EPA METHOD 5 CALCULATIONS

(1.) Volume of Dry Gas in Cubic Feet Sampled at Meter Conditions

$$V_{ma} = (V_m)(Y)$$

(2.) Volume of Dry Gas in Cubic Feet Sampled at Standard Conditions

$$V_{ma_{std}} = \frac{(V_{ma})(T_{std})[(P_b) + (P_m / 13.6)]}{(t_m + 460)(29.92)}$$

$$V_{ms_{std}} = \frac{(V_{ma})(528)[(P_b + (P_m / 13.6)]}{(t_m + 460)(29.92)}$$

(3.) Volume of Water Vapor Collected in Cubic Feet at Standard Conditions

$$V_{w_{gas}} = \frac{(V_w)(\rho H_2O)(R)(T_{std})}{(P_{std})(M_{H_2O})(453.6\, gm / lb)}$$

$$V_{w_{gas}} = (V_w)(0.0474)$$

(4.) Percent Moisture in Stack Gas at Standard Conditions

$$\% M = \frac{V_{w_{gas}}}{V_{ma_{std}} + V_{w_{gas}}}(100)$$

(5.) Mole Fraction of Dry Gas at Standard Conditions

$$M_d = \frac{100 - \% M}{100}$$

EPA METHOD 5 CALCULATIONS

(6.) Average Molecular Weight of Dry Stack Gas

$$MW_d = 0.44\,(\%CO_2) + 0.32\,(\%O_2) + (0.28)\,(\%N_2 + \%CO)$$

(7.) Average Molecular Weight of Total Stack Gas

$$MW = (MW_d)\ X\ (M_d) + [(18)(1 - M_d)]$$

(8.) Stack Pressure

$$P_s = P_b + \frac{P_{static}}{13.6}$$

(9.) Stack Velocity at Stack Conditions

$$V_s = \frac{(C_p)(60)(2g)(\rho man.oil)(P_{std})(MW_{air})(t_s + 460)}{(12)(\rho air)(P_s)(MW)(T_{std})}$$

$$V_s = (5128.2)(C_p)\sqrt{\frac{(t_s + 460)}{(P_s)(MW)}}\,(\sqrt{\Delta P}$$

(10.) Stack Gas Volumetric Flow Rate at Standard Conditions

$$Q_s = (v_s)(A_s)(M_d)\frac{(T_{std})(P_s)}{(t_s + 460)(P_{std})}$$

$$Q_s = (v_s)(A_s)(M_d)\frac{(528)(P_s)}{(t_s + 460)(29.92)}$$

EPA METHOD 5 CALCULATIONS

(11.) Percent Isokinetic

$$\%I = \frac{(V_{ma_{std}})(t_s + 460)(P_{std})(100\%)}{(M_d)(T_{std})(P_s)(T_t)(v_s)(D_n)^2\left[\frac{\pi}{4}\right]\left[\frac{1}{144}\right]}$$

$$\%I = \frac{(V_{ma_{std}})(t_s + 460)}{(M_d)(P_s)(T_t)(v_s)(D_n)^2}\,1{,}038.963$$

(12.) Particulate Concentration

(English)

$$C_{t_{std}} = \frac{(m_p)(1\ grain)}{(V_{ma_{std}})(0.06480\ grams)}$$

(Metric)

$$C_{t_{std}} = \frac{(m_p)(35.31\ ft^3)}{\left[V_{ma_{std}}\right](1\ meter^3)}$$

(13.) Particulate Concentration Emitted in Pounds Per Hour

(English)

$$C_{emit} = \left[C_{t_{std}}\right](Q_s)\frac{(60\ \text{min.})(1\ pound)}{(1\ hour)(7000\ grains)}$$

EPA METHOD 13 CALCULATIONS

(1) Concentration of Gaseous Fluorides at Standard Conditions

English

$$C_{F_S} = \frac{(m_{F_g})}{(V_{ma_{std}})} \frac{(1\ grain)}{(0.0648\ gram)}$$

Metric

$$C_{F_S} = \frac{(m_{F_g})}{(V_{ma_{std}})} \frac{(35.31\ ft^3)}{(1\ meter^3)}$$

(2) Concentration of Particulate Fluorides at Standard Conditions

English

$$C_{F_p} = \frac{(m_{F_p})}{(V_{ma_{std}})} \frac{(1\ grain)}{(0.0648\ gram)}$$

Metric

$$C_{F_p} = \frac{(m_{F_p})}{(V_{ma_{std}})} \frac{(35.31\ ft^3)}{(1\ meter^3)}$$

(3) Concentration of Total Fluorides at Standard Conditions

English

$$C_{F_p} = \frac{(m_{Ft})}{(V_{ma_{std}})} \frac{(1\ grain)}{(0.0648\ gram)}$$

Metric

$$C_{F_p} = \frac{(m_{F_t})}{(V_{ma_{std}})} \frac{(35.31\ ft^3)}{(1\ meter^3)}$$

(4) Total Fluoride Emissions at Standard Conditions

$$C_{Ft_{emit}} = (C_{Ft}) \frac{(1\ pound)}{(453{,}600\ mg)} (Q_s) \frac{(60\ \text{min})}{(hour)} \frac{(1\ meter^3)}{(35.31\ ft^3} = lb./hour$$

(5) Total Fluoride Emitted Per Ton of Aluminum Produced

$$F\ /\ Al = \frac{(c_{Ft_{emit}})}{(Al_D)\ /\ 24 \frac{hours}{day}\ /\ 2000\ \frac{lbs.}{ton}}$$

EPA METHOD 14 CALCULATIONS

(Changes from, or additions to, 1-5, & 13)

(1) Volumetric Flow Rate of Gas Out of the Roof at Standard Conditions

$$Q_r = \frac{(A_r)(V_{roof})(M_d)(P_b)(T_{std})}{(P_{std})(t_r + 460)}$$

$$Q_r = \frac{(13{,}588)(V_{roof})(M_d)(P_b)(528)}{(29.92)(t_r + 460)}$$

(2) Percent Isokinetic - Manifold to Roof

$$\%I_r = \frac{(V_s)(t_3 + 460)(P_s)(100)}{(V_3)(t_s + 460)(P_b)(A_{ratio})}$$

(3) Particulate Emission Out the Roof at Standard Conditions

$$C_{emit} = \frac{(C_{t_{std}})(Q_r)(60 \text{ min} / hr)}{(7000\ grains/lb)}$$

(4) Fluoride Emission Out the Roof at Standard Conditions

$$C_{Ft\,emit} = \frac{(c_{Ft})(Q_r)(60 \text{ min} / hr)}{(7000\ grains/lb)}$$

(5) Isokinetic Correction of Emission Rate Values

$$1 + \frac{(\%I_r - 120)}{200}\ X\ Concentration\ Value$$