

Average of Square Roots of Δp_i

$$\left(\sqrt{\Delta p}\right)_{avg} = \frac{\sum_{i=1} \sqrt{P_i}}{n}$$

Average Δp

$$\Delta p_{avg} = \left[\sqrt{\Delta p_{avg}}\right]^2$$

Absolute Stack Pressure

$$P_s = P_b + \frac{P_g}{13.6}$$

Stack Gas Dry Molecular Weight

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

Stack Gas Wet Molecular Weight

$$M_s = M_d(1 - B_{ws}) + 18.0B_{ws}$$

Stack Gas Velocity

$$v_s = K_p C_p \left(\sqrt{\Delta p}\right)_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

$$K_p = \begin{aligned} &= 85.48 \text{ (English Units)} \\ &= 34.96 \text{ (Metric Units)} \end{aligned}$$

Area of Stack (Circular)

$$A_s = \pi \left(\frac{D_s}{2}\right)^2$$

Area of Stack (Rectangular)

$$A_s = LW$$

Volumetric Flow Rate (acfm)

$$Q_a = 60v_s A_s$$

Volumetric Flow Rate (scfm)

$$Q_s = K_1 v_s A_s \frac{P_s}{T_s}$$

Volumetric Flow Rate (dscfm)

$$Q_{sd} = K_1 (1 - B_{ws}) v_s A_s \frac{P_s}{T_s}$$

Dry Gas Meter Volume

$$V_{m(std)} = K_1 Y \frac{V_m (P_{bar} + \frac{\Delta H}{13.6})}{T_m} \quad \text{or} \quad = V_m Y \left(\frac{T_{std}}{P_{std}} \right) \frac{(P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

$$K_1 = 17.64 \text{ (English Units)}$$

$$= 0.3858 \text{ (Metric Units)}$$

Volume of Water Vapor

$$V_{wc(std)} = K_2 (V_f - V_i)$$

$$K_2 = 0.04706 \text{ (English Units)}$$

$$= 0.001333 \text{ (Metric Units)}$$

Stack Gas Moisture Fraction

$$B_{ws} = \frac{V_{wc(std)}}{V_{m(std)} + V_{wc(std)}}$$

Pollutant Mass Rate

$$\overline{PMR}_s = c_s Q_s$$

Estimated Nozzle Diameter

$$D_{n(est)} = \sqrt{\frac{K_3 Q_m P_m \sqrt{T_s M_s}}{T_m C_p (1 - B_{ws}) \sqrt{P_s \Delta p_{avg}}}}$$

$$K_3 = 0.03575 \text{ (English Units)}$$
$$= 0.6071 \text{ (Metric Units)}$$

K-Factor

$$K = \frac{\Delta H}{\Delta P} = K_6 D_n^4 \Delta H_{@} C_p^2 (1 - B_{ws})^2 \frac{M_d T_m P_s}{M_s T_s P_m}$$

$$K_6 = 846.72 \text{ (English Units)}$$
$$= 8.009 \times 10^{-5} \text{ (Metric Units)}$$

Meter Orifice Flowrate

$$\Delta H = K \Delta P$$

Average Moisture Content

$$B_{ws} = \frac{V_{wc(std)}}{V_{m(std)} + V_{wc(std)}}$$

Isokinetic Rate Percentage

$$\% I = \frac{K_s T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$$

$$K_s = 0.09450 \text{ (English Units)}$$
$$= 4.320 \text{ (Metric Units)}$$

Average Standard Flow Rate of Dry Stack Gas

$$Q_{sd(avg)} = 3600 (1 - B_{ws(avg)}) v_{s(avg)} A_s \left(\frac{T_{std}}{T_{s(avg)}} \right) \left(\frac{P_s}{P_{std}} \right)$$

% Excess Air

$$\% EA = \frac{(\% O_2) + 0.5(\% CO)}{0.0264(\% N_2) - (\% O_2) + 0.5(\% CO)}$$

F_o Factor

$$F_o = \frac{20.9 - \% O_2}{\% CO_2}$$

Nomenclature

A_n	Sampling Nozzle Cross-Sectional Area, mm ² (in ²)
A_s	Stack Cross-Sectional Area, m ² (ft ²)
B_{ws}	Moisture Fraction in Stack Gas, % H ₂ O
C_p	Pitot Tube Calibration Coefficient
$C_{p(Std)}$	Standard Pitot Tube Calibration Coefficient
C_s	Particulate Concentration in Stack Gas, g/dscm gr/dscm (lb/dscf gr/dscf)
D_e	Equivalent Diameter, m (ft)
D_n	Sampling Nozzle Diameter, mm (in)
D_s	Stack Diameter
Δp	Stack Gas Velocity Pressure, mm H ₂ O (in H ₂ O)
$(\Delta p^{1/2})_{avg}$	Average of the Squareroots of Velocity Pressure, (mm H ₂ O) ^{1/2} (in H ₂ O) ^{1/2}
%EA	Percent Excess Air, %
F_d	F factor for dry effluent, used with percent O ₂ , dry basis
F_o	Fuel Factor
$\Delta H_{@}$	Pressure Drop across Orifice Meter for 21.2 lpm (0.75cfm) at Std Conditions, mm H ₂ O (inH ₂ O)
ΔH	Pressure Drop across Orifice Meter, mm H ₂ O (in H ₂ O)
%I	Isokinetic Sampling Rate, %
K	Isokinetic Rate Constant
K_p	Pitot Tube Constant
K'	Critical Orifice Calibration Factor
L	Length of Duct Cross-Section at Sampling Site, m (ft)
m	Mass, g (lb)
M_d	Stack Gas Dry Molecular Weight, g/g-mole (lb/lb-mole)
M_s	Stack Gas Wet Molecular Weight, g/g-mole (lb/lb-mole)
pmr	Pollutant Mass Emission Rate, kg/hr (lb/hr)
P_b/P_{bar}	Barometric Pressure, mm Hg (in Hg)
P_s	Absolute Stack Pressure, mm Hg (in Hg)
P_{std}	Standard Pressure, 760 mm Hg (29.92 in Hg)
Q_{aw}	Actual Wet Volumetric Flowrate, acmm (acfm)
Q_{sd}	Dry Standard Volumetric Flowrate, dscmm (dscfm)
ρ_w	Density of Water, 0.9982 g/ml

θ	Time (minutes)
T_s	Stack Temperature, °C (°F)
T_{std}	Standard Temperature, 293K (528°R)
T_{amb}	Ambient Temperature, °C (°F)
V_{cr}	Critical Orifice Volume, m ³ (ft ³)
V_m	Dry Gas Meter Volume, m ³ (ft ³)
V_{lc}	Volume or Mass Liquid Collected in Impingers, ml or g
V_s	Stack Gas Velocity
W	Width of Duct Cross-Section at Sampling Site, m (ft)
Y	Dry Gas Meter Calibration Factor