



Team Results for Clean Snowmobile Challenge 2019 Team 107



2019 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

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Test Date       : 2019/03/04 19:46:08
Team Name      : South Dakota
Team Number    : 107
Model         : D902
Engine        : Kubota
Displacement[cc] : 898.00
100% Speed    : 3520
100% Torque   : 43.0
No of Strokes : 4
Fuel          : Diesel
                H/C: 1.81      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 :	15.6	6.9	3.9	2.0	0.0	5.0
HC_m	g/hr :	1.06	0.19	0.27	0.33	0.16	0.15
CO_m	g/hr :	0.84	0.02	0.00	0.04	0.00	1.20
NOx_m	g/hr :	36.73	37.45	31.54	25.06	17.41	33.49
Soot_m	mg/hr:	104.14	18.41	7.67	16.87	1.66	26.73
N2O_m	mg/hr:	0.02	0.02	0.02	0.02	0.01	0.02
CO2_m	g/hr :	17739.67	7496.17	5286.26	3686.34	1323.73	6788.92
CH4_m	g/hr :	0.05	0.03	0.04	0.04	0.03	0.04
W_HC	g/hr :	0.13	0.05	0.07	0.10	0.01	0.15
W_CO	g/hr :	0.10	0.00	0.00	0.01	0.00	1.20
W_NOx	g/hr :	4.41	10.11	7.88	7.77	0.87	33.49
W_HCNOx	g/hr :	4.53	10.16	7.95	7.87	0.88	33.64
W_Soot	mg/hr:	12.50	4.97	1.92	5.23	0.08	26.73
W_N2O	g/hr :	0.00	0.01	0.00	0.01	0.00	0.02
W_CO2	g/hr :	2128.76	2023.97	1321.57	1142.77	66.19	6788.92
W_CH4	g/hr :	0.01	0.01	0.01	0.01	0.00	0.04

Total Weighted Power [kW] 5.310

Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	0.36	0.12	31.04	31.40
Specific Mass [g/kW-hr]	0.07	0.02	5.85	5.91
BSFC [g/kW-hr]	425.2			

Total Soot [mg/hr] 24.70 Specific Soot [mg/kW-hr] 4.65

Not Used for Competition

Total N2O [mg/hr]	0.02	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	6683.24	Specific CO2 [g/kW-hr]	1258.70
Total CH4 [g/hr]	0.04	Specific CH4 [g/kW-hr]	0.01
RMC BSFC [g/kW-hr]	427.66		

EMISSION TESTS:

	Value	Limit	Result
Power	15.84	<96.94 kW	PASS
Soot	4.65	<50 mg/kW-hr	PASS
CO	0.02	<275 g/kW-hr	PASS
HC + NOX	5.91	<90 g/kW-hr	PASS
E-Score	206.05	>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	3519.88	2992.83	2639.65	2289.07	1176.03	2710.16
Torque	Nm	42.34	21.88	14.15	8.18	0.00	17.59
Power	kW	15.61	6.86	3.91	1.96	0.00	4.99
BSFC	g/kw-hr	357.38	343.63	424.94	591.33	**	427.66
Fuel	g/hr	5577.50	2356.44	1661.88	1159.06	416.24	2134.67
T_int	degC	13.49	17.81	15.74	17.55	14.29	15.88
RelHumid	%	13.48	10.84	11.17	12.89	11.47	11.74
Baro	in Hg	28.66	28.66	28.66	28.66	28.66	28.66
Baro	mmHg	728.01	727.95	727.89	728.02	727.90	727.96
Pvap_kPa	kPa	0.19	0.19	0.17	0.22	0.17	0.19
Pvap_inHg	inHg	0.05	0.06	0.05	0.07	0.05	0.05
AbsHumidity	grains/lb	8.35	8.57	7.86	10.05	7.44	8.33
SatPres	kPa	96.87	96.86	96.87	96.84	96.88	96.87
Hum Factor		0.76	0.76	0.76	0.77	0.76	0.76
F_fac		0.99	1.01	1.00	1.00	1.00	1.00
K_fac		1.02	1.03	1.02	1.02	1.02	1.02
Humidity	g/kg	1.19	1.22	1.12	1.44	1.06	1.19
H2		0.00	0.00	0.00	0.00	0.00	0.00
WetDry Factor		0.88	0.94	0.95	0.96	0.98	1.00



