.25	29.25	29.25	29.25	29.25
Baro	mmHg	742.90	742.95	742.89	742.85	742.84
Pvap_kPa	kPa	0.27	0.24	0.27	0.24	0.25
Pvap_inHg	inHg	0.08	0.07	0.08	0.07	0.07
AbsHumidity	grains/lb	11.81	10.66	11.74	10.69	10.85
SatPres	kPa	98.78	98.81	98.78	98.80	98.79
Hum Factor		0.77	0.77	0.77	0.77	0.77
F_fac		0.97	0.97	0.97	0.97	0.97
K_fac		0.99	0.99	0.99	0.99	0.99
Humidity	g/kg	1.69	1.52	1.68	1.53	1.55
H2		2.84	1.69	0.29	0.02	0.00
WetDry Factor		0.84	0.84	0.84	0.84	0.84



Team Results for Clean Snowmobile Challenge 2013 Team 9 ECO



Modal Emissions Concentrations

ModeNum		1	2	3	4	5
THC	ppmC1	1393.84	1216.85	308.90	207.03	192.19
CO	%	5.18	3.39	0.67	0.05	0.00
N2O	ppm	0.00	0.00	6.64	0.86	0.10
CH4	ppm	311.58	170.67	84.28	49.98	89.27
CO2	%	9.28	10.39	12.11	12.64	12.59
O2	%	0.00	0.00	0.00	0.00	0.20
CNOx	ppm	147.18	129.58	72.35	14.40	17.65
AHC	ppm	30.34	47.14	9.68	2.69	0.17
C2H2	ppm	10.88	5.69	2.47	2.20	1.87
C2H4	ppm	140.53	74.90	7.49	1.70	1.44
C3H6	ppm	16.31	6.26	0.01	0.05	0.04
C4H6	ppm	10.14	18.40	10.07	0.88	0.13
ETOH	ppm	91.74	86.03	18.57	6.90	2.48
H2O	%	16.07	16.21	16.42	16.19	15.88
HCHO	ppm	10.29	5.82	1.20	0.68	0.73
HCN	ppm	61.57	95.26	7.81	1.36	0.85
HNCO	ppm	9.16	21.31	14.17	1.21	0.50
MECHO	ppm	46.89	39.05	2.97	1.77	0.17
NC5	ppm	34.77	78.57	28.18	14.03	7.32
NH3	ppm	207.34	430.08	268.64	17.19	0.16
NO	ppm	192.22	169.05	94.27	18.93	23.44
NO2	ppm	0.03	0.02	0.00	0.00	0.00
Soot	mg/m3	0.69	0.21	0.04	0.01	0.01
AFR	:1	8.68	9.32	10.51	10.77	10.90



Team Results for Clean Snowmobile Challenge 2013 Team 9 ECO



Measurement Accuracy (SAE paper 961804)

	H2_XLS %	ModalHC_Dry %	ModalFTIR_H2O %	N2 %	Ar %	AFR :1	Tr_Eff -
1	3.384	0.166	16.073	82.570	0.954	12.799	1.000
2	2.021	0.145	16.209	83.844	0.969	13.643	1.000
3	0.348	0.037	16.422	85.974	0.994	15.057	1.000
4	0.026	0.025	16.192	86.333	0.998	15.381	1.000
5	0.002	0.023	15.877	86.105	0.995	15.557	0.990

	ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
	161.667	0.166	0.021	0.187	104.351	4.351
	72.994	0.145	0.018	0.163	103.465	3.465
	11.814	0.037	0.005	0.042	102.665	2.665
	4.913	0.025	0.003	0.028	102.530	2.530
	1.431	-0.127	-0.016	-0.143	102.170	2.170

Power Run

Team 9 ECO

TeamNumber	9
TeamName	ETS
Model	Rotax
Engine	600 ACE

Displacement cc	594.00
RatedSpeed	6159
RatedTorque	70.6

