



## Team Results for Clean Snowmobile Challenge 2019 Team 102



### 2019 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

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Test Date       : 2019/03/05 09:30:13
Team Name      : Kettering
Team Number    : 102
Model          : Smart Car Diesel
Engine         : Mercedes
Displacement[cc] : 799.00
100% Speed     : 3778
100% Torque    : 54.0
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 :	22.8	9.3	5.3	2.6	0.0	7.1
HC_m	g/hr :	7.37	2.02	1.11	2.71	0.45	0.89
CO_m	g/hr :	0.33	0.06	0.03	0.62	0.04	0.28
NOx_m	g/hr :	270.03	177.15	106.39	2.46	9.48	113.88
Soot_m	mg/hr:	2.99	3.99	2.30	1.06	0.76	1.78
N2O_m	mg/hr:	0.05	0.03	0.04	0.02	0.03	0.04
CO2_m	g/hr :	24184.48	10611.75	7036.41	4825.63	1630.81	9463.04
CH4_m	g/hr :	0.14	0.05	0.05	0.07	0.08	0.07
W_HC	g/hr :	0.88	0.55	0.28	0.84	0.02	0.89
W_CO	g/hr :	0.04	0.02	0.01	0.19	0.00	0.28
W_NOx	g/hr :	32.40	47.83	26.60	0.76	0.47	113.88
W_HCNOx	g/hr :	33.29	48.38	26.87	1.60	0.50	114.77
W_Soot	mg/hr:	0.36	1.08	0.57	0.33	0.04	1.78
W_N2O	g/hr :	0.01	0.01	0.01	0.01	0.00	0.04
W_CO2	g/hr :	2902.14	2865.17	1759.10	1495.94	81.54	9463.04
W_CH4	g/hr :	0.02	0.01	0.01	0.02	0.00	0.07

Total Weighted Power [kW] 7.386

#### Weighted Emissions

	HC	CO	NOx	HC+NOx
Total Mass [g/hr]	2.57	0.26	108.07	110.64
Specific Mass [g/kW-hr]	0.35	0.03	14.63	14.98
BSFC [g/kW-hr]	420.7			

Total Soot [mg/hr] 2.38      Specific Soot [mg/kW-hr] 0.32

#### Not Used for Competition

Total N2O [mg/hr]	0.03	Specific N2O [mg/kW-hr]	0.00
Total CO2 [g/hr]	9103.90	Specific CO2 [g/kW-hr]	1232.64
Total CH4 [g/hr]	0.07	Specific CH4 [g/kW-hr]	0.01
RMC BSFC [g/kW-hr]	417.80		

#### EMISSION TESTS:

	Value	Limit	Result
Power	21.37	<96.94 kW	PASS
Soot	0.32	<50 mg/kW-hr	PASS
CO	0.03	<275 g/kW-hr	PASS
HC + NOX	14.98	<90 g/kW-hr	PASS
E-Score	200.00	>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	3778.73	3211.29	2833.63	2456.40	1001.02	2877.32
Torque	Nm	57.73	27.62	17.81	10.23	0.00	23.64
Power	kW	22.84	9.29	5.28	2.63	0.00	7.12
BSFC	g/kw-hr	333.11	359.40	418.78	577.29	**	417.80
Fuel	g/hr	7609.33	3337.59	2212.85	1519.84	513.07	2975.50
T_int	degC	52.13	49.79	51.05	58.74	57.08	52.13
RelHumid	%	17.52	16.50	15.25	16.67	14.31	16.45
Baro	in Hg	28.67	28.67	28.67	28.67	28.67	28.67
Baro	mmHg	728.25	728.31	728.34	728.26	728.34	728.30
Pvap_kPa	kPa	1.70	1.44	1.41	2.16	1.73	1.60
Pvap_inHg	inHg	0.50	0.43	0.42	0.64	0.51	0.47
AbsHumidity	grains/lb	77.84	65.84	64.33	99.34	79.01	73.01
SatPres	kPa	95.38	95.65	95.69	94.92	95.37	95.49
Hum Factor		1.01	0.96	0.95	1.13	1.02	0.99
F_fac		1.10	1.09	1.10	1.12	1.12	1.10
K_fac		1.08	1.08	1.08	1.10	1.09	1.08
Humidity	g/kg	11.12	9.41	9.19	14.19	11.29	10.43
H2		0.00	0.00	0.00	0.00	0.00	0.00
WetDry Factor		0.92	0.94	0.95	0.96	0.97	1.00



