



# Team Results for Clean Snowmobile Challenge 2018 Team 113



## 2018 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

Test Date : 2018/03/09 09:49:50  
Team Name : South Dakota  
Team Number : 113  
Model : Polaris  
Engine : Kubota Titan  
Displacement[cc] : 898.00  
100% Speed : 3642  
100% Torque : 49.5  
No of Strokes : 4  
Fuel : DIESEL H/C: 1.74 O/C: 0.01

ModeNum	:	1	2	3	4	5	RMC
Weighting	:	0.12	0.27	0.25	0.31	0.05	1.00
Power kW	:	18.5	8.2	4.7	2.3	0.0	6.1
HC_m g/hr	:	0.00	0.00	0.00	0.00	0.00	-0.34
CO_m g/hr	:	0.00	0.00	0.00	0.07	0.00	0.08
NOx_m g/hr	:	56.81	44.36	33.75	26.48	20.32	38.46
Soot_m mg/hr	:	1.56	3.01	1.02	16.88	0.49	6.27
N2O_m mg/hr	:	0.05	0.02	0.02	0.02	0.01	0.02
CO2_m g/hr	:	17560.69	7605.99	5069.92	3318.49	1952.99	6657.64
CH4_m g/hr	:	0.14	0.04	0.05	0.08	0.05	0.07
W_HC g/hr	:	0.00	0.00	0.00	0.00	0.00	-0.34
W_CO g/hr	:	0.00	0.00	0.00	0.02	0.00	0.08
W_NOx g/hr	:	6.82	11.98	8.44	8.21	1.02	38.46
W_HCNOx g/hr	:	6.82	11.98	8.44	8.21	1.02	38.12
W_Soot mg/hr	:	0.19	0.81	0.26	5.23	0.02	6.27
W_N2O g/hr	:	0.01	0.00	0.00	0.00	0.00	0.02
W_CO2 g/hr	:	2107.28	2053.62	1267.48	1028.73	97.65	6657.64
W_CH4 g/hr	:	0.02	0.01	0.01	0.02	0.00	0.07

Total Weighted Power [kW] 6.317

### Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	0.00	0.02	36.46	36.46
Specific Mass [g/kW-hr]	0.00	0.00	5.77	5.77
BSFC [g/kW-hr]	336.8			

Total Soot [mg/hr] 6.51 Specific Soot [mg/kW-hr] 1.03

### Not Used for Competition

Total N2O [mg/hr]	0.02	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	6554.76	Specific CO2 [g/kW-hr]	1037.64
Total CH4 [g/hr]	0.07	Specific CH4 [g/kW-hr]	0.01
RMC BSFC [g/kW-hr]	343.54		

### EMISSION TESTS:

	Value	Limit	Result
Power	18.87	<96.94 kW	PASS
Soot	1.03	<50 mg/kW-hr	PASS
CO	0.00	<275 g/kW-hr	PASS
HC + NOX	5.77	<90 g/kW-hr	PASS
E-Score	206.15	>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	1479	11431
Speed	rpm	3642.36	3095.48	2731.35	2367.52	1851.23	2844.38
Torque	Nm	48.39	25.27	16.32	9.41	0.00	20.34
Power	kW	18.46	8.19	4.67	2.33	0.00	6.06
BSFC	g/kw-hr	297.47	290.35	339.56	444.71	**	343.54
Fuel	g/hr	5490.81	2378.21	1585.24	1037.65	610.66	2081.39
T_int	degC	23.49	24.90	21.41	22.23	20.08	23.36
RelHumid	%	26.30	22.60	19.57	26.49	19.25	23.20
Baro	in Hg	28.82	28.83	28.83	28.82	28.83	28.82
Baro	mmHg	732.09	732.17	732.22	732.14	732.21	732.16
Pvap_kPa	kPa	0.63	0.58	0.42	0.59	0.38	0.55
Pvap_inHg	inHg	0.19	0.17	0.12	0.18	0.11	0.16
AbsHumidity	grains/lb	28.34	26.24	18.80	26.66	17.19	24.80
SatPres	kPa	96.97	97.03	97.20	97.02	97.23	97.06
Hum Factor		0.82	0.81	0.79	0.81	0.79	0.81
F_fac		1.02	1.02	1.01	1.01	1.01	1.02
K_fac		1.03	1.03	1.03	1.03	1.02	1.03
Humidity	g/kg	4.05	3.75	2.69	3.81	2.46	3.54
H2		0.00	0.00	0.00	0.00	0.00	0.00
WetDry Factor		0.89	0.94	0.96	0.96	0.97	1.00



