Chemical Fume Hood Field Performance Testing: Past, Present and Future

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Chemical fume hood defined

"…a ventilated enclosure that, when connected to a properly designed laboratory ventilation system, will carry the undesirable effluents (generated within the enclosure during a laboratory procedure) away from laboratory personnel."
SEFA 1 - 2002

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What compels fume hood testing?

U.S. Department of Labor, Occupational Safety & Health Administration

Regulations (Standards - 29 CFR)

Occupational exposure to hazardous chemicals in laboratories. - 1910.1450 (e)(3)(iii)

"A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment"

How we test: who has a say?

- Hood manufacturers (recommendations)
- SEFA (Scientific Equipment Furniture Association), formerly SAMA (Scientific Apparatus Manufacturer Association) (recommended practices)
- ASHRAE 110 (performance test protocol)
- NFPA (National Fire Protection Assoc.)
- ANSI Z9.5 Sub-Committee of AIHA (lab ventilation standard)
- Users, commissioning agents and field certifiers

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Standards, Guidelines, RPs

SAMA "Standard" LF-10-1981

Laboratory Fume Hoods **(replaced LF7-1975)**

Section 7: Field Evaluation

- Room condition check (cross drafts ≤ 20% face velocity)
- Face velocity test (1ft^2 grid)
- Sash operation check
- Smoke testing
- Airflow alarm performance verification (where applicable)

"It must be recognized that no fume hood can operate properly if excessive cross drafts are present"

Standards, Guidelines, RPs (contd.)

SAMA LF-10-1981 (contd.)

5.2 Face velocity guide

- Grade A use with "extreme toxicity"
  average 125-150 fpm
- Grade B for "most operations"
  average 100 fpm
- Grade C where "hazard is not high"
  average 75-80 fpm

*referenced NFPA 45 and ASHRAE Engineering Guide and Data Book 1971 as face velocity guide sources.

"Governmental code…may require specific face velocities other than those listed.."

Standards, Guidelines, RPs (contd.)

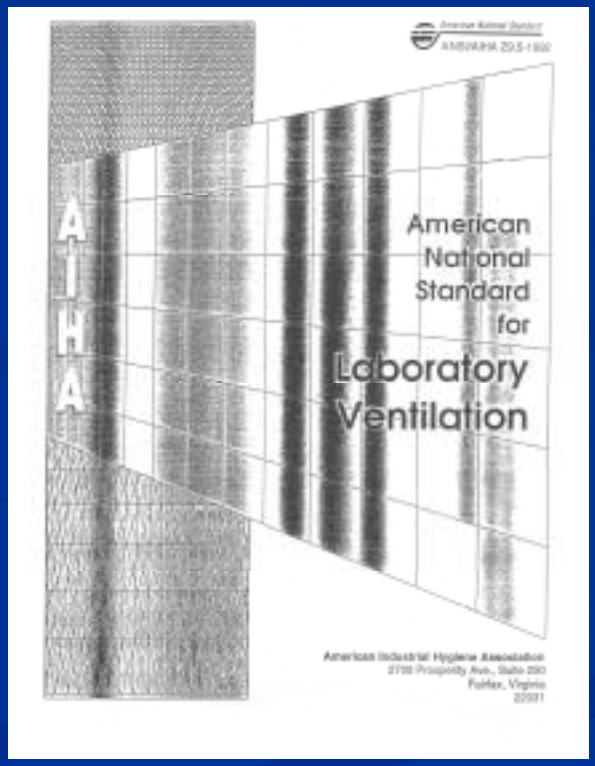
ANSI/AIHA Z9.5 - 1992

American National Standard for Laboratory Ventilation

Purpose:

"To establish minimum requirements and procedures for laboratory ventilation systems that are used to prevent personnel from overexposure to harmful or potentially harmful contaminants generated within the laboratory"