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Modal Emissions Concentrations

ModeNum		1	2	3	4	5	RMC
THC	ppmC1	24.61	5.17	7.95	11.16	7.96	4.16
CO	%	0.00	0.00	0.00	0.00	0.00	0.00
N2O	ppm	1.80	1.62	1.48	1.87	0.96	1.68
CH4	ppm	1.04	0.71	1.06	1.23	1.34	0.99
CO2	%	12.95	6.33	4.82	3.90	2.05	5.89
O2	%	1.20	11.01	13.24	14.55	16.83	12.26
CNOx	ppm	256.52	302.52	275.25	253.86	258.17	277.73
AHC	ppm	0.22	0.71	0.85	0.81	1.31	0.72
C2H2	ppm	0.39	0.08	0.04	0.05	0.03	0.09
C2H4	ppm	0.24	0.24	0.28	0.17	0.24	0.30
C3H6	ppm	0.22	0.31	0.23	0.18	0.20	0.22
C4H6	ppm	0.88	0.44	0.30	0.35	0.46	0.43
ETOH	ppm	2.79	1.30	1.49	1.08	1.34	1.56
H2O	%	12.15	5.97	4.62	3.93	2.43	0.00
HCHO	ppm	0.65	0.37	0.32	0.37	0.15	0.41
HCN	ppm	0.32	0.38	0.31	0.28	0.23	0.33
HNCO	ppm	1.86	1.41	1.32	1.08	1.01	1.33
MECHO	ppm	0.00	0.00	0.00	0.00	0.00	0.00
NC5	ppm	1.01	1.07	1.23	0.80	1.02	1.08
NH3	ppm	0.10	0.03	0.02	0.31	0.02	0.10
NO	ppm	239.98	124.31	140.49	170.01	163.20	158.11
NO2	ppm	96.89	272.59	221.61	161.26	176.95	206.66
Soot	mg/m3	1.37	0.29	0.13	0.33	0.05	0.41
AFR	:1	15.44	31.91	41.96	51.74	96.46	35.33



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Measurement Accuracy (SAE paper 961804)

ModeNum	H2_XLS %	ModalHC_Dry %	ModalFTIR_H2O %	N2 %	Ar %	AFR :1	Tr_Eff -
1	0.000	0.003	12.152	82.613	0.955	15.413	0.939
2	0.000	0.001	5.967	79.782	0.922	31.851	0.459
3	0.000	0.001	4.621	79.131	0.915	41.892	0.354
4	0.000	0.001	3.930	78.813	0.911	51.661	0.294
5	0.000	0.001	2.430	76.581	0.885	96.333	0.190

ModeNum	ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
1	1.059	-0.896	-0.112	-1.008	98.712	1.288
2	0.193	-3.641	-0.455	-4.096	95.093	4.907
3	0.274	-3.265	-0.408	-3.673	95.352	4.648
4	0.331	-2.869	-0.359	-3.227	95.735	4.265
5	0.161	-1.703	-0.213	-1.916	94.940	5.060

Carbon Balance Verification

		1	2	3	4	5	6
Power	kW	15.607	6.857	3.911	1.960	0.000	4.992
BSFC	g/kw-hr	357.38	343.63	424.94	591.33	**	427.66
Fuel_MassFlow	g/hr	5577.5	2356.4	1661.9	1159.1	416.2	2134.7
HC_m	g/hr	1.0593	0.1925	0.2739	0.3312	0.1614	0.1509
CO_m	g/hr	0.8393	0.0178	0.0000	0.0362	0.0019	1.2013
CO2_m	g/hr	17740	7496	5286	3686	1324	6789
TW_Power	kW	5.3096					
TW_BSFC	g/kw-hr	425.21					
Fuel_MassFlow	g/hr	5577.5	2356.4	1661.9	1159.1	416.2	2134.7
FuelCalc	g/hr	5577.6	2356.4	1661.9	1159.1	416.3	2134.7
FuelCalcDev	%	-0.0010652	0.0005769	-0.0006838	-0.0025198	-0.0040656	0.0007446

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

Power Run

Team 107

TeamNumber	107
TeamName	South Dakota
Model	D902
Engine	Kubota

Displacement cc	898.00
RatedSpeed	3520
RatedTorque	43.0

