



Team Results for Clean Snowmobile Challenge 2019 Team 6



2019 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

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Test Date       : 2019/03/06 15:45:20
Team Name      : Michigan Tech
Team Number    : 6
Model          : R1
Engine         : Yamaha
Displacement[cc] : 1049.00
100% Speed    : 8186
100% Torque    : 55.8
No of Strokes  : 4
Fuel           : Gas
                H/C: 1.95      O/C: 0.00
  
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ModeNum	:	1	2	3	4	5	RMC
Weighting	:	0.12	0.27	0.25	0.31	0.05	1.00
Power	kW :	48.6	20.8	12.3	6.2	0.0	15.7
HC_m	g/hr :	155.84	12.18	16.20	40.99	16.63	14.30
CO_m	g/hr :	608.36	275.26	329.41	506.98	136.95	412.87
NOx_m	g/hr :	154.32	12.73	3.65	1.39	0.01	16.15
Soot_m	mg/hr :	5.46	2.68	5.53	20.36	0.38	8.40
N2O_m	mg/hr :	0.15	0.02	0.01	0.01	0.00	0.03
CO2_m	g/hr :	42141.21	21308.09	16249.59	10959.06	2671.37	19117.80
CH4_m	g/hr :	5.40	2.45	2.22	3.89	1.09	3.22
W_HC	g/hr :	18.70	3.29	4.05	12.71	0.83	14.30
W_CO	g/hr :	73.00	74.32	82.35	157.16	6.85	412.87
W_NOx	g/hr :	18.52	3.44	0.91	0.43	0.00	16.15
W_HCNOx	g/hr :	37.22	6.73	4.96	13.14	0.83	30.45
W_Soot	mg/hr :	0.66	0.72	1.38	6.31	0.02	8.40
W_N2O	g/hr :	0.02	0.00	0.00	0.00	0.00	0.03
W_CO2	g/hr :	5056.95	5753.18	4062.40	3397.31	133.57	19117.80
W_CH4	g/hr :	0.65	0.66	0.56	1.20	0.05	3.22

Total Weighted Power [kW] 16.462

Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	39.58	393.69	23.30	62.88
Specific Mass [g/kW-hr]	2.40	23.92	1.42	3.82
BSFC [g/kW-hr]	420.2			

Total Soot [mg/hr] 9.09 Specific Soot [mg/kW-hr] 0.55

Not Used for Competition

Total N2O [mg/hr]	0.03	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	18403.40	Specific CO2 [g/kW-hr]	1117.95
Total CH4 [g/hr]	3.12	Specific CH4 [g/kW-hr]	0.19
RMC BSFC [g/kW-hr]	399.92		

EMISSION TESTS:

	Value	Limit	Result
Power	47.87	<96.94 kW	PASS
Soot	0.55	<50 mg/kW-hr	PASS
CO	23.92	<275 g/kW-hr	PASS
HC + NOX	3.82	<90 g/kW-hr	PASS
E-Score	201.47	>175	PASS
Valid Data for All 5 Modes			PASS
RMC			PASS
LAB EMISSION TEST			PASS



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Modal Raw Data : Engine / Environmental

ModeNum		1	2	3	4	5	RMC
Total Points	points	600	1520	1200	1200	1200	11431
PtsInMode	points	1210	3370	3470	1800	1480	11431
Speed	rpm	8185.73	6957.23	6139.28	5111.92	1631.07	6167.66
Torque	Nm	56.68	28.57	19.17	11.62	0.00	24.36
Power	kW	48.59	20.82	12.33	6.22	0.00	15.73
BSFC	g/kw-hr	284.86	332.23	433.28	606.59	**	399.92
Fuel	g/hr	13841.54	6916.01	5340.70	3774.04	933.26	6291.25
T_int	degC	27.57	34.67	36.32	33.37	38.24	33.73
RelHumid	%	17.37	13.46	13.66	14.53	12.80	14.45
Baro	in Hg	28.91	28.91	28.91	28.91	28.91	28.91
Baro	mmHg	734.34	734.28	734.34	734.34	734.28	734.31
Pvap_kPa	kPa	0.52	0.57	0.63	0.58	0.65	0.59
Pvap_inHg	inHg	0.15	0.17	0.19	0.17	0.19	0.17
AbsHumidity	grains/lb	23.12	25.74	28.38	26.05	29.21	26.38
SatPres	kPa	97.39	97.32	97.27	97.32	97.24	97.31
Hum Factor		0.80	0.81	0.82	0.81	0.82	0.81
F_fac		1.02	1.04	1.05	1.04	1.05	1.04
K_fac		1.03	1.05	1.05	1.04	1.05	1.04
Humidity	g/kg	3.30	3.68	4.05	3.72	4.17	3.77
H2		0.10	0.09	0.14	0.32	0.35	0.15
WetDry Factor		0.86	0.87	0.87	0.87	0.87	1.00



