



Team Results for Clean Snowmobile Challenge 2019 Team 2



2019 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

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Test Date       : 2019/03/06 14:42:06
Team Name      : UMD
Team Number    : 2
Model          : Ranger
Engine         : Polaris
Displacement[cc] : 1000.00
100% Speed    : 7803
100% Torque   : 60.6
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 :	49.5	21.5	12.4	6.1	0.0	16.1
HC_m	g/hr :	20.31	14.96	7.83	4.69	0.39	3.67
CO_m	g/hr :	646.22	360.95	246.39	173.84	0.02	305.07
NOx_m	g/hr :	55.29	16.56	4.71	2.14	0.69	10.80
Soot_m	mg/hr:	182.92	17.82	2.52	1.19	0.72	13.88
N2O_m	mg/hr:	0.06	0.04	0.02	0.01	0.00	0.03
CO2_m	g/hr :	45239.28	23329.67	16605.83	11562.78	3062.85	20482.03
CH4_m	g/hr :	3.25	3.53	2.16	1.16	0.22	2.58
W_HC	g/hr :	2.44	4.04	1.96	1.45	0.02	3.67
W_CO	g/hr :	77.55	97.46	61.60	53.89	0.00	305.07
W_NOx	g/hr :	6.63	4.47	1.18	0.66	0.03	10.80
W_HCNOx	g/hr :	9.07	8.51	3.14	2.12	0.05	14.47
W_Soot	mg/hr:	21.95	4.81	0.63	0.37	0.04	13.88
W_N2O	g/hr :	0.01	0.01	0.00	0.00	0.00	0.03
W_CO2	g/hr :	5428.71	6299.01	4151.46	3584.46	153.14	20482.03
W_CH4	g/hr :	0.39	0.95	0.54	0.36	0.01	2.58

Total Weighted Power [kW] 16.692

Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	9.91	290.49	12.98	22.89
Specific Mass [g/kW-hr]	0.59	17.40	0.78	1.37
BSFC [g/kW-hr]	433.5			

Total Soot [mg/hr] 27.79 Specific Soot [mg/kW-hr] 1.67

Not Used for Competition

Total N2O [mg/hr]	0.02	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	19616.79	Specific CO2 [g/kW-hr]	1175.22
Total CH4 [g/hr]	2.25	Specific CH4 [g/kW-hr]	0.14
RMC BSFC [g/kW-hr]	413.13		

EMISSION TESTS:

