sampling period (approximately five minutes).

(4) The calculations are performed in the normal way except in the case of propane. The density of propane (0.6109 kg/m³/carbon atom) is used in place of the density of exhaust hydrocarbons.

(5) The gravimetric mass is subtracted from the CVS measured mass and then divided by the gravimetric mass to determine the percent accuracy of the system.

(6) Good engineering practice requires that the cause for any discrepancy greater than ±two percent must be found and corrected.

§ 90.425 CVS calibration frequency.

Calibrate the CVS positive displacement pump or critical flow venturi following initial installation, major maintenance, or as necessary when indicated by the CVS system verification (described in § 90.424(e)).

§ 90.426 Dilute emission sampling calculations—gasoline fueled engines.

(a) The final reported emission test results must be computed by use of the following formula:

$$A_{WM} = \frac{\sum_{i}^{n}\left(W_i \cdot WF_i\right)}{\sum_{i}^{n}\left(P_i \cdot WF_i\right)} \cdot K_{H_i}$$

Where:

A_{WM} = Final weighted brake-specific mass emission rate for an emission (HC, CO, CO_2, or NO_X) [g/kW-hr]

W_i = Average mass flow rate of an emission (HC, CO, CO_2, NO_X) from a test engine during mode i [g/hr]

WF_i = Weighting factor for each mode i as defined in § 90.410(a).

P_i = Gross average power generated during mode i [kW], calculated from the following equation,

$$P_i = \frac{2\pi}{60{,}000} \times \text{speed} \times \text{torque}$$

Where:

speed = average engine speed measured during mode i [rev./minute]

torque = average engine torque measured during mode i [N-m]

K_{Hi} = NO_X humidity correction factor for mode i. This correction factor only affects calculations for tion factor only affects calculations for NO_X and is equal to one for all other emissions. K_{Hi} is also equal to 1 for all two-stroke engines.

(b) The mass flow rate, W_i in g/hr, of an emission for mode i is determined from the following equations:

$$W_i = Q_i \cdot \text{Density} \cdot \left(\frac{C_{Di} - C_{Bi}}{10^6} \cdot \left(1 - \frac{1}{DF_i}\right)\right)$$

Where:

Q_i = Volumetric flow rate oandard conditions [m³/hr at STP].

Density = Density of a specific emission ($Density_{HC}$, $Density_{CO}$, $Density_{CO2}$, $Density_{NOx}$) [g/m³].

DF_i = Dilution factor of the dilute exhaust during mode i.

C_{Di} = Concentration of the emission (HC, CO, NO_X) in dilute exhaust extracted from the CVS during mode i [ppm].

C_{Bi} = Concentration of the emission (HC, CO, NO_X) in the background sample during mode i [ppm].

STP = Standard temperature and pressure. All volumetric calculations made for the equations in this section are to be corrected to a standard temperature of 20 °C and 101.3 kPa.

(c) Densities for emissions that are to be measured for this test procedure are:

$Density_{HC}$ = 576.8 g/m³
$Density_{NOX}$ = 1912 g/m³
$Density_{CO}$ = 1164 g/m³
$Density_{CO2}$ = 1829 g/m³

(1) The value of $Density_{HC}$ above is calculated based on the assumption that the fuel used has a carbon to hydrogen ratio of 1:1.85. For other fuels $Density_{HC}$ can be calculated from the following formula:

$$Density_{HC} = \frac{M_{HC}}{R_{STP}}$$

Where:

M_{HC} = The molecular weight of the hydrocarbon molecule divided by the number of carbon atoms in the molecule [g/mole]

R_{STP} = Ideal gas constant for a gas at STP=0.024065 [m³-mole].

(2) The idealized molecular weight of the exhaust hydrocarbons, i.e., the molecular weight of the hydrocarbon molecule divided by the number of carbon atoms in the molecule, M_{HC}, can be calculated from the following formula:

$$M_{HC} = M_C + \alpha M_H + \beta M_O$$

Where:

M_C = Molecular weight of carbon=12.01 [g/mole]

M_H = Molecular weight of hydrogen=1.008 [g/mole]

M_O = Molecular weight of oxygen=16.00 [g/mole]

α = Hydrogen to carbon ratio of the test fuel

β = Oxygen to carbon ratio of the test fuel

(3) The value of $Density_{NOX}$ above assumes that NO_X is entirely in the form of NO_2

(d) The dilution factor, DF, is the ratio of the volumetric flow rate of the background air to that of the raw engine exhaust. The following formula is used to determine DF:

$$DF = \frac{13.4}{C_{D_{HC}} + C_{D_{CO}} + C_{D_{CO_2}}}$$

Where:

C_{DHC} = Concentration of HC in the dilute sample [ppm]

C_{DCO} = Concentration of CO in the dilute sample [ppm]

C_{DCO2} = Concentration of CO_2 in the dilute sample [ppm]

(e) The humidity correction factor K_H is an adjustment made to measured NO_X values. This corrects for the sensitivity that a spark-ignition engine has to the humidity of its combustion air. The following formula is used to determine K_H for NO_X calculations:

K_H = (9.953 H + 0.832)

Where:

H = the amount of water in an ideal gas; 40 CFR 1065.645 describes how to determine this value (referred to as x_{H_2O}).

K_H = 1 for two-stroke gasoline engines.

(f)–(g) [Reserved]

(h) The fuel mass flow rate, F_i, can be either measured or calculated using the following formula:

$$F_i = \frac{M_{FUEL}}{T}$$

Where:

M_{FUEL} = Mass of fuel consumed by the engine during the mode [g]

T = Duration of the sampling period [hr]

(i) The mass of fuel consumed during the mode sampling period, M_{FUEL}, can be calculated from the following equation:

$$M_{FUEL} = \frac{G_s}{R_2 \times 273.15}$$

Where:

G_s = Mass of carbon measured during the mode sampling period [g]

R_2 = The fuel carbon weight fraction, which is the mass of carbon in fuel per mass of fuel [g/g]

The grams of carbon measured during the mode, G_s, can be calculated from the following equation:

$$G_s = \frac{12.011 \times HC_{mass}}{12.011 + 1.008\alpha} + 0.429CO_{mass} + 0.273CO_{2mass}$$

Where:

HC_{mass}=mass of hydrocarbon emissions for the mode sampling period [grams]

CO_{2mass}=mass of carbon monoxide emissions for the mode sampling period [grams]

CO_{2mass}=mass of carbon dioxide emissions for the mode sampling period [grams]

α=The atomic hydrogen to carbon ratio of the fuel

[60 FR 34598, July 3, 1995, as amended at 70 FR 40450, July 13, 2005]

§ 90.427 Catalyst thermal stress resistance evaluation.

(a) The purpose of the evaluation procedure specified in this section is to determine the effect of thermal stress on catalyst conversion efficiency for Phase 1 engines. The thermal stress is imposed on the test catalyst by exposing it to quiescent heated air in an oven. The evaluation of the effect of such stress on catalyst performance is based on the resultant degradation of