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Modal Emissions Concentrations

ModeNum		1	2	3	4	5	RMC
THC	ppmC1	1538.33	239.63	414.08	1510.39	2496.84	310.44
CO	%	0.30	0.27	0.42	0.93	1.03	0.45
N2O	ppm	4.86	1.02	0.69	1.42	1.59	2.35
CH4	ppm	46.59	42.04	49.62	125.10	142.55	61.11
CO2	%	13.21	13.31	13.19	12.82	12.74	13.18
O2	%	0.02	0.00	0.00	0.00	0.00	-0.01
CNOx	ppm	462.77	76.10	28.35	15.58	0.26	106.56
AHC	ppm	19.95	0.00	0.00	3.67	12.50	3.01
C2H2	ppm	2.21	0.55	0.71	2.24	0.58	0.99
C2H4	ppm	16.91	2.27	5.47	35.84	5.54	10.20
C3H6	ppm	15.37	0.70	3.32	17.14	1.52	5.70
C4H6	ppm	5.38	5.02	5.88	8.13	3.60	5.70
ETOH	ppm	2.99	3.82	5.12	5.17	3.45	4.11
H2O	%	14.18	13.14	13.04	12.81	12.72	0.00
HCHO	ppm	0.36	0.00	0.00	0.07	1.72	0.51
HCN	ppm	1.74	0.66	0.60	0.60	0.57	0.75
HNCO	ppm	4.56	2.45	2.68	3.11	1.55	2.71
MECHO	ppm	0.93	0.00	0.00	0.00	0.00	0.26
NC5	ppm	14.58	3.62	5.82	14.09	44.36	18.57
NH3	ppm	90.06	127.26	149.82	179.02	100.11	135.92
NO	ppm	575.95	94.23	34.98	19.47	0.42	131.19
NO2	ppm	0.09	0.02	0.05	0.06	0.06	0.05
Soot	mg/m3	0.03	0.03	0.08	0.43	0.03	0.10
AFR	:1	14.12	14.51	14.39	13.83	13.51	14.41



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Measurement Accuracy (SAE paper 961804)

ModeNum	H2_XLS %	ModalHC_Dry %	ModalFTIR_H2O %	N2 %	Ar %	AFR :1	Tr_Eff -
1	0.115	0.179	14.177	84.466	0.976	14.407	0.999
2	0.102	0.028	13.145	82.062	0.949	14.531	1.000
3	0.160	0.048	13.044	81.589	0.943	14.441	1.000
4	0.364	0.173	12.805	80.525	0.931	14.093	1.000
5	0.402	0.286	12.721	80.144	0.926	13.950	1.000

ModeNum	ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
1	155.842	0.167	0.021	0.188	101.571	1.571
2	12.181	0.028	0.003	0.031	98.792	1.208
3	16.201	0.048	0.006	0.054	98.400	1.600
4	40.985	0.173	0.022	0.195	97.794	2.206
5	16.627	0.286	0.036	0.322	97.565	2.435

Carbon Balance Verification

		1	2	3	4	5	6
Power	kW	48.590	20.817	12.326	6.222	0.000	15.731
BSFC	g/kw-hr	284.86	332.23	433.28	606.59	**	399.92
Fuel_MassFlow	g/hr	13842	6916	5341	3774	933	6291
HC_m	g/hr	155.84	12.18	16.20	40.99	16.63	14.30
CO_m	g/hr	608.36	275.26	329.41	506.98	136.95	412.87
CO2_m	g/hr	42141	21308	16250	10959	2671	19118
TW_Power	kW	16.462					
TW_BSFC	g/kw-hr	420.25					
Fuel_MassFlow	g/hr	13842	6916	5341	3774	933	6291
FuelCalc	g/hr	13867	6918	5343	3781	936	6293
FuelCalcDev	%	-0.18229	-0.02693	-0.04773	-0.17570	-0.28947	-0.03527

\$HCR_ENG	1.949
\$OCR_ENG	0
MassFracCFuel H/C ratio	0.85943

Power Run

Team 6

TeamNumber	6
TeamName	Michigan Tech
Model	R1
Engine	Yamaha

Displacement cc	1049.00
RatedSpeed	8186
RatedTorque	55.8

