



# AMERICAN NATIONAL STANDARD

*ANSI/ASSE Z9.10 – 2017*  
*Fundamentals Governing the Design and Operation of*  
*Dilution Ventilation Systems in Industrial Occupancies*

ANSI/ASSE Z9.10 – 2017



AMERICAN SOCIETY OF  
SAFETY ENGINEERS

The information and materials contained in this publication have been developed from sources believed to be reliable. However, the American Society of Safety Engineers (ASSE) as secretariat of the ANSI accredited Z9 Committee or individual committee members accept no legal responsibility for the correctness or completeness of this material or its application to specific factual situations. By publication of this standard, ASSE or the Z9 Committee does not ensure that adherence to these recommendations will protect the safety or health of any persons, or preserve property.

**ANSI®**  
**ANSI/ASSE Z9.10 – 2017**

**American National Standard**

**Fundamentals Governing the Design and Operation of  
Dilution Ventilation Systems in Industrial Occupancies**

Secretariat

**American Society of Safety Engineers**  
520 N. Northwest Highway  
Park Ridge, Illinois 60068

**Approved February 17, 2017**

**American National Standards Institute, Inc.**

## **American National Standard**

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus and other criteria for approval have been met by the standards developer. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution. The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he/she has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards. The American National Standards Institute does not develop standards and will in no circumstance give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretation should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

Caution Notice: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Published March 2017

**American Society of Safety Engineers**  
**520 N. Northwest Highway**  
**Park Ridge, Illinois 60068**  
**(847) 699-2929 • [www.asse.org](http://www.asse.org)**

Copyright ©2017 by American Society of Safety Engineers  
All Rights Reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Printed in the United States of America

## **Foreword** (This Foreword is not a part of American National Standard Z9.10-2017.)

This standard describes fundamental good practices related to the commissioning, design, selection, installation, operation, maintenance and testing of dilution ventilation (DV) or general exhaust ventilation (GEV) systems used for the control of employee exposure to airborne contaminants.

It is intended for use by individuals who have involvement in the design, installation, operation and maintenance of DV/GEV system; such individuals may include owners, employers, industrial hygienists, safety professionals, facility engineers, maintenance personnel, testing and balancing personnel, ventilation system designers and others with responsibility for such systems.

It is thought to be compatible with related and recognized standards of good practice. Where incompatibilities are found, use the more stringent or more correct version.

*General Coverage.* The standard describes recommended practices for the management, operation, testing and maintenance of dilution ventilation systems used for control of employee exposures to airborne contaminants, alone or in conjunction with local exhaust ventilation systems.

The standard covers industrial employee occupancies such as foundry operations, semiconductor manufacturing facilities, welding operations and any other industrial process where employees are present.

*Format.* The standard is presented in a two-column format. The left column presents the requirements of the standard; the right column provides clarification and explanation of the requirements plus "how to comply" information. The Appendix provides supplementary information by standard section number. The letter "(A)" at the end of a section or paragraph designates an Appendix entry for that section or paragraph.

Standard requirements should be considered minimum criteria and can be adapted to the needs of the user establishment. Demonstrably equal or better approaches are acceptable. When deviating from the standard, documentation should be provided. The standard is auditable by those trained in the OH&S sciences as well as in design, operation and maintenance of industrial ventilation systems. An audit form is provided in the Appendix.

*Overlap.* For sections to be mutually exclusive and to stand alone, similar requirements may be stated in more than one section of the standard.

*Flexibility.* Requirements are minimum criteria and can be adapted to the needs of the user. Demonstrably equal or better approaches are acceptable.

Where standard provisions are in conflict with other standards and codes, the more stringent or correct should be applied. Where the user deviates from the standard's requirements, the user should document justification for the deviation.

*Response and Update.* Suggestions for improvement of this standard are welcome. The Committee will carefully consider all comments and suggestions. Comments should be sent to the Z9 Secretariat, American Society of Safety Engineers, 520 N. Northwest Highway, Park Ridge, Illinois 60068.

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:

Theodore Knutson, MS, P.E., Chair  
Geoffrey Raifsnider, P.E., Vice Chair  
Ovidiu Munteanu, Secretary  
Timothy R. Fisher, CSP, CHMM, ARM, CPEA, Assistant Secretary  
Jennie Dalesandro, Administrative Technical Support

**Organization Represented**

**Name of Representative**

American Foundry Society  
American Industrial Hygiene Association  
American Society of Safety Engineers

Robert Scholz  
Lou DiBerardinis, CIH, CSP  
Paul Osley, P.E., CSP, CIH, CHMM  
Jeffrey Nesbitt, CSP, CIH

ASHRAE  
Burton, D. Jeff  
Covestro LLC  
Figueroa, Crescente  
Global Finishing Solutions

Thomas C. Smith  
D. Jeff Burton, P.E.  
Terry L. Ketchum  
Crescente Figueroa, Ph.D., CIH  
Geoffrey Raifsnider  
Brian Schadrie, P.E.

