



Designation: E2993 – 23

Standard Guide for Evaluating Potential Hazard in Buildings as a Result of Methane in the Vadose Zone¹

This standard is issued under the fixed designation E2993; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides a consistent basis for assessing methane in the vadose zone, evaluating hazard and risk, determining the appropriate response, and identifying the urgency of the response.

1.2 *Purpose*—This guide covers techniques for evaluating potential hazards associated with methane present in the vadose zone beneath or near existing or proposed buildings or other structures (for example, potential fires or explosions within the buildings or structures), when such hazards are suspected to be present based on due diligence or other site evaluations (see 6.1.1). Buildings in this context include normal below grade utilities associated with a building.

1.3 *Objectives*—This guide: (1) provides a practical and reasonable industry standard for evaluating, prioritizing, and addressing potential methane hazards based on mass flow and (2) provides a tool for screening out low-risk sites.

1.4 This guide offers a set of instructions for performing one or more specific operations. This guide cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This guide is not intended to represent or replace the standard of care by which the adequacy of a given professional service should be judged, nor should this guide be applied without consideration of a project's many unique aspects. The word “Standard” in the title means only that the guide has been approved through the ASTM International consensus process.

1.5 Not addressed by this guide are:

1.5.1 Requirements or guidance or both with respect to methane sampling or evaluation in federal, state, or local regulations. Users are cautioned that federal, state, and local guidance may impose specific requirements that differ from those of this guide;

1.5.2 Safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use;

1.5.3 Emergency response situations such as sudden ruptures of gas lines or pipelines;

1.5.4 Methane entry into an enclosure from other than vadose zone soils (for example, methane evolved from well water brought into an enclosure; methane generated directly within the enclosure; groundwater intrusion, methane from leaking natural gas lines or appliances within the enclosure, direct migration into buildings from mine entries, etc.);

1.5.5 Methane entry into an enclosure situated atop or immediately adjacent to a municipal solid waste (MSW) landfill or a Construction and Demolition (C&D) landfill;

1.5.6 Methane from oil & gas reservoirs, injection wells, or other sources potentially under high pressures relative to typical vadose zone pressures;

1.5.7 Methane risk during construction activities, work in trenches, and confined space work (which are all best addressed via real-time monitoring);

1.5.8 Potential hazards from other gases and vapors that may also be present in the subsurface such as hydrogen sulfide, carbon dioxide, and/or volatile organic compounds (VOCs);

1.5.9 Anoxic conditions in enclosed spaces;

1.5.10 The forensic determination of methane source; or

1.5.11 Potential consequences of fires or explosions in enclosed spaces or other issues related to safety engineering design of structures or systems to address fires or explosions.

1.6 *Units*—The values stated in SI units are to be regarded as the standard.

1.6.1 *Exception*—Values in inch/pound units are provided for reference.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

¹ This guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.02 on Real Estate Assessment and Management.

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Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

- D653 Terminology Relating to Soil, Rock, and Contained Fluids
- D1356 Terminology Relating to Sampling and Analysis of Atmospheres
- D1946 Practice for Analysis of Reformed Gas by Gas Chromatography
- D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D5088 Practice for Decontamination of Field Equipment Used at Waste Sites
- D6725 Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers
- D7663 Practice for Active Soil Gas Sampling in the Vadose Zone for Vapor Intrusion Evaluations
- E2600 Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions
- F1815 Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity, and Bulk Density of Athletic Field Rootzones

2.2 Other Standards:

- British Standards Institution (BSI), Guidance on Investigations for Ground Gases, Permanent Gases, and Volatile Organic Compounds (VOCs). BS8576. 2013³
- British Standards Institution (BSI), Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings. BS 8485:2015+A1:2019³
- California DTSC, Evaluation of Biogenic Methane for Constructed Fills and Dairies Sites, March 28, 2012
- CL:AIRE Ground Gas Monitoring and “Worst Case” Conditions. August 2018
- County of Los Angeles Building Code, Volume 1, Title 26, Section 110 Methane⁴
- ITRC Document VI-1 Vapor Intrusion Pathway: A Practical Guideline⁵
- ITRC Document PVI-1 Petroleum Vapor Intrusion: Fundamentals of Screening, Investigation, and Management⁶
- EPA 530-R-10-003 Conceptual Model Scenarios for the Vapor Intrusion Pathway

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

³ Available from British Standards Institution (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., <http://www.bsigroup.com>.

⁴ Available from dpw.lacounty.gov.

⁵ Available from the Interstate Technology & Regulatory Council, <http://www.itrcweb.org/Documents/VI-1.pdf>.

⁶ Available from the Interstate Technology & Regulatory Council, <http://www.itrcweb.org/PetroleumVI-Guidance/>

New South Wales (NSW) EPA. Assessment and Management of Hazardous Ground Gases. May 2020.
29 CFR 1910.146 Permit-Required Confined Spaces⁷

3. Terminology

3.1 Definitions:

3.1.1 This section provides definitions and descriptions of terms used in or related to this guide. An acronym list is also included. The terms are an integral part of this guide and are critical to an understanding of the guide and its use.

3.1.2 *advection, n*—transport of molecules along with the flow of a greater medium as occurs because of differential pressures.

3.1.3 *ambient air, n*—any unconfined portion of the atmosphere; open air.

3.1.4 *barometric lag, n*—time difference between changes in total atmospheric pressure (barometric pressure) and subsequent changes in total gas pressure measured at a specific point in the subsurface.

3.1.4.1 *Discussion*—Atmospheric pressure variations include routine diurnal highs and lows as well as changes associated with exceptional meteorological conditions (weather fronts). The time lag means that differential pressure between the surface and the subsurface point may be out of phase and may reverse ($\pm$ relative to zero) with resulting reversals in soil gas flow direction over time between the shallow subsurface and the surface.

3.1.5 *barometric pumping, n*—variation in the ambient atmospheric pressure that causes motion of vapors in, or into, porous and fractured earth materials.

3.1.6 *biogas, n*—mixture of methane and carbon dioxide produced by the microbial decomposition of organic wastes, also known as microbial gas.

3.1.6.1 *Discussion*—For the purposes of this standard, biogas may arise from any organic material not specifically excluded in 1.5. The sources addressed include plant material, soil organic carbon, and petroleum hydrocarbons from past releases.

3.1.7 *biogenic, adv*—resulting from the activity of living organisms.

3.1.8 *contaminant, n*—substance not normally found in an environment at the observed concentration.

3.1.9 *continuous monitoring, n*—measurements of selected parameters performed at a frequency sufficient to define critical trends, identify changes of interest, and allow for relationships with other attributes in a predictive capacity.

3.1.10 *dead volume, n*—total air-filled internal volume of the sampling system.

3.1.11 *differential pressure, n*—relative difference in pressure between two measurement points (ΔP).

3.1.11.1 *Discussion*— ΔP measurements are typically the differences between pressure at some depth in the vadose zone and pressure above ground at the same location (indoors or

⁷ Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., Washington, DC 20210, <http://www.osha.gov>.