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TECHNICAL INFORMATION DOCUMENT

Isokinetic Equation for Method 5D

INTRODUCTION

The velocities from exhaust gases from positive pressure baghouses are often too low to measure accurately with the Type S pitot tube specified in Method 2. Therefore, Method 5D (Particulate Matter Method for Positive Pressure Fabric Filters) requires that the gas flow rate at the fabric filter inlet be measured according to Method 2 and isokinetic sampling rates be based on the average velocity that is calculated for the outlet measurement site. To set the proper orifice meter ΔH, the average Δp at the inlet must be adjusted for the stack area and gas density differences. An isokinetic equation relating ΔH to the inlet velocity pressure (Δp_i) is presented below.

EQUATION

$$\Delta H = 846.7\ C_p^{\,2}\ \Delta H_@\ D_n^{\,4} \left[\frac{A_i}{A_o}\right]^2 \left[\frac{P_i\ T_m\ M_m}{P_m\ T_i\ M_i}\right] (1-B_{wo})^2\ \Delta p_i$$

where:

C_p = pitot tube coefficient, dimensionless.

$\Delta H_@$ = orifice pressure differential that equates to 0.75 cfm of air at 68°F and 29.92 in. Hg.

D_n = diameter of nozzle, in^2.

A_i = cross-sectional area of inlet, ft^2.

A_o = cross-section area of outlet, ft^2.

T_i = absolute temperature of the stack gas at inlet, °R.

T_m = absolute temperature at orifice meter, °R.

P_i = absolute stack pressure at inlet, in. Hg.

P_m = pressure at orifice meter, in. Hg.

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B_{wo} = water vapor in gas stream at outlet, proportion by volume.

Δp_i = average velocity head at inlet, in. H_2O.

M_m = molecular weight of sample gas at orifice meter, dry basis, lb/lb-mole.

M_i = molecular weight of stack gas at inlet, lb/lb-mole.

$846.7 = [(85.49)(60)(\pi)]^2/[(4)^2(144)^2(0.9244)]$.

REFERENCE

1. Shigehara, R.T. Adjustments in the EPA Nomograph for Different Pitot Tube Coefficients and Dry Molecular Weights. In: Stack Sampling Technical Information - A Collection of Monographs and Papers, Vol. III. U.S. Environmental Protection Agency. Publication No. EPA-450-2-78-042c. October 1978. pp. 48-49.