	Value	Limit	Result
Power	49.49	<96.94 kW	PASS
Soot	1.67	<50 mg/kW-hr	PASS
CO	17.40	<275 g/kW-hr	PASS
HC + NOX	1.37	<90 g/kW-hr	PASS
E-Score	204.74	>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	11432
PtsInMode	points	1210	3370	3470	1800	1480	11432
Speed	rpm	7803.73	6632.52	5853.61	5073.67	1510.17	5908.27
Torque	Nm	60.52	30.89	20.16	11.39	0.00	26.06
Power	kW	49.46	21.45	12.36	6.05	0.00	16.12
BSFC	g/kw-hr	297.41	354.43	437.34	621.85	**	413.13
Fuel	g/hr	14708.70	7603.50	5404.03	3763.25	973.02	6660.06
T_int	degC	26.99	22.27	22.29	24.39	21.91	23.29
RelHumid	%	13.91	16.53	18.70	14.81	17.98	16.16
Baro	in Hg	28.90	28.91	28.91	28.91	28.91	28.91
Baro	mmHg	734.18	734.25	734.24	734.22	734.21	734.22
Pvap_kPa	kPa	0.40	0.37	0.42	0.37	0.40	0.38
Pvap_inHg	inHg	0.12	0.11	0.12	0.11	0.12	0.11
AbsHumidity	grains/lb	17.95	16.58	18.79	16.65	17.70	17.14
SatPres	kPa	97.48	97.52	97.47	97.51	97.49	97.50
Hum Factor		0.79	0.78	0.79	0.78	0.79	0.79
F_fac		1.02	1.01	1.01	1.01	1.01	1.01
K_fac		1.03	1.02	1.02	1.03	1.02	1.03
Humidity	g/kg	2.56	2.37	2.68	2.38	2.53	2.45
H2		0.10	0.11	0.10	0.10	0.00	0.10
WetDry Factor		0.87	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	191.14	270.36	198.72	170.08	52.12	75.21
CO	%	0.30	0.33	0.31	0.31	0.00	0.31
N2O	ppm	1.81	2.22	1.32	1.07	1.56	1.77
CH4	ppm	26.73	55.74	47.90	36.65	26.25	46.22
CO2	%	13.52	13.39	13.38	13.32	13.05	13.32
O2	%	0.00	0.00	0.00	0.00	0.82	0.06
CNOx	ppm	158.03	90.91	36.31	23.63	28.21	67.21
AHC	ppm	5.18	0.00	0.00	0.00	0.00	0.45
C2H2	ppm	0.63	0.46	0.43	0.45	0.36	0.48
C2H4	ppm	2.64	4.24	2.62	2.88	0.24	3.23
C3H6	ppm	0.67	0.82	0.31	0.26	0.62	0.55
C4H6	ppm	3.33	3.99	5.13	4.92	0.70	4.52
ETOH	ppm	3.63	3.32	4.15	3.48	2.37	3.66
H2O	%	13.21	13.24	13.26	13.23	12.65	0.00
HCHO	ppm	0.00	0.00	0.00	0.00	0.00	0.00
HCN	ppm	1.48	1.38	1.12	1.02	0.15	1.34
HNCO	ppm	2.19	3.07	2.56	2.37	1.29	2.81
MECHO	ppm	0.01	0.01	0.01	0.00	0.00	0.01
NC5	ppm	10.40	2.20	1.72	2.43	1.18	3.11
NH3	ppm	69.25	102.99	129.92	124.28	5.32	111.44
NO	ppm	201.17	116.61	46.64	30.86	36.44	86.19
NO2	ppm	0.04	0.09	0.01	0.00	0.02	0.07
Soot	mg/m3	0.96	0.18	0.04	0.02	0.05	0.16
AFR	:1	14.52	14.48	14.51	14.52	15.32	14.59



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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	0.022	13.206	83.209	0.962	14.530	1.000
2	0.124	0.031	13.244	82.765	0.957	14.504	1.000
3	0.119	0.023	13.256	82.698	0.956	14.515	1.000
4	0.120	0.020	13.234	82.399	0.952	14.516	1.000
5	0.000	0.006	12.654	82.635	0.955	15.296	0.958

ModeNum	ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
1	20.314	0.019	0.002	0.021	100.259	0.259
2	14.960	0.031	0.004	0.035	99.701	0.299
3	7.834	0.023	0.003	0.026	99.582	0.418
4	4.689	0.020	0.002	0.022	99.209	0.791
5	0.388	-0.617	-0.077	-0.694	98.784	1.216

Carbon Balance Verification

		1	2	3	4	5	6
Power	kW	49.455	21.453	12.357	6.052	0.000	16.121
BSFC	g/kw-hr	297.41	354.43	437.34	621.85	**	413.13
Fuel_MassFlow	g/hr	14709	7604	5404	3763	973	6660
HC_m	g/hr	20.314	14.960	7.834	4.689	0.388	3.672
CO_m	g/hr	646.22	360.95	246.39	173.84	0.02	305.07
CO2_m	g/hr	45239	23330	16606	11563	3063	20482
TW_Power	kW	16.692					
TW_BSFC	g/kw-hr	433.49					
Fuel_MassFlow	g/hr	14709	7604	5404	3763	973	6660
FuelCalc	g/hr	14712	7606	5405	3764	973	6661
FuelCalcDev	%	-0.020711	-0.030302	-0.021833	-0.018499	-0.004682	-0.007137

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

Power Run

Team 2

TeamNumber	2
TeamName	UMD
Model	Ranger
Engine	Polaris

Displacement cc	1000.00
RatedSpeed	7803
RatedTorque	60.6

