ASHRAE

STANDARD

**ANSI/ASHRAE Standard 110-2016**
(Supersedes ASHRAE Standard 110-1995)

# Methods of Testing Performance of Laboratory Fume Hoods

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## ANSI/ASHRAE Standard 110-2016, Methods of Testing Performance of Laboratory Fume Hoods



**NOTE**

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## FOREWORD

*First published in 1985 and revised in 1995, ASHRAE Standard 110 provides a method of testing the performance of laboratory fume hoods. This revised edition has been expanded in a number of significant ways:*

- *The test procedures now require digital collection of data rather than allowing manual data collection.*
- *Some modifications have been made to the test procedure. These modifications were made based on the experience of the committee members or to clarify statements in the 1995 edition of the standard.*
- *Informative Appendix A, which provides explanatory information, has been expanded.*
- *Informative Appendix B, a new nonmandatory section, provides guidance to anyone using the standard as a diagnostic tool in investigating the cause of poor hood performance.*

*The aim of this standard is to provide a test that takes into account the wide variety of factors that influence the performance of laboratory fume hoods. The ability of a laboratory hood to provide protection for the user at the face of the hood is strongly influenced by the aerodynamic design of the hood, the method of operation of the hood, the stability of the exhaust ventilation system, the supply ventilation of the laboratory room, the work practices of the user, and other features of the laboratory in which it is installed. Therefore, there is a need for a test method that can be used to evaluate the performance of a laboratory hood in the ideal environment and 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 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 this standard. These include the following:*

- ***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.*
- ***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. Generally, users have standardized the requirement that all work should occur at least 6 in. (150 mm) behind the face of the hood. However, significantly improved protection can be achieved by working farther than 6 in. (150 mm) from the face of the hood.*
- ***Internal obstructions.*** *The location of too much laboratory equipment (bottles, glass, etc.) in the hood will disturb airflow patterns into the hood.*
- ***The procedure being performed.*** *The intrinsic hazard of the procedure being performed can affect the level of safety required by the user.*
- ***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.*
- ***Rate of response.*** *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 summary, there are many factors to consider in evaluating the performance of a laboratory hood installation. This standard provides one tool in evaluating such safety.*

*This test method presumes a conditioned environment. No test can be devised which would, conducted once or infrequently (for example, annually), reflect the results which would be obtained in an 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 the substance should be present. Another analogy would be a method for measuring airflow: the method prescribes how the flow should be measured, not how much it should be.*

*The desired hood performance should be defined through the cooperative efforts of the user, the chemical hygiene officer, the applications engineer, and other parties affected by the hood performance. It should be noted that the performance test method does not give a direct correlation between testing with a tracer gas and operator exposures. This method of testing is not intended to replace a personal sampling monitoring program. Many factors, such as the physical properties of the material, the rate and mode of evolution, the amount of time the user spends at the face of the hood, and several other factors must be integrated by a trained observer into a complete evaluation of user exposure. The performance test method 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 manufacturer 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 the following three tests:*

- *Flow visualization*
- *Face velocity measurements*
- *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 performance specification once the required control levels have been set. The desired hood performance should be defined through the cooperative efforts of the hood user, the chemical hygiene officer, the applications engineer, and other parties who may be affected by unsatisfactory fume hood performance. Three alternate 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 in the condition in which the user has established the hood. This includes obstructions within the hood, maladjustment of 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 test opening or openings, which should address both the design opening and the typical use openings*
*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. Acceptable smoke visualization tests*
*f. Performance rating (as defined in the standard)*
*g. Sash movement performance rating*
*h. For variable-air-volume (VAV) hoods, the speed of response and the time to steady state*
*i. For auxiliary air hoods, the percentage of auxiliary air supply*
*j. Special conditions or tests*

*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. Informative Appendix B addresses some possible applications of the test procedure as a diagnostic tool.*

*The test protocol provides for the hood sash to be placed at the design opening. Because operation of the hood may be with the sash opened beyond the design criteria, it is prudent to also conduct the tests with the hood full 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 in any detail. 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 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 particulates from some types of grinding operations or gases from a high-pressure tubing leak. These conditions are abnormal, and a typical or "standard" laboratory hood may not be appropriate for such operations or conditions.*

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

*It is important to evaluate the performance of the laboratory hood under dynamic conditions. This performance test method may be modified to evaluate a dynamic challenge. 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. 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.*

## 1. PURPOSE

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

## 2. SCOPE

**2.1** This method of testing applies to conventional, bypass, auxiliary air, and variable-air-volume (VAV) laboratory fume hoods.

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

## 3. DEFINITIONS AND ABBREVIATIONS

**3.1 Definitions.** This section defines the following terms as they are used in this standard. For the definitions of other terms used in this standard, refer to *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration.*[1]