STANDARD

ANSI/ASHRAE Standard 129-1997 (RA 2002)

Reaffirmation of ANSI/ASHRAE Standard 129-1997 (with minor editorial changes)

Measuring Air-Change Effectiveness

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NOTE

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FOREWORD

This standard defines a method of measuring air-change effectiveness in mechanically ventilated buildings or spaces. The method involves an age-of-air approach to air-change effectiveness and employs tracer gas procedures to measure the age of air. The age of the air at a given location is the average amount of time that has elapsed since the air molecules at that location entered the building. The definition of air-change effectiveness is based on a comparison of the age of air in the occupied portions of the building to the age of air that would exist under conditions of perfect mixing of the ventilation air.

The need for a test method for air-change effectiveness arose from discussions concerning ANSI/ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality *with regard to the uniformity of air distribution within buildings and mixing within ventilated spaces. Short-circuiting airflow patterns, in which a significant portion of supply air flows directly to the exhaust, bypassing the occupied portion of the ventilated space, have been a source of concern. Short circuiting could adversely impact indoor air quality and thermal comfort in the occupied space and increase energy use. Additionally, there is an increased interest in innovative ventilation, such as displacement ventilation, that may be more effective in maintaining acceptable indoor air quality than ventilation that causes indoor air to be thoroughly mixed.*

The effective rate at which outside air is provided to the occupied portion of the ventilated space is determined by both the pattern of air flow within the ventilated space and by the extent of the mechanical recirculation of air by the ventilation system. Increased mechanical recirculation decreases both the adverse effect of short circuiting and the benefits of displacement flow. The air-change effectiveness parameter defined in this standard reflects the combined influence of the indoor airflow pattern and mechanical recirculation on the age of air at locations where people breathe. Appendix B describes how measured values of air-change effectiveness can be used to adjust the outdoor air requirements for ventilation determined in accordance with ANSI/ASHRAE Standard 62-2001.

The test method has been used successfully in laboratory test rooms to study the performance of different ventilation systems, but there is considerably less experience in the field where many factors can complicate the measurement process and increase measurement uncertainty. Therefore, the standard places strict limitations on the characteristics of the spaces that can be tested with the method. While the test method will not be usable in all field situations, it is generally applicable in laboratory test rooms. Future versions of the standard will benefit from additional experience with the test method in the field, perhaps making the test method more widely applicable.

1. PURPOSE

This standard prescribes a method for measuring air-change effectiveness in mechanically ventilated spaces and buildings that meet specified criteria. The air-change effectiveness is a measure of the effectiveness of outdoor air distribution to the breathing level within the ventilated space.

2. SCOPE

2.1 The method of measuring air-change effectiveness compares the age of air where occupants breathe to the age of air that would occur throughout the space if the indoor air were perfectly mixed.

2.2 The standard includes measurement procedures and criteria for assessing the suitability of the test space for measurements of air-change effectiveness.

3. DEFINITIONS

adjoining spaces: any ventilated or unventilated indoor space that adjoins, or is surrounded by, the test space.

age of air: the average time elapsed since molecules of air in a given volume of air entered the building from outside.

building air infiltration: uncontrolled inward leakage of air (that may contain enriched water vapor) through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density.

calibration gas: a mixture of air and tracer gas with a tracer gas concentration that is known within specified tolerances, used to calibrate tracer gas instruments.

concentration: the quantity of one constituent dispersed in a defined amount of another.

concentration, tracer gas: the volume or mass of tracer gas divided by the volume or mass of air plus tracer gas.

exfiltration: converse of building air infiltration.

exhaust air: air discharged from a space to the outdoors as differentiated from air transferred from one space to an adjacent space.

indoor air volume: the entire air volume of a space or building in which the ventilation air is distributed, including ductwork and plenums. The volume of indoor furnishings, equipment, and occupants must be subtracted from the gross indoor volume that is based on interior dimensions of the space or building.

nominal time constant: the indoor air volume of a space or building divided by the rate of outdoor air supply; the nominal time constant also equals the average age of air exiting from the space or building. The reciprocal of the nominal time constant is called the nominal air-change rate.

outdoor air: air outside a building or taken from outdoors and not previously circulated through the system.