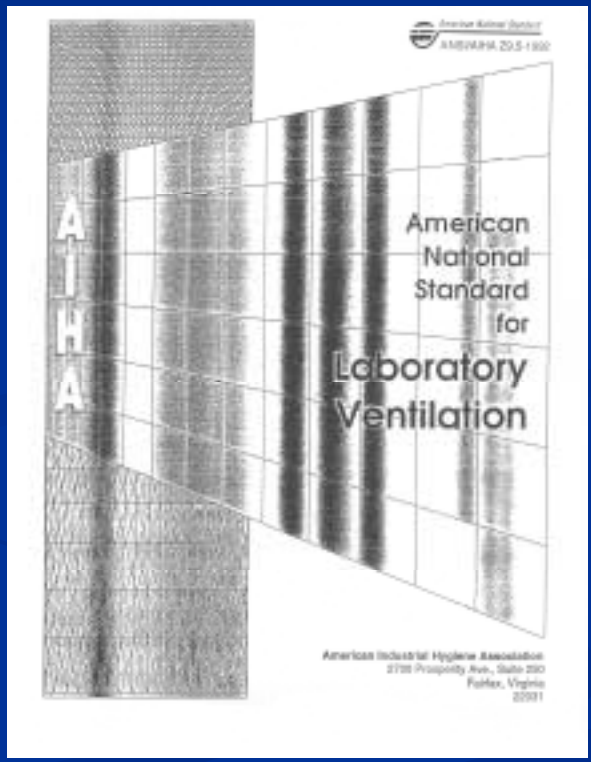
Mix of normative and informative information although not always clear what is what



Standards, Guidelines, RPs (contd.)

ANSI/AIHA Z9.5 - 1992 (contd.)

- Specifies selection of hoods shall be based on as-manufactured performance testing per ANSI/ASHRAE 110. Recognizes ASHRAE 110 as potential, but not required tool of field performance testing. References target tracer gas control ratings for AM and AU conditions.
- Periodic performance tests shall be done annually, but no clear requirements on test protocols ("If face velocity testing is used"…"face velocity alone is inadequate measure of hood performance"……."smoke testing is valuable…")
- Airflow monitors for new and renovated hoods



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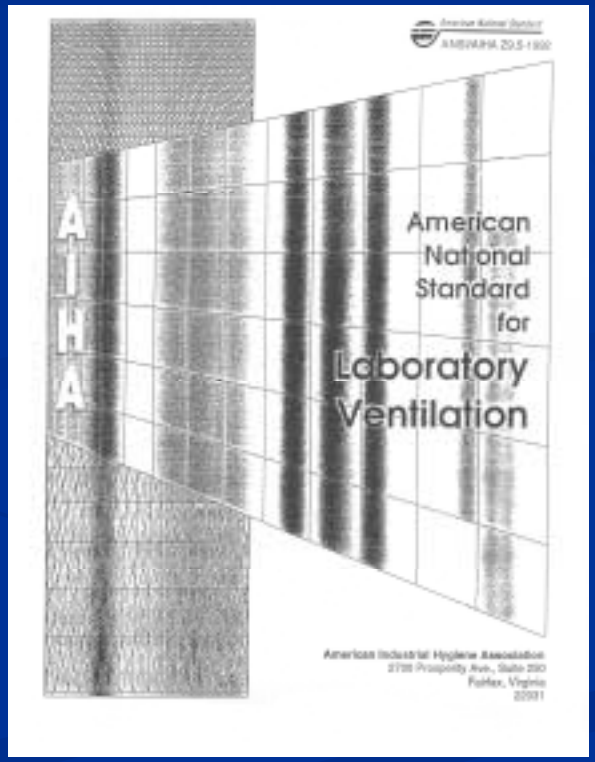
Standards, Guidelines, RPs (contd.)

ANSI/AIHA Z9.5 - 1992 (contd.)

- Keys on supply air as hood performance factor--"Proper distribution of room air supply is as important--perhaps more important--than hood face velocity…

Cross drafts shall be ≤ 50% face velocity

- "Each hood shall maintain an average face velocity of 80 - 120 fpm……the user should select an appropriate hood face velocity for each hood based on the criteria presented in the *Industrial Ventilation Manual*….This standard does not establish a standard for face velocity because of the importance of other parameters and the existence of an applicable performance test."



