



Team Results for Clean Snowmobile Challenge 2019 Team 111



2019 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

```

Test Date       : 2019/03/05 12:21:41
Team Name      : Michigan Tech
Team Number    : 111
Model          : KDW
Engine         : Kohler
Displacement[cc] : 993.00
100% Speed    : 3832
100% Torque   : 49.4
No of Strokes : 4
Fuel           : Diesel
                H/C: 1.81      O/C: 0.00
  
```

ModeNum	1	2	3	4	5	RMC
Weighting	0.12	0.27	0.25	0.31	0.05	1.00
Power kW	20.7	8.6	4.9	2.5	0.0	6.4
HC_m g/hr	93.53	2.61	4.49	8.47	0.54	3.91
CO_m g/hr	16.08	0.04	5.38	1.16	2.15	3.65
NOx_m g/hr	82.52	63.04	52.09	44.51	27.71	58.68
Soot_m mg/hr	1.48	1.16	1.09	0.86	0.36	-1.02
N2O_m mg/hr	0.06	0.02	0.02	0.02	0.01	0.03
CO2_m g/hr	18679.43	9785.23	6445.17	4321.43	1717.54	8247.49
CH4_m g/hr	0.89	0.10	0.07	0.11	0.03	0.18
W_HC g/hr	11.22	0.70	1.12	2.62	0.03	3.91
W_CO g/hr	1.93	0.01	1.35	0.36	0.11	3.65
W_NOx g/hr	9.90	17.02	13.02	13.80	1.39	58.68
W_HCNOx g/hr	21.13	17.73	14.14	16.42	1.41	62.59
W_Soot mg/hr	0.18	0.31	0.27	0.27	0.02	-1.02
W_N2O g/hr	0.01	0.01	0.01	0.01	0.00	0.03
W_CO2 g/hr	2241.53	2642.01	1611.29	1339.64	85.88	8247.49
W_CH4 g/hr	0.11	0.03	0.02	0.03	0.00	0.18

Total Weighted Power [kW] 6.797

Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	15.70	3.75	55.13	70.83
Specific Mass [g/kW-hr]	2.31	0.55	8.11	10.42
BSFC [g/kW-hr]	407.5			

Total Soot [mg/hr] 1.05 Specific Soot [mg/kW-hr] 0.15

Not Used for Competition

Total N2O [mg/hr]	0.03	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	7920.36	Specific CO2 [g/kW-hr]	1165.25
Total CH4 [g/hr]	0.19	Specific CH4 [g/kW-hr]	0.03
RMC BSFC [g/kW-hr]	408.43		

EMISSION TESTS:

	Value	Limit	Result
Power	19.81	<96.94 kW	PASS
Soot	0.15	<50 mg/kW-hr	PASS
CO	0.55	<275 g/kW-hr	PASS
HC + NOX	10.42	<90 g/kW-hr	PASS
E-Score	202.91	>175	PASS
Valid Data for All 5 Modes			PASS
RMC			PASS
LAB EMISSION TEST			PASS



**Team Results for
Clean Snowmobile Challenge 2019
Team 111**



Modal Raw Data : Engine / Environmental

ModeNum		1	2	3	4	5	RMC
Total Points	points	600	1411	1200	1200	1200	11432
PtsInMode	points	1210	3370	3470	1800	1480	11432
Speed	rpm	3831.64	3266.13	2874.37	2490.48	1190.57	2940.94
Torque	Nm	51.69	25.12	16.32	9.41	0.00	20.66
Power	kW	20.74	8.59	4.91	2.45	0.00	6.36
BSFC	g/kw-hr	288.00	358.34	413.75	557.30	**	408.43
Fuel	g/hr	5972.89	3078.38	2033.02	1367.37	541.47	2598.11
T_int	degC	21.42	39.80	37.28	40.74	24.49	35.49
RelHumid	%	17.07	15.01	14.79	17.42	13.55	15.53
Baro	in Hg	28.76	28.76	28.77	28.76	28.77	28.76
Baro	mmHg	730.42	730.56	730.71	730.44	730.72	730.54
Pvap_kPa	kPa	0.37	0.82	0.72	1.00	0.34	0.69
Pvap_inHg	inHg	0.11	0.24	0.21	0.30	0.10	0.20
AbsHumidity	grains/lb	16.44	37.20	32.37	45.26	15.38	31.14
SatPres	kPa	97.01	96.57	96.70	96.38	97.08	96.70
Hum Factor		0.78	0.85	0.83	0.88	0.78	0.83
F_fac		1.01	1.06	1.05	1.07	1.02	1.05
K_fac		1.03	1.06	1.06	1.06	1.03	1.05
Humidity	g/kg	2.35	5.31	4.62	6.47	2.20	4.45
H2		0.00	0.00	0.00	0.00	0.00	0.00
WetDry Factor		0.92	0.95	0.96	0.96	0.97	1.00



