# ANSI/ASSP Z9.5-2012

## Laboratory Ventilation

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AMERICAN SOCIETY OF
**SAFETY PROFESSIONALS**

# ANSI/AIHA® Z9.5 – 2012
# Laboratory Ventilation

Secretariat

**American Industrial Hygiene Association**

**Approved April 26, 2012**

American National Standard

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## Contents

**Appendices**

## Foreword (This foreword is not part of the American National Standard Z9.5–2012.)

General coverage. This standard describes required and recommended practices for the design and operation of laboratory ventilation systems used for control of exposure to airborne contaminants. It is intended for use by employers, architects, industrial hygienists, safety engineers, Chemical Hygiene Officers, Environmental Health and Safety Professionals, ventilation system designers, facilities engineers, maintenance personnel, and testing and balance personnel. It is compatible with the ACGIH® *Industrial Ventilation: A Manual of Recommended Practices*, ASHRAE ventilation standards, and other recognized standards of good practice.

**HOW TO READ THIS STANDARD. The standard is presented in a two-column format. The left column represents the requirements of the standard as expressed by the use of "shall." The right column provides description and explanation of the requirements and suggested good practices or examples as expressed by the use of "should." Appendices 1 and 2 provide supplementary information on definitions and references. Appendix 3 provides more detailed information on stack design. Appendix 4 provides a sample audit document and Appendix 5 presents a sample table of contents for a Laboratory Ventilation Management Plan.**

Flexibility. Requirements should be considered minimum criteria and can be adapted to the needs of the User establishment. It is the intent of the standard to allow and encourage innovation provided the main objective of the standard, "control of exposure to airborne contaminants," is met. Demonstrably equal or better approaches are acceptable. When standard provisions are in conflict, the more stringent applies.

Response and Update. Please contact the standards coordinator at AIHA®, 3141 Fairview Park Drive, Suite 777, Falls Church, VA 22042, if you have questions, comments, or suggestions. As with all ANSI standards, this is a "work in progress." Future versions of the standard will incorporate suggestions and recommendations submitted by its Users and others.

This standard was processed and approved for submittal to ANSI by the Z9 Accredited Standards Committee on Health and Safety Standards for Ventilation Systems. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard the Z9 Committee had the following members:

Thomas Smith, Chair
Theodore Knutson, Vice Chair
David Hicks, Secretariat Representative
At the time of publication, the Secretariat Representative was David Hicks.

| *Organization Represented* | *Name of Representative* |
|---|---|
| ACGIH® | G. Knutson |
| ASHRAE | T. Smith |
| American Foundry Society | R. Scholz |
| ASSE | P. Osley |
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Subcommittee Z9.5 on Laboratory Ventilation, which developed this standard, had the following members:

Steve Crooks, Chair
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C.J. McAfee
R.A. DeLuca
P. Pinkston
K. Kretchman
S. Lengerich
P. Carpenter (Technical Resource)
A. Kolesnikov (Observer)

* retired during the standard's development

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* Contributing member of Z9.5 subcommittee but not a voting member of the full Z9 Committee at the time of standard approval.

# American National Standard for Laboratory Ventilation

**Requirements of the Standard**

**Clarification and Explanation of the Requirements**

## 1 Scope, Application and Purpose

### 1.1 Scope and Application

This standard applies to the ventilation in most laboratories and is written for all laboratory ventilation stakeholders. An emphasis is placed on those with legal responsibilities and liability for providing a safe laboratory. However, users/operators, industrial hygienists, other safety and environmental professionals will also find the standard written for their needs.

Laboratories conduct teaching, research, quality control, and related activities and should satisfy several general objectives, in addition to being suited for the intended use they should

- be energy efficient without sacrificing safety, compliance, or space condition requirements,
- be safe places to work,
- comply with environmental, health, and safety regulations, and
- meet any necessary criteria for the occupants and technology involved in terms of control of temperature, humidity, and air quality.

The standard cannot establish strict liability in all cases but does attempt to fix accountability in many relationships that exist with its context. Please note that such relationships are defined throughout the standard and generally encompass the following: administration - occupant; employer - employee; management - staff; owner - occupant; owner - tenant; teacher - student; designer - owner, etc.

This standard does not apply to the following types of laboratories or hoods except as it may relate to general laboratory ventilation:

- animal facilities,
- biosafety cabinets,
- explosives laboratories,
- high containment facilities (e.g., BSL 3, BSL 4, facilities operating under “chemical surety plans,” etc.),
- laminar flow hoods and isolators (e.g., a clean bench for product protection, not employee protection), and
- radioisotope laboratories.

General laboratory safety practices are not included except where they may relate to the ventilation system’s proper function or effectiveness.

Appendix 2 offers several references providing information, guidelines or specific requirements for

- laboratory animals – AAALAC,
- biosafety cabinets – NSF,
- biohazardous materials – ABSA, and CDC,
- flammables, pyrophoric and explosives – NFPA, ISEE, and IMC,
- high containment facilities – CDC, ISPE, and USAMRICD,
- laminar flow hoods and isolators – NSF and CETA,
- radioactive materials – NRC, and
- special environmental requirements for product protection such as contamination control from particulates – CETA and IEST.

This standard does not apply to comfort considerations unless they have an effect on contaminant control ventilation.

### 1.2 Purpose

The primary purpose of this standard is to establish minimum requirements and best practices for laboratory ventilation systems to protect personnel from physical harm and overexposure to harmful or potentially harmful airborne contaminants generated within the laboratory. The standard's requirements also aim to protect property where relevant.

