ANSI/ASSE Z9.1 – 2016
Ventilation and Control of Airborne Contaminants During Open-Surface Tank Operations
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.
American National Standard

Ventilation and Control of Airborne Contaminants
During Open-Surface Tank Operations

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

Approved July 28, 2016

American National Standards Institute, Inc.
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Caution Notice: This American National Standard may be revised or withdrawn at any time.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.
Foreword  (This Foreword is not a part of American National Standard Z9.1-2016.)

This standard was developed from extended and careful examination of successful current practice in the control of health hazards resulting from open-surface tank operations. The requirements set forth are considered the minimum necessary to ensure the safety of the workers involved. Appendix A contains information on the properties of potentially toxic contaminants.


How to Read this Standard: 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.

This standard also contains Appendices, which are informative and are not considered a mandatory part of this 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 should be applied. Where the user deviates from standards requirements, the user should document justification for the deviation.

Auditing: The standard is auditable. An Audit Form is provided in the Appendix B.

Response and Update: Please contact the American Society of Safety Engineers if you have questions, comments or suggestions. As with all ANSI standards, this is a work in progress. New technology and research continues to change in this field and it is hoped that future versions of the standard will reflect this growth in knowledge. Suggestions for improvement are welcome, and should be sent to:

American Society of Safety Engineers
520 N. Northwest Highway
Park Ridge, IL 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

American Foundry Society
American Industrial Hygiene Association
American Society of Heating, Refrigeration & A/C
American Society of Safety Engineers
Burton, D. Jeff
Covestro LLC
Figueroa, Crescente
Global Finishing Solutions
Knutson Ventilation Inc.

National Association of Metal Finishers

National Institutes of Health (NIH)
National Institute for Occupational Safety & 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
Thermo Fisher Scientific

Name of Representative

Robert Scholz
Lou DiBerardinis, CIH, CSP, MIT
Thomas C. Smith
Paul Osley, P.E., CSP, CIH, CHMM
Jeffrey Nesbitt, CSP, CIH
D. Jeff Burton, CIH, CSP, P.E.
Terry L. Ketchum
Crescente Figueroa, Ph.D., CIH
Geoffrey Raifsnider, P.E.
Brian Schadrie, P.E.
Theodore Knutson, MS, P.E.
Gerhard Knutson, Ph.D., CIH
Kyle Hankinson
Kenneth Hankinson
Farhad Memarzadeh, Ph.D., P.E.
Michael G. Elliott, Ph.D., P.E., CIH
Neil McManus, CIH, ROH
Kathleen Paulson, P.E.
Steven Crooks, CIH, CSP
John Price, CIH, CSP
Ronald D. Schaible, CSP, CIH
Ellen Pomer
John Sheehy, Ph.D.
Brian Haynack
Jay Dick
Kathryn Johanski

Non-Voting Members:

Lindsey Cook, CIH, CSP
Lee Hathon
John H. Llibre
Don R. Scarbrough

Subgroup Z9.1 had the following members:

Gerhard Knutson, Ph.D, CIH (Chair)
Theodore Knutson, MS, P.E. (Vice-Chair)
D. Jeff Burton, MS, P.E.
Ken Hankinson
Kyle Hankinson
Clint Holm, MS
Kathleen Paulson, P.E.
Contents

SECTION ............................................................................................................ PAGE
1. Scope, Purpose and Application ................................................................. 7
2. Referenced Standards and Publications .................................................... 9
3. Definitions ..................................................................................................... 11
4. Classification of Open-Surface Tank Operations ....................................... 16
5. Emission and Exposure Control Requirements ........................................ 20
6. Push-Pull Ventilation .................................................................................. 41
7. General Exhaust Ventilation ...................................................................... 42
8. Vapor Degreasing Tanks ........................................................................... 42
9. Special Precautions for Cyanide .............................................................. 43
10. Operation and Maintenance ................................................................... 43
11. Respirators ................................................................................................ 45

Appendices:
A  Chemical Data Tables ................................................................................ 47
B  Audit Form .................................................................................................. 51
1. SCOPE, PURPOSE AND APPLICATION

1.1 Scope. This standard establishes minimum control requirements and ventilation system design criteria for controlling and removing air contaminants to protect the health of personnel engaged in open-surface tank operations. It is not intended to cover fire protection.

1.2 Objectives. The objectives of this standard are to:

- Protect the health and well-being of open-surface tank workers by establishing minimum requirements to control emissions of gases, vapors or mists from open-surface tank operations.
- Prevent explosive concentration of gases or vapors in ducts, hoods and enclosures.
- Protect workers from splashes and other contact with liquids.
- Prevent objectionable increases in humidity.
- Advise establishments to conform to local or state air pollution regulations.

Due to the wide variation between operations, locations, work practices, construction, equipment age, etc., compliance with this standard cannot guarantee that the objectives of Section 1.2 will be met at all times and at all locations.

1.3 Application. This standard applies to industrial occupancies utilizing open surface tanks, and tanks with automated tank covers, for the purpose of immersing parts in liquids or vapors for: cleaning, altering the