**Team Results for
Clean Snowmobile Challenge 2019
Team 111**



Modal Emissions Concentrations

ModeNum		1	2	3	4	5	RMC
THC	ppmC1	1320.00	46.10	99.19	233.89	25.09	74.76
CO	%	0.01	0.00	0.01	0.00	0.00	0.00
N2O	ppm	2.71	1.34	1.51	2.04	0.91	1.88
CH4	ppm	10.91	1.52	1.36	2.55	1.14	3.01
CO2	%	8.29	5.44	4.48	3.75	2.51	4.95
O2	%	8.06	12.32	13.76	14.83	16.06	13.64
CNOx	ppm	350.22	335.08	346.39	369.77	387.72	336.92
AHC	ppm	68.62	0.39	0.08	11.03	0.00	10.09
C2H2	ppm	0.55	0.37	0.36	0.37	0.26	0.40
C2H4	ppm	2.09	2.33	6.75	7.37	1.38	4.60
C3H6	ppm	3.94	0.32	1.28	0.44	0.35	0.89
C4H6	ppm	0.01	0.23	0.27	0.16	0.15	0.20
ETOH	ppm	4.78	1.37	1.23	2.03	0.96	1.78
H2O	%	7.90	5.21	4.36	3.69	2.83	0.00
HCHO	ppm	7.55	0.00	0.00	0.36	0.00	1.33
HCN	ppm	2.52	0.03	0.02	0.04	0.02	0.25
HNCO	ppm	5.21	1.52	1.35	1.37	1.26	1.72
MECHO	ppm	11.54	0.00	0.03	0.38	0.00	1.78
NC5	ppm	88.25	3.34	2.68	14.06	1.84	14.14
NH3	ppm	2.42	0.02	0.25	0.09	0.08	0.36
NO	ppm	445.75	393.68	415.44	421.01	495.69	405.52
NO2	ppm	0.87	0.97	0.35	0.46	0.50	0.85
Soot	mg/m3	0.01	0.01	0.01	0.01	0.01	-0.01
AFR	:1	23.13	37.10	44.89	53.04	78.10	41.87



**Team Results for
Clean Snowmobile Challenge 2019
Team 111**



Measurement Accuracy (SAE paper 961804)

ModeNum	H2_XLS %	ModalHC_Dry %	ModalFTIR_H2O %	N2 %	Ar %	AFR :1	Tr_Eff -
1	0.004	0.143	7.895	80.834	0.934	23.808	0.600
2	0.000	0.005	5.213	79.476	0.919	37.086	0.397
3	0.002	0.010	4.363	79.142	0.915	44.995	0.330
4	0.000	0.024	3.690	78.710	0.910	53.580	0.281
5	0.002	0.003	2.826	76.452	0.884	78.093	0.226

ModeNum	ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
1	93.526	-3.519	-0.440	-3.958	95.626	4.374
2	2.608	-3.455	-0.432	-3.887	95.287	4.713
3	4.485	-3.138	-0.392	-3.530	95.647	4.353
4	8.467	-2.797	-0.350	-3.146	95.811	4.189
5	0.539	-2.006	-0.251	-2.256	94.247	5.753

Carbon Balance Verification

		1	2	3	4	5	6
Power	kW	20.739	8.591	4.914	2.454	0.000	6.361
BSFC	g/kw-hr	288.00	358.34	413.75	557.30	**	408.43
Fuel_MassFlow	g/hr	5972.9	3078.4	2033.0	1367.4	541.5	2598.1
HC_m	g/hr	93.526	2.608	4.485	8.467	0.539	3.915
CO_m	g/hr	16.083	0.040	5.384	1.157	2.149	3.649
CO2_m	g/hr	18679	9785	6445	4321	1718	8247
TW_Power	kW	6.7971					
TW_BSFC	g/kw-hr	407.52					
Fuel_MassFlow	g/hr	5972.9	3078.4	2033.0	1367.4	541.5	2598.1
FuelCalc	g/hr	5987.0	3078.7	2033.7	1368.6	541.5	2598.7
FuelCalcDev	%	-0.23579	-0.01104	-0.03166	-0.09214	-0.01329	-0.02105

\$HCR_ENG	1.808
\$OCR_ENG	0
MassFracCFuel H/C ratio	0.86826

Power Run

Team 111

TeamNumber	111
TeamName	Michigan Tech
Model	KDW
Engine	Kohler

Displacement cc	993.00
RatedSpeed	3832
RatedTorque	49.4

