Designation: E 2029 – 99

Standard Test Method for Volumetric and Mass Flow Rate Measurement in a Duct Using Tracer Gas Dilution[1]

This standard is issued under the fixed designation E 2029; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method describes the measurement of the volumetric and mass flow rate of a gas stream within a duct, stack, pipe, mine tunnel, or flue using a tracer gas dilution technique. For editorial convenience all references in the text will be to a duct, but it should be understood that this could refer equally well to a stack, pipe, mine tunnel, or flue. This test method is limited to those applications where the gas stream and the tracer gas can be treated as ideal gases at the conditions of the measurement. In this test method, the gas stream will be referred as air, though it could be any another gas that exhibits ideal gas law behavior.

1.2 This test method is not restricted to any particular tracer gas although experimental experience has shown that certain gases are used more readily than others as suitable tracer gases. It is preferable that the tracer gas not be a natural component of the gas stream.

1.3 Use of this test method requires a knowledge of the principles of gas analysis and instrumentation. Correct use of the formulas presented here requires consistent use of units.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.* For specific precautionary statements, see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*

D 3154 Test Method for Average Velocity in a Duct (Pitot Tube Method)[2]

D 3464 Test Method for Average Velocity in a Duct Using a Thermal Anemometer[2]

2.2 *ANSI/ASME Standard:*

ANSI/ASME TC 19.1–1985 (1994) Measurement Uncertainty: Instrument Apparatus[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *ideal gas*, *n*—a gas or gas mixture for which the ratio of the pressure divided by product of the density and temperature is a constant.

3.1.2 *mass flow*, *n*—the total mass of air passing the sampling point per unit time (kg/s, lb/min).

3.1.3 *tracer gas*, *n*—a gas that can be mixed with air and measured in very low concentrations.

3.1.4 *tracer gas analyzer*, *n*—a device that measures the concentration of tracer gas in an air sample.

3.1.5 *tracer gas mass concentration*, *n*—the ratio of the mass of tracer gas in air to the total mass of the air-tracer mixture. For an ideal gas, the mass concentration is independent of temperature and pressure.

3.1.6 *tracer gas molar concentration*, *n*—the ratio of the number of moles of tracer gas in air to the total number of moles of the air-tracer mixture.

3.1.7 *tracer gas volume concentration*, *n*—the ratio of the volume of tracer gas in air to the total volume of the air-tracer mixture. For an ideal gas, the volume concentration is independent of temperature and pressure and is equal to the molar concentration.

3.1.8 *volumetric flow*, *n*—the total volume of air passing the sampling point per unit time (m^3/s, ft^3/min).

3.2 *Symbols:*

C = mass concentration[4] of tracer gas (ppb-mass, ppm-mass, ppt-mass)

C_U = upstream mass concentration[4] of tracer gas (ppb-mass, ppm-mass, ppt-mass)

C_D = downstream mass concentration[4] of tracer gas (ppb-mass, ppm-mass, ppt-mass)

C_I = injection stream mass concentration[4] of tracer gas (ppb-mass, ppm-mass, ppt-mass)

c = volume concentration[4] of tracer gas (ppb, ppm, ppt)

[1] This test method is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.41 on Air Leakage and Ventilation.

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[2] *Annual Book of ASTM Standards*, Vol 11.03.

[3] Available from American National Standards Institute, 11 W. 42nd Street, 13th floor, New York, NY 10036.

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