In light of significant efforts and initiative to reduce greenhouse gases, the standard also confronts energy considerations, especially where there is a potential to impact worker health and safety.

This standard:

- informs the designer of the requirements and conflicts among various criteria relative to laboratory ventilation,
- informs the user of information needed by designers, and
- sets forth ventilation requirements that will, combined with appropriate work practices, achieve acceptable concentrations of air contaminants.

Thus, this standard provides insight on how inadequate ventilation or other ventilation system deficiencies can impact safety and containment. However, this standard cannot provide designers and users with everything needed for conducting hazard assessments. Designers and users are thereby cautioned to not misconstrue the purpose of this standard as addressing comprehensive hazard control for particular hazards posed by all operations that may occur in a laboratory room. See Section 2.4.

Persons responsible for laboratory operations and those working within laboratories may not be aware of how ventilation can impact environment, health and safety. On the other hand, ventilation system design professionals cannot be expected to be fully aware of all the particular hazards posed by every type of operation that may occur in a laboratory.

## 2 Laboratory Ventilation Management Plan

### 2.1 General Requirements

Management shall establish a Laboratory Ventilation Management Plan (LVMP) to ensure proper selection, operation, use, and maintenance of laboratory ventilation equipment.

An LVMP shall be implemented to ensure proper operation of the lab ventilation systems, help protect laboratory personnel working with potentially hazardous airborne materials, provide satisfactory environmental air quality and maintain efficient operation of the laboratory ventilation systems.

The LVMP shall provide guidelines and specifications for

- commissioning to verify proper performance prior to occupancy and use of the laboratory hoods,
- description of training programs for ensuring proper use, testing and maintenance of the laboratory hoods,
- design of laboratory ventilation systems,
- maintenance procedures for providing and documenting reliable operation,
- periodic confirmation that the ventilation system is used properly,
- selection of appropriate laboratory hoods,
- specification of monitors to continuously verify proper operation of the laboratory hoods, and
- standard procedures for routine testing.

Laboratory workers and other building occupants depend on proper operation of the ventilation systems to provide safe, comfortable and productive environments for work with hazardous materials. The ventilation systems comprise numerous sub-systems and individual components including air handling units, exhaust fans, airflow controls, chemical fume hoods, biological safety cabinets and other local exhaust devices. Ensuring safe and efficient operation of laboratory ventilation systems requires careful management of the systems from design to operation.

An LVMP provides the framework for keeping the systems operating to satisfy the primary functional requirements of building personnel.

Management participation in the selection, design, and operation of laboratory ventilation systems is critical to the overall success of the effort. The program should be supported by top management. A sample Table of Contents for a Laboratory Ventilation Management Plan is included in Appendix 5.

Management should understand that ventilation equipment is not furniture, but rather it is part of installed capital equipment. It must be interfaced to the building ventilation system.

An effective LVMP should satisfy several general objectives. It should;

- define the responsibilities of departments and personnel responsible for ensuring proper operation of the systems,
- describe how the systems are to be commissioned, tested and maintained,
- provide a description of the systems and define the functional requirements,
- provide specifications for design and operation of the laboratory hood systems, and
- result in safe, dependable and efficient operation of the laboratory ventilation systems.

### 2.1.1 Exposure Control Devices

Adequate laboratory fume hoods, special purpose hoods, or other engineering controls shall be used when there is a possibility of employee overexposure to air contaminants generated by a laboratory activity.

There are numerous exposure control devices including:

- biological safety cabinets,
- gloveboxes,
- aboratory fume hoods,
- local exhaust hoods, and
- other ventilated enclosures

Exposure control devices are available in a wide variety of designs with different capabilities and limitations. Selecting the appropriate exposure control device is important to ensuring adequate protection for the laboratory worker.

OSHA requires that, employers are responsible for ensuring that exposure control devices are functioning properly and implementing feasible control measures to reduce employee exposures if the exposures exceed the PELs (§29 CFR 1910.1450(e)(3)(iii)). Furthermore, if an employer discovers through their hazard assessment efforts or employee feedback, that exposure control devices are not effectively reducing employee exposures, it is the employer's responsibility to adjust controls or replace engineering controls as necessary.

OSHA does not promulgate specific control device testing protocols

The performance of an exposure control device is ultimately determined by its ability to control exposure to within applicable standards or other safe limits.

The capture and/or containment of the selected exposure control device shall be considered adequate if, in combination with prudent practice, laboratory worker exposure levels are maintained below published or in-house exposure limits or below those limits identified in applying or using published exposure limits.

OSHA specifically states the following requirements in regards to employee exposure monitoring:

1910.1450(d) Employee exposure determination

1910.1450(d)(1) Initial monitoring.

If exposure limits [e.g., Occupational Safety and Health Administration Permissible Exposure Limits (OSHA PELs), National Institute for Occupational Safety and Health Recommended Exposure Limits (OSHA RELs), American Conference of Governmental Industrial Hygienists threshold limit values (ACGIH® TLVs® ), American Industrial Hygiene Association Workplace Environmental Exposure Limits (AIHA® WEELs®), German MAKs, (maximum admissible concentrations)] or similar limits used in prescribing and/or assessing safe handling do not exist for chemicals used in the laboratory, the employers should establish comparable in-house guidelines. Qualified industrial hygienists and toxicologists working in conjunction may be best suited to accomplish this need.