Designation: E1465 – 08a

Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings[1]

This standard is issued under the fixed designation E1465; 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 practice covers the design and construction of two radon control options for use in new low-rise residential buildings. These unobtrusive (built-in) soil depressurization options are installed with a pipe route appropriate for their intended initial mode of operation, that is, fan-powered or passive. One of these pipe routes should be installed during a residential building's initial construction. Specifications for the critical gas-permeable layer, the radon system's piping, and radon entry pathway reduction are comprehensive and common to both pipe routes.

1.1.1 The first option has a pipe route appropriate for a fan-powered radon reduction system. The radon fan should be installed after *(1)* an initial radon test result reveals unacceptable radon concentrations and therefore a need for an operating radon fan, or *(2)* the owner has specified an operating radon fan, as well as acceptable radon test results before occupancy. Fan operated soil depressurization radon systems reduce indoor radon concentrations up to 99 %.

1.1.2 The second option has a more efficient pipe route appropriate for passively operated radon reduction systems. Passively operated radon reduction systems provide radon reductions of up to 50 %. When the radon test results for a building with an operating passive system are not acceptable, that system should be converted to fan-powered operation. Radon systems with pipe routes installed for passive operation can be converted easily to fan-powered operation; such fan operated systems reduce indoor radon concentrations up to 99 %.

1.2 The options provide different benefits:

1.2.1 The option using the pipe route for fan-powered operation is intended for builders with customers who want maximum unobtrusive built-in radon reduction and documented evidence of an effective radon reduction system before a residential building is occupied. Radon systems with fan-powered type pipe routes allow the greatest architectural freedom for vent stack routing and fan location.

1.2.2 The option using the pipe route for passive operation is intended for builders and their customers who want unobtrusive built-in radon reduction with the lowest possible operating cost, and documented evidence of acceptable radon system performance before occupancy. If a passive system's radon reduction is unacceptable, its performance can be significantly increased by converting it to fan-powered operation.

1.3 Fan-powered, soil depressurization, radon-reduction techniques, such as those specified in this practice, have been used successfully for slab-on-grade, basement, and crawlspace foundations throughout the world.

1.4 Radon in air testing is used to assure the effectiveness of these soil depressurization radon systems. The U.S. national goal for indoor radon concentration, established by the U.S. Congress in the 1988 Indoor Radon Abatement Act, is to reduce indoor radon as close to the levels of outside air as is practicable. The radon concentration in outside air is assumed to be 0.4 picocuries per litre (pCi/l) (15 Becquerels per cubic metre (Bq/m^3)); the U.S.'s average radon concentration in indoor air is 1.3 pCi/L (50 Bq/m^3). The goal of this practice is to make available new residential buildings with indoor radon concentrations below 2.0 pCi/L (75 Bq/m^3) in occupiable spaces.

1.5 This practice is intended to assist owners, designers, builders, building officials and others who design, manage, and inspect radon systems and their construction for new low-rise residential buildings.

1.6 This practice can be used as a model set of practices, which can be adopted or modified by state and local jurisdictions, to fulfill objectives of their residential building codes and regulations. This practice also can be used as a reference for the federal, state, and local health officials and radiation protection agencies.

1.7 The new dwelling units covered by this practice have never been occupied. Radon reduction for existing low rise residential buildings is covered by Practice E2121, or by state and local building codes and radiation protection regulations.

1.8 Fan-powered soil depressurization, the principal strategy described in this practice, offers the most effective and

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most reliable radon reduction of all currently available strategies. Historically, far more fan-powered soil depressurization radon reduction systems have been successfully installed and operated than all other radon reduction methods combined. These methods are not the only methods for reducing indoor radon concentrations **(1-3)**.[2]

1.9 Section 7 is *Occupational Radon Exposure and Worker