Knutson Ventilation Inc.

Theodore Knutson, MS, P.E.  
Gerhard Knutson, Ph.D., CIH

National Association for Surface Finishing

Kyle Hankinson

National Institute for Occupational Safety & Health  
National Institutes of Health  
NorthWest Occupational Health & Safety  
Paulson, Kathleen  
People, Property & Environmental Protection, Inc.  
Price, John  
Robson Forensic, Inc.  
Saint-Gobain Abrasives  
Sheehy, John  
Sherwin-Williams Company

Kenneth Hankinson  
Michael G. Elliott, Ph.D., P.E., CIH  
Farhad Memarzadeh, Ph.D., P.E.  
Neil McManus, CIH, ROH  
Kathleen "Kappy" Paulson, P.E.

Thermo Fisher Scientific

Steven Crooks  
John Price, CIH, CSP  
Ronald D. Schaible, CSP, CIH  
Ellen Pomer  
John Sheehy, Ph.D.  
Brian Haynack  
Jay Dick  
Kathryn Johanski, CIH

**Non-Voting Members:**

Lindsey Cook, CIH, CSP  
Lee Hathon  
Don R. Scarbrough

**Subgroup Z9.10 had the following members:**

D. Jeff Burton, P.E. (Chair)  
Lou DiBerardinis, CIH, CSP  
Crescente Figueroa, Ph.D., CIH  
Lee Hathon  
Jeffrey B. Hicks  
Gary Q. Johnson  
Gerhard Knutson, Ph.D., CIH

Theodore Knutson, MS, P.E.  
Rodney R. Larsen  
Dennis O'Brien  
Jeff Throckmorton

<b>Contents</b>	SECTION.....	PAGE
	1. Scope and Exclusions .....	7
	1.1 Scope .....	7
	1.2 Exclusions .....	7
	1.3 Conflicts with Other Standards and Codes .....	7
	2. Referenced Standards & Guidelines .....	8
	3. Definitions.....	8
	4. General Requirements .....	15
	5. Plant Layout & Construction.....	21
	6. Dilution Ventilation System Equipment .....	24
	7. Dilution Air .....	30
	8. Operation & Maintenance .....	37
	9. Inspection, Monitoring, Testing, Balancing and Operational Checks .....	39
	10. Management of Dilution Ventilation Systems .....	42
	Appendices:	
	A Supplementary Information .....	45
	B Audit Form.....	51

## AMERICAN NATIONAL STANDARD Z9.10 FUNDAMENTALS GOVERNING THE DESIGN AND OPERATION OF DILUTION VENTILATION SYSTEMS IN INDUSTRIAL OCCUPANCIES

### STANDARD REQUIREMENTS

### EXPLANATORY INFORMATION

*(Not part of American National  
Standard Z9.10)*

#### 1. SCOPE AND EXCLUSIONS

**1.1 Scope.** This standard establishes minimum requirements for the commissioning, design, specification, construction, installation, management, operation, maintenance and testing of dilution ventilation systems (including demand dilution ventilation) used for the reduction, prevention and control of employee exposure to harmful concentrations of airborne substances in the industrial environment. The standard establishes minimum DV requirements to provide safe and healthful working conditions in industrial employee occupancies.

**E1.1** Properly operating dilution ventilation systems are used to maintain acceptable air quality in the industrial occupational work environment through dilution and removal of air contaminants.

The standard also applies to supply and LEV makeup air systems where the makeup air is used for dilution.

The standard also applies to supplied-air islands and similar ventilation systems where the supply air is also used for dilution.

Employee comfort is a secondary factor in the standard.

**1.2 Exclusions.** This standard does not cover:

**E1.2** LEV systems are covered in ANSI/ASSE Z9.2. Laboratory ventilation systems are covered in ANSI/ASSE Z9.5. See Appendix A2 for addresses.

- ventilation used exclusively for commercial buildings and/or comfort ventilation
- HVAC and dilution ventilation systems used in non-industrial employee occupancies
- Laboratory ventilation
- LEV systems
- displacement ventilation systems
- natural dilution ventilation systems (A)
- dilution used exclusively for fire protection (A)
- systems used exclusively for heat removal and heat stress control

HVAC and dilution ventilation systems for comfort and non-industrial employee occupancies are covered in current versions of other standards and guidelines, e.g., ASHRAE 62 and AIHA's guideline, *Recommendations for the Management, Operation, Testing and Maintenance of HVAC Systems*. See Appendix A1.2 for information on natural ventilation systems and dilution ventilation used to protect against fire hazards.

Information on heat stress can be found at: <http://www.cdc.gov/niosh/topics/heatstress/>

**1.3 Conflicts with Other Standards and Codes.** Where standard provisions may be in conflict with building codes or other