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**Modal Emissions Concentrations**

ModeNum		1	2	3	4	5	RMC
THC	ppmC1	80.43	36.53	25.44	79.05	20.76	16.57
CO	%	0.00	0.00	0.00	0.00	0.00	0.00
N2O	ppm	1.87	1.80	2.78	1.70	4.26	2.17
CH4	ppm	1.30	0.77	1.03	1.69	3.09	1.19
CO2	%	8.30	6.03	5.07	4.42	2.36	5.52
O2	%	8.07	11.36	12.80	13.81	16.27	12.77
CNOx	ppm	886.75	963.04	733.75	21.53	131.25	635.72
AHC	ppm	4.47	0.00	0.00	2.07	0.01	1.05
C2H2	ppm	0.02	0.01	0.01	0.33	0.07	0.07
C2H4	ppm	0.31	0.18	0.14	1.53	0.13	0.45
C3H6	ppm	0.43	0.43	0.46	0.25	0.33	0.36
C4H6	ppm	0.65	1.01	0.53	0.14	0.23	0.59
ETOH	ppm	2.56	2.22	1.92	3.86	1.56	2.46
H2O	%	7.84	5.77	5.02	4.23	2.55	0.00
HCHO	ppm	0.00	0.03	0.01	0.01	0.00	0.02
HCN	ppm	0.21	0.25	0.24	0.03	0.09	0.20
HNCO	ppm	3.36	4.88	3.23	1.48	1.33	3.23
MECHO	ppm	0.00	0.00	0.00	0.00	0.00	0.00
NC5	ppm	9.54	2.85	2.28	6.08	1.71	4.34
NH3	ppm	0.12	0.03	0.03	0.08	0.03	0.06
NO	ppm	604.05	395.02	316.86	14.26	22.26	298.32
NO2	ppm	270.87	609.47	453.69	4.81	106.52	343.36
Soot	mg/m3	0.02	0.04	0.03	0.02	0.02	0.02
AFR	:1	24.21	33.36	39.74	45.52	83.21	37.65



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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	0.009	7.842	80.851	0.935	24.200	0.600
2	0.000	0.004	5.772	79.581	0.920	33.322	0.443
3	0.000	0.003	5.019	79.482	0.919	39.692	0.375
4	0.000	0.008	4.226	78.672	0.909	45.573	0.328
5	0.000	0.002	2.548	75.879	0.877	83.167	0.216

ModeNum	ModalWHC %	ModalC1 %	ModalC8 %	ModalSUM_HC %	ModalT_Emiss %	ModalError %
1	7.365	-3.600	-0.450	-4.050	95.596	4.404
2	2.020	-3.564	-0.445	-4.009	95.052	4.948
3	1.109	-3.336	-0.417	-3.753	95.545	4.455
4	2.715	-3.098	-0.387	-3.485	95.134	4.866
5	0.451	-1.899	-0.237	-2.136	93.751	6.249

**Carbon Balance Verification**

		1	2	3	4	5	6
Power	kW	22.843	9.287	5.284	2.633	0.000	7.122
BSFC	g/kw-hr	333.11	359.40	418.78	577.29	**	417.80
Fuel_MassFlow	g/hr	7609.3	3337.6	2212.8	1519.8	513.1	2975.5
HC_m	g/hr	7.3652	2.0204	1.1090	2.7146	0.4510	0.8924
CO_m	g/hr	0.33015	0.05981	0.02871	0.62214	0.03768	0.28184
CO2_m	g/hr	24184	10612	7036	4826	1631	9463
TW_Power	kW	7.3857					
TW_BSFC	g/kw-hr	420.67					
Fuel_MassFlow	g/hr	7609.3	3337.6	2212.8	1519.8	513.1	2975.5
FuelCalc	g/hr	7610.3	3337.8	2213.0	1520.2	513.1	2975.6
FuelCalcDev	%	-0.012871	-0.007369	-0.005788	-0.025286	-0.011521	-0.002734

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

# Power Run

## Team 102

TeamNumber	102
TeamName	Kettering
Model	Smart Car Diesel
Engine	Mercedes

Displacement cc	799.00
RatedSpeed	3778
RatedTorque	54.0

