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ASHRAE® STANDARD

AN AMERICAN NATIONAL STANDARD

Method of Testing Performance of Laboratory Fume Hoods

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(This foreword is not a part of this standard but is included for information purposes only.)

FOREWORD

The performance of a laboratory fume hood in providing protection for the worker at the face of the hood is strongly influenced by the aerodynamic design of the hood, the ventilation of the laboratory room, and by other features of the laboratory in which it is installed. Therefore, there is a need for a performance test that can be used in the field to establish an "as used" performance rating, including the influences of the laboratory arrangement and its ventilation system.

This standard defines a reproducible method of testing laboratory fume hoods. It does not define safe procedures. However, laboratory hoods are considered by many to be the primary safety devices in conducting laboratory operations.

There are many important factors in the safe operation of laboratory hoods that are not described in the standard. These include:

1. *Cross-drafts. Air currents may, by creating turbulent air pockets, draw contaminants from the hoods. Such cross-drafts could be caused by air supply diffusers or grilles, open windows or doors, or rapid movements of people in front of the hood.*
2. *Work procedures. There is substantial evidence to suggest that all work in a hood should be conducted as far back in the hood as practical. Typically, users have standardized the requirement that all work should occur at least 6 inches behind the face of the hood. However, significantly improved protection can be achieved by working farther than 6 inches from the face of the hood.*
3. *Internal obstructions. The location of too much laboratory equipment (bottles, glass, etc.) in the hood will disturb airflow patterns into the hood.*
4. *The procedure being performed. The intrinsic hazard of the procedure being performed can affect the level of safety required by the user.*
5. *Thermal challenge. Heat produced in the hood can cause significant disturbance in hood performance and even cause leakage of warm and possibly contaminated air from the top of the hood or from behind the sash.*
6. *Rate of response. The transient state or interval required for a variable-air-volume hood to respond to a rapid opening of the sash, or the time interval required for a hood to respond to a change in static pressure in the main exhaust duct serving multiple hoods, may affect hood performance.*

In short, there are many factors to consider in evaluating the safety of a laboratory hood installation. This standard will provide one tool in evaluating such safety.

The test presumes a conditioned environment. No test can be devised that would, conducted once or infrequently (viz., annually), reflect the results that would be obtained in a unconditioned laboratory with various conditions of windows, wind velocity, etc.

The procedure is a performance test method and does not constitute a performance specification. It is analogous to a method of chemical analysis, which prescribes how to analyze for a chemical constituent, not how much of that substance should be present. Another analogy would be a method for measuring airflow; it prescribes how the flow should be measured, not how much it should be.

The desired hood performance should be defined as a result of the cooperative efforts of such people as the user, the chemical hygiene officer, and the applications engineer. It should be noted that the performance test does not give a direct correlation between testing with a tracer gas and operator exposures. Many factors, such as the physical properties of the material, the rate and mode of evolution, the amount of time the worker spends at the face of the hood, and several other factors, must be integrated, by a trained observer, into a complete evaluation of worker exposure. The performance test does, however, give a relative and quantitative determination of the efficiency of the hood containment under a set of specific, although arbitrary, conditions. The same test can be used to evaluate hoods in the manufacturer's facilities under (presumably) ideal conditions or under some specified condition of room air supply or during the commissioning of a new or renovated laboratory before the user has occupied the laboratory.

This method consists of three tests:

1. *flow visualization,*
2. *face velocity measurements, and*
3. *tracer gas containment.*

The flow visualization and face velocity tests should always precede tracer gas testing for a thorough evaluation of hood performance. The flow visualization and face velocity tests can be conducted without the tracer gas test as a combination of a quantitative velocity measurement and a qualitative evaluation of hood performance. This portion of the standard could be used in the testing and balancing of new facilities and periodic tests of many hoods at a large facility. The full test procedure (visualization, face velocity, and tracer gas) is a quantitative measurement of a hood's containment ability and is useful for hood development and rigorous evaluation of hood performance.

This standard may be used as part of a specification once the required control level has been determined. Three alternative ratings can be determined, depending on the condition of the test. An "as manufactured" (AM) test would be conducted at the hood manufacturer's location and would test only the design of the laboratory hood independent of the laboratory environment. An "as installed" (AI) test would be conducted in a newly constructed or renovated laboratory after thorough testing and balancing has been completed but before the user has occupied the laboratory. Consequently, the test would include the influences of the laboratory environment, such as the aerodynamic design of the hood, the supply air system, the geometry of the room, and the exhaust air system. The final test would be an "as used" (AU) test in which the investigator accepts the hood and the condition in which the user has established the hood.

the baffles, thermal challenge within the hood, and other factors.