Standards, Guidelines, RPs (contd.)

ANSI/AIHA ASHRAE 110 - 1985, 1995

Method of Testing Performance of Laboratory Fume Hoods

- Provides test methodology NOT performance specifications for evaluation of chemical fume hood performance
- Outlines qualitative and quantitative means of testing
- Face velocity (use of thermal anemometer specified, 1ft^2 grid pattern, reading over five seconds); VAV response test, where applicable; small and large volume airflow visualization tests; tracer gas testing

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Standards, Guidelines, RPs (contd.)

ANSI/AIHA ASHRAE 110 (contd.)

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Standards, Guidelines, RPs (contd.)

ANSI/AIHA ASHRAE 110 wake up quiz

Which is the correct sash position for tracer gas containment testing?

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Standards, Guidelines, RPs (contd.)

SEFA 1.2 - 1996

Laboratory Fume Hoods Recommended Practices

(superceded SAMA LF 10 1981)

Section 6: Recommends "if required" manufacturer's "quantitative" test per ANSI/ASHRAE 110 - 1995

Section 7: Field Evaluation

No change from SAMA LF 10

(cross drafts, face velocity, smoke, alarm performance verification)

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Standards, Guidelines, RPs (contd.)

SEFA 1.2 - 1996

Laboratory Fume Hoods Recommended Practices

(contd.)

Section 5.2 Face Velocity Guide:

"Face velocities of laboratory fume hoods may be established on the basis of the toxicity or hazard of the materials used or the operations conducted within the fume hood."

"Note: Governmental codes, rules or regulations may require specific face velocities. A fume hood face velocity of 100 fpm is considered acceptable in standard practice. In certain situations, face velocity of up to 125 fpm or as low as 75 fpm may be acceptable..."

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Standards, Guidelines, RPs (contd.)

SEFA 1 - 2002

Laboratory Fume Hoods Recommended Practices

- Section 4.3.1 and 5.3.4

  "Face velocity *shall* be adequate to provide containment. Face velocity is not a measure of safety."
- Section 4.3.2
- "The manufacturer *shall* provide AM test data per ANSI/ASHRAE 110 - 1995 or current."
- Section 5.3.4

  Face velocity shall be done per ANSI/ASHRAE 110 - 1995 or current.
- Section 5.3.5

  Recommends ASHRAE 110 test upon installation
- Section 5.4.2

  Cross drafts shall be $\leq$ 20 - 50 % face velocity

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Standards, Guidelines, RPs (contd.)