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## Modal Emissions Concentrations

ModeNum		1	2	3	4	5	RMC
THC	ppmC1	0.00	0.00	0.00	0.00	0.00	-8.67
CO	%	0.00	0.00	0.00	0.00	0.00	0.00
N2O	ppm	3.08	1.29	1.48	1.49	0.99	1.71
CH4	ppm	2.49	0.84	1.24	2.02	1.54	1.54
CO2	%	11.36	5.90	4.45	3.16	2.22	5.36
O2	%	3.46	11.58	13.75	15.07	16.55	12.95
CNOx	ppm	351.42	329.24	283.46	241.20	221.32	296.01
AHC	ppm	0.02	0.00	0.00	0.17	0.00	0.08
C2H2	ppm	0.27	0.06	0.02	0.05	0.11	0.09
C2H4	ppm	0.25	0.22	0.14	0.12	0.22	0.35
C3H6	ppm	0.48	0.63	0.51	0.44	0.42	0.53
C4H6	ppm	0.57	0.53	0.32	0.37	0.29	0.43
ETOH	ppm	0.83	1.93	2.09	1.74	1.91	1.81
H2O	%	10.76	5.66	4.37	3.52	2.66	0.00
HCHO	ppm	1.52	0.02	0.00	0.00	0.00	0.23
HCN	ppm	0.22	0.31	0.26	0.20	0.20	0.26
HNCO	ppm	0.88	0.93	0.82	0.85	0.63	0.88
MECHO	ppm	0.00	0.00	0.00	0.00	0.00	0.00
NC5	ppm	2.16	1.36	1.06	2.16	0.83	1.60
NH3	ppm	0.01	0.04	0.05	0.13	0.03	0.05
NO	ppm	292.56	87.20	172.27	142.94	191.97	154.12
NO2	ppm	135.94	317.50	186.06	153.09	89.49	211.74
Soot	mg/m3	0.02	0.04	0.02	0.31	0.01	0.09
AFR	:1	17.26	33.75	44.97	61.68	88.25	38.30



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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	0.000	10.759	81.843	0.946	17.444	0.826
2	0.000	0.000	5.656	79.531	0.919	34.081	0.432
3	0.000	0.000	4.366	79.010	0.913	45.386	0.331
4	0.000	0.000	3.522	76.904	0.889	62.238	0.271
5	0.000	0.000	2.657	76.741	0.887	89.033	0.203

ModeNum	ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
1	0.000	**	**	**	**	**
2	0.000	**	**	**	**	**
3	0.000	**	**	**	**	**
4	0.000	**	**	**	**	**
5	0.000	**	**	**	**	**

## Carbon Balance Verification

		1	2	3	4	5	6
Power	kW	18.458	8.191	4.668	2.333	0.000	6.059
BSFC	g/kw-hr	297.47	290.35	339.56	444.71	**	343.54
Fuel_MassFlow	g/hr	5490.8	2378.2	1585.2	1037.6	610.7	2081.4
HC_m	g/hr	0.00000	0.00000	0.00000	0.00000	0.00000	-0.33704
CO_m	g/hr	0.002805	0.000000	0.000000	0.074740	0.004731	0.077211
CO2_m	g/hr	17561	7606	5070	3318	1953	6658
TW_Power	kW	6.3170					
TW_BSFC	g/kw-hr	336.84					
Fuel_MassFlow	g/hr	5490.8	2378.2	1585.2	1037.6	610.7	2081.4
FuelCalc	g/hr	5548.2	2403.1	1601.8	1048.5	617.0	2103.1
FuelCalcDev	%	-1.0446	-1.0446	-1.0446	-1.0446	-1.0446	-1.0422

\$HCR_ENG	1.736
\$OCR_ENG	0.009
MassFracCFuel H/C ratio	0.86380

# Power Run

Team 113

TeamNumber	113
TeamName	South Dakota
Model	Polaris
Engine	Kubota Titan

Displacement cc	898.00
RatedSpeed	3642
RatedTorque	49.5

