



# Team Results for Clean Snowmobile Challenge 2016 Team 13



## 2016 Clean Snowmobile Competition - Lab Emission Event Emission Data Sheet

Test Date : 2016/03/10 16:06:10  
Team Name : Waterloo  
Team Number : 13  
Model : Weber  
Engine : Weber  
Displacement[cc] : 750.00  
100% Speed : 7524  
100% Torque : 49.6  
No of Strokes : 4  
Fuel : GASOLINE H/C: 2.00 O/C: 0.03

| ModeNum      | : | 1        | 2    | 3    | 4    | 5    |
|--------------|---|----------|------|------|------|------|
| Weighting    | : | 0.12     | 0.27 | 0.25 | 0.31 | 0.05 |
| Power kW     | : | 33.2     | 0.0  | 0.0  | 0.0  | 0.0  |
| HC_m g/hr    | : | 50.47    | **   | **   | **   | **   |
| CO_m g/hr    | : | 7775.12  | **   | **   | **   | **   |
| NOx_m g/hr   | : | 227.32   | **   | **   | **   | **   |
| Soot_m mg/hr | : | 1211.90  | **   | **   | **   | **   |
| N2O_m mg/hr  | : | 0.27     | **   | **   | **   | **   |
| CO2_m g/hr   | : | 49407.38 | **   | **   | **   | **   |
| CH4_m g/hr   | : | 18.13    | **   | **   | **   | **   |
| W_HC g/hr    | : | 6.06     | **   | **   | **   | **   |
| W_CO g/hr    | : | 933.01   | **   | **   | **   | **   |
| W_NOx g/hr   | : | 27.28    | **   | **   | **   | **   |
| W_HCNOx g/hr | : | 33.33    | **   | **   | **   | **   |
| W_Soot mg/hr | : | 145.43   | **   | **   | **   | **   |
| W_N2O g/hr   | : | 0.03     | **   | **   | **   | **   |
| W_CO2 g/hr   | : | 5928.89  | **   | **   | **   | **   |
| W_CH4 g/hr   | : | 2.18     | **   | **   | **   | **   |

Total Weighted Power [kW] 3.978

### Weighted Emissions

|                         | HC   | CO     | NOx   | HC+NOx |
|-------------------------|------|--------|-------|--------|
| Total Mass [g/hr]       | 6.06 | 933.01 | 27.28 | 33.33  |
| Specific Mass [g/kW-hr] | 1.52 | 234.52 | 6.86  | 8.38   |
| BSFC [g/kW-hr]          | **** |        |       |        |

Total Soot [mg/hr] 145.43 Specific Soot [mg/kW-hr] 36.55

### Not Used for Competition

|                    |         |                         |         |
|--------------------|---------|-------------------------|---------|
| Total N2O [mg/hr]  | 0.03    | Specific N2O [mg/kW-hr] | 0.01    |
| Total CO2 [g/hr]   | 5928.89 | Specific CO2 [g/kW-hr]  | 1490.28 |
| Total CH4 [g/hr]   | 2.18    | Specific CH4 [g/kW-hr]  | 0.55    |
| RMC BSFC [g/kW-hr] | 0       |                         |         |

### EMISSION TESTS:

|                            | Value  | Limit        | Result            |
|----------------------------|--------|--------------|-------------------|
| Power                      | 39.12  | <96.94 kW    | PASS              |
| Soot                       | 36.55  | <50 mg/kW-hr | PASS              |
| CO                         | 234.52 | <275 g/kW-hr | FAIL              |
| HC + NOX                   | 8.38   | <90 g/kW-hr  | FAIL              |
| E-Score                    | 145.78 | >175         | FAIL              |
| Valid Data for All 5 Modes |        |              | FAIL              |
| RMC                        |        |              | FAIL (-50 Points) |
| LAB EMISSION TEST          |        |              | FAIL              |



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## Modal Raw Data : Engine / Environmental

| ModeNum       |           | 1        | 2     | 3     | 4     | 5     |
|---------------|-----------|----------|-------|-------|-------|-------|
| Total Points  | points    | 289      | 1     | 1     | 1     | 1     |
| PtsInMode     | points    | 1509     | 1     | 1     | 1     | 1     |
| Speed         | rpm       | 7431.46  | 0.00  | 0.00  | 0.00  | 0.00  |
| Torque        | Nm        | 42.60    | 0.00  | 0.00  | 0.00  | 0.00  |
| Power         | kW        | 33.15    | 0.00  | 0.00  | 0.00  | 0.00  |
| BSFC          | g/kw-hr   | 593.87   | **    | **    | **    | **    |
| Fuel          | g/hr      | 19688.58 | ##### | ##### | ##### | ##### |
| T_int         | degC      | 22.13    | 0.00  | 0.00  | 0.00  | 0.00  |
| RelHumid      | %         | 33.95    | 0.00  | 0.00  | 0.00  | 0.00  |
| Baro          | in Hg     | 28.97    | 0.00  | 0.00  | 0.00  | 0.00  |
| Baro          | mmHg      | 735.82   | 0.00  | 0.00  | 0.00  | 0.00  |
| Pvap_kPa      | kPa       | 0.76     | 0.00  | 0.00  | 0.00  | 0.00  |
| Pvap_inHg     | inHg      | 0.22     | 0.00  | 0.00  | 0.00  | 0.00  |
| AbsHumidity   | grains/lb | 33.86    | **    | **    | **    | **    |
| SatPres       | kPa       | 97.34    | 0.00  | 0.00  | 0.00  | 0.00  |
| Hum Factor    |           | 0.84     | **    | **    | **    | **    |
| F_fac         |           | 1.01     | **    | **    | **    | **    |
| K_fac         |           | 1.02     | **    | **    | **    | **    |
| Humidity      | g/kg      | 4.84     | **    | **    | **    | **    |
| H2            |           | 1.06     | **    | **    | **    | **    |
| WetDry Factor |           | 0.87     | 1.00  | 1.00  | 1.00  | 1.00  |



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## Modal Emissions Concentrations

| ModeNum |       | 1      | 2    | 3    | 4    | 5    |
|---------|-------|--------|------|------|------|------|
| THC     | ppmC1 | 356.74 | 0.00 | 0.00 | 0.00 | 0.00 |
| CO      | %     | 2.75   | 0.00 | 0.00 | 0.00 | 0.00 |
| N2O     | ppm   | 6.11   | 0.00 | 0.00 | 0.00 | 0.00 |
| CH4     | ppm   | 112.33 | 0.00 | 0.00 | 0.00 | 0.00 |
| CO2     | %     | 11.13  | 0.00 | 0.00 | 0.00 | 0.00 |
| O2      | %     | 0.02   | 0.00 | 0.00 | 0.00 | 0.00 |
| CNOx    | ppm   | 489.84 | **   | **   | **   | **   |
| AHC     | ppm   | 5.89   | 0.00 | 0.00 | 0.00 | 0.00 |
| C2H2    | ppm   | 9.98   | 0.00 | 0.00 | 0.00 | 0.00 |
| C2H4    | ppm   | 39.36  | 0.00 | 0.00 | 0.00 | 0.00 |
| C3H6    | ppm   | 0.99   | 0.00 | 0.00 | 0.00 | 0.00 |
| C4H6    | ppm   | 22.32  | 0.00 | 0.00 | 0.00 | 0.00 |
| ETOH    | ppm   | 6.82   | 0.00 | 0.00 | 0.00 | 0.00 |
| H2O     | %     | 13.41  | 0.00 | 0.00 | 0.00 | 0.00 |
| HCHO    | ppm   | 1.32   | 0.00 | 0.00 | 0.00 | 0.00 |
| HCN     | ppm   | 10.27  | 0.00 | 0.00 | 0.00 | 0.00 |
| HNCO    | ppm   | 12.53  | 0.00 | 0.00 | 0.00 | 0.00 |
| MECHO   | ppm   | 0.21   | 0.00 | 0.00 | 0.00 | 0.00 |
| NC5     | ppm   | 1.23   | 0.00 | 0.00 | 0.00 | 0.00 |
| NH3     | ppm   | 613.87 | 0.00 | 0.00 | 0.00 | 0.00 |
| NO      | ppm   | 584.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| NO2     | ppm   | 0.51   | 0.00 | 0.00 | 0.00 | 0.00 |
| Soot    | mg/m3 | 5.12   | 0.00 | 0.00 | 0.00 | 0.00 |
| AFR     | :1    | 12.79  | **   | **   | **   | **   |



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Measurement Accuracy (SAE paper 961804)

| ModeNum | H2_XLS<br>% | ModalHC_Dry<br>% | ModalFTIR_H2O<br>% | N2<br>% | Ar<br>% | AFR<br>:1 | Tr_Eff<br>- |
|---------|-------------|------------------|--------------------|---------|---------|-----------|-------------|
| 1       | 1.219       | 0.041            | 13.415             | 78.896  | 0.912   | 13.450    | 0.999       |
| 2       | **          | 0.000            | 0.000              | 0.000   | 0.000   | **        | **          |
| 3       | **          | 0.000            | 0.000              | 0.000   | 0.000   | **        | **          |
| 4       | **          | 0.000            | 0.000              | 0.000   | 0.000   | **        | **          |
| 5       | **          | 0.000            | 0.000              | 0.000   | 0.000   | **        | **          |

| ModeNum | ModalWHC<br>% | ModalC1<br>% | ModalC8<br>% | ModalSUM_HC<br>% | ModalT_Emiss<br>% | ModalError<br>% |
|---------|---------------|--------------|--------------|------------------|-------------------|-----------------|
| 1       | 50.470        | 0.023        | 0.003        | 0.026            | 97.178            | 2.822           |
| 2       | **            | **           | **           | **               | **                | **              |
| 3       | **            | **           | **           | **               | **                | **              |
| 4       | **            | **           | **           | **               | **                | **              |
| 5       | **            | **           | **           | **               | **                | **              |

# Power Run

Team 13

|            |          |
|------------|----------|
| TeamNumber | 13       |
| TeamName   | Waterloo |
| Model      | Weber    |
| Engine     | Weber    |

|                 |        |
|-----------------|--------|
| Displacement cc | 750.00 |
| RatedSpeed      | 7524   |
| RatedTorque     | 49.6   |