If this standard is to be used as part of a specification, the following criteria must be specified:

a) Sash design position or positions
b) Average face velocity
c) Range of face velocities
d) Average face velocity for sash at 25% and 50% of the design hood opening
e) Performance rating
f) Sash movement performance rating
g) Response time for VAV hoods
h) Percentage of auxiliary air supply

This standard does not constitute an engineering investigation of what the causes may be for poor performance or of ways to improve the performance. The test may, of course, be used as an aid to such an investigation.

The test protocol provides for the hood sash to be placed at the design opening. Since operation of the hood with the sash opened may be beyond the design criteria, it is prudent to also conduct the tests with the hood fully open to test potential conditions of misuse.

A properly designed hood installed in a properly designed laboratory may still be misused. For example, the user may have the hood too full of laboratory equipment or may be using the hood for storage space. The possibilities are too varied to specify closely. Therefore, the test procedure is to be conducted on the hood "as is." The equipment in the hood should be operating normally.

Although the test uses a tracer gas to evaluate the performance of laboratory fume hoods, the procedure is valid when the contaminant is a particulate. Fine dust, small enough to be of health significance, will be carried along with the hood air currents in a fashion similar to the transport of a gas. However, the test is not applicable to operations where the contaminant is released violently, such as particulate from some types of grinding operations or gases from a high-pressure tubing leak. These conditions are abnormal, and a typical or "standard" laboratory fume hood is not appropriate for such conditions.

The test may be used to evaluate the performance of an auxiliary air hood for protecting the worker at the hood face. It does not attempt, nor is it intended, to measure the ability of the hood to capture the auxiliary supply air.

Sometimes the performance of the laboratory hood under dynamic conditions is critical for complete evaluation. This test procedure can be modified to evaluate a dynamic challenge; however, the number of possible variables that could be tested is beyond a performance test. Specific operations, such as a pedestrian walking past the hood, laboratory doors opening, and specific actions at the hood, are only a few of the challenges that could be expected at the hood. This test method addresses only the dynamic challenge of sash movement. Variable-air-volume (VAV) hoods place a significant emphasis on the sash movement and the potential effect on hood performance. However, some constant-volume hoods may also experience a decrease in protection when the sash is moved.

The purpose of this standard is to specify a quantitative and qualitative test method for evaluating the fume containment of a laboratory fume hood.

2. SCOPE

2.1 This method of testing applies to conventional, bypass, auxiliary air, and VAV laboratory fume hoods.

2.2 This method of testing is intended primarily for laboratory and factory testing but may be used as an aid in evaluating installed performance.

3. DEFINITIONS

air supply fixtures: devices or openings through which air flows into the laboratory room. For the purpose of this standard, all accessories, connecting duct adapters, or other mounting airways shall be considered part of the supply fixture and reported as a unit or assembly. Some specific supply fixtures are defined as follows:

grille: a louvered or perforated face over an opening.
register: a combination grille and damper assembly.
diffuser: an outlet designed to mix supply air and room air and to distribute it in varying directions.
perforated ceiling: perforated ceiling panels used to distribute the air uniformly throughout the ceiling or a portion of the ceiling. Filter pads may be used to achieve a similar result.

auxiliary air: unconditioned or partially conditioned supply or supplemental air delivered to a laboratory at the laboratory fume hood to reduce room air consumption.

control level: the average measured concentration of gas, parts of tracer gas per million parts of air by volume (ppm), that is not exceeded at the hood face with a 4.0 Lpm release rate.

face velocity: average velocity of air moving perpendicular to the hood face, usually expressed in feet per minute (fpm) or meters per second (m/s).

fume hood system: an arrangement consisting of a fume hood, its adjacent room environment, and the air exhaust equipment, such as blowers and ductwork, required to make the hood operable.

hood face: the plane of minimum area at the front portion of a laboratory fume hood through which air enters when the sash(es) is(are) fully opened, usually in the same plane as the sash(es) when sash(es) is(are) present.

Lpm: litres per minute.

laboratory fume hood: a boxlike structure enclosing a source of potential air contamination, with one open or par-