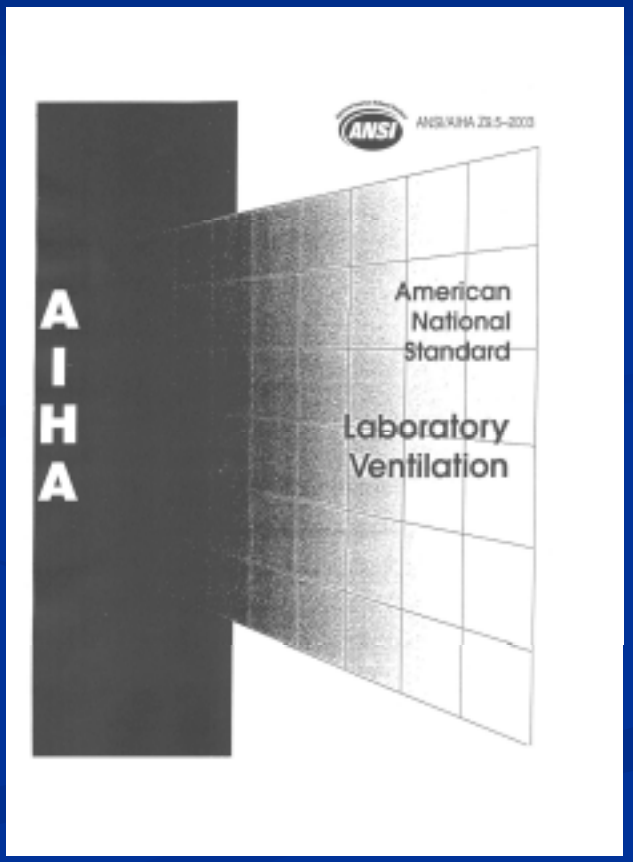
ANSI/AIHA Z9.5 - 2003

American National Standard for Laboratory Ventilation

- Normative and informative sections
- Establishes employer requirement for Ventilation Management Plan
- Section 3.3.1 normative

"The average face velocity of the hood shall produce sufficient capture and containment of hazardous materials generated under as-used conditions"

- Provides guidance on face velocity ranges (informative)



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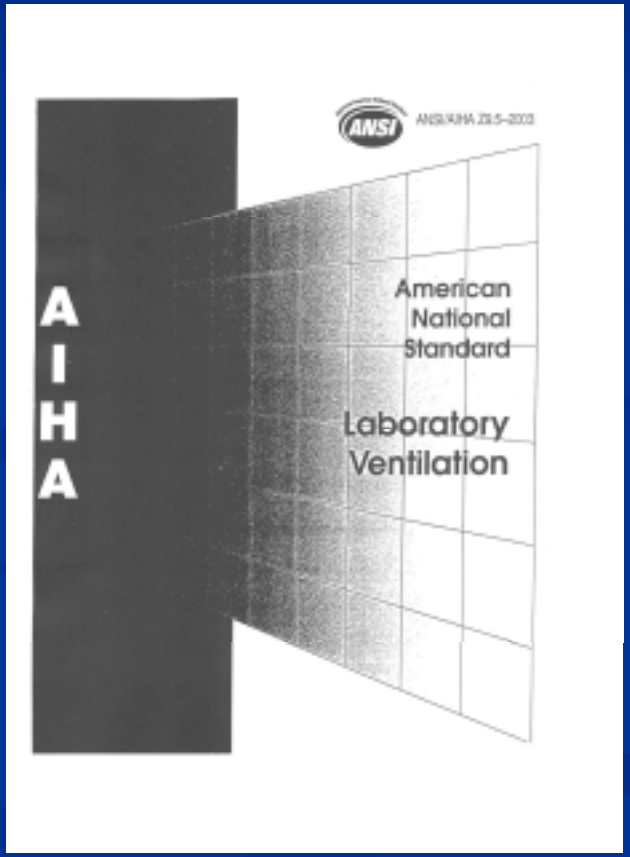
Standards, Guidelines, RPs (contd.)

ANSI/AIHA Z9.5 - 2003 (contd.)

- Section 3.3.3
  All hoods shall have flow monitoring device
- Section 6.3.5
  Cross draft velocities shall not be of such magnitude and direction as to negatively impact containment"
- Section 6.3.7
  Tracer gas tests shall be performed on newly installed hoods per ASHRAE 110 (recommended for existing hoods--informative)
- Periodic performance monitoring 90 - 120% baseline FV



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Standards, Guidelines, RPs (contd.)

ANSI/ASHRAE 110 - 2006 (expected--not yet published)

- Mannequin height 22” above work surface (vs. 26” in present version)
- Tracer gas starts 30 seconds prior to measurement
- SME test time cycles reduced from 90 seconds to 60 seconds, shortening the SME test
- Appendix provides for procedure for cross draft measurement
- Appendix provides for troubleshooting guidance on poor containment performance
- Appendix provides for suggested optional dynamic tracer gas tests

Where does this leave us?

- There is no standard specifying face velocity measurement as an adequate means of fume hood performance testing
- Face velocity airflow verification
- It's all about containment
- Think about the big (ventilation) picture

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Final Thoughts

- Expect the unexpected
- Use the ASHRAE 110 test if you really want to know about containment

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