Kansas City PM Characterization Study
Final Report

Appendix L
PEMS Fuel Economy Calculation Equations Only

Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

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The following equations are used by the SEMTECH-G in calculating emissions and fuel economy. These equations are presented in Revision 2.2 of the SEMTECH-G User Manual. Additional details regarding computations performed by the SEMTECH-G may be found in the SEMTECH-G User's Manual.,

- **Dry-to-wet conversion factor**, K_w = 1 - $[H_20]_{condensed}$

where $[H_20]_{condensed} = [H_20]_{exhaust} - [H_20]_{residual}$

- **Standard Volumetric Exhaust Flow Rate**:

$$V_{std} = \frac{\dot{m}}{\rho_{std}}$$

where

$$\rho_{std}\ (g/l) = \frac{P}{R_{exhaust}T} = \frac{1atm}{R_{exhaust}(293^{\circ}K)}$$

$$R_{exhaust}\left(\frac{l-atm}{g-{}^{\circ}K}\right) = \frac{R^{\circ}}{MW_{exhaust}} = \frac{0.0821\left(\frac{l-atm}{mol-{}^{\circ}K}\right)}{MW_{exhaust}\ (g/mol)}$$

and

$$MW_{exhaust} = \frac{1}{100}\Sigma\left[[CO_2]\bullet 44.01 + [O_2]\bullet 32.0 + [N_2]_{\bullet 28.013 + [H_2 0]\bullet 18.105}\right]$$

- **Instantaneous Mass Emissions**

$$\text{Pollutant}\ (grams/\text{sec}) = \frac{[\text{Pollutant}]_{wet}}{100}\ x\ V_{std}\ x\ \rho_{CO2,std}$$

- **NOx Humidity Correction Factor**

$$Kh = \frac{1}{[1-.0047\ x\ (h-75)]}$$

where h is the absolute humidity in grains/lb of dry air, given by:

$$h = \frac{43.478\ (RH)\ (P_s)}{P_{baro} - P_s\ (RH/100)}$$

where RH is the relative humidity (%) and $P_{s,}$ the saturation vapor pressure in mm-Hg at the engine intake air dry-bulb temperature, is empirically derived using the following equation from the ASCE Manuals and Reports on Engineering Practice No. 70, 1990 (Jensen, et al).

$$P_s(kPa) = EXP\left[\frac{16.78T_{sample} - 116.9}{T_{sample} + 237.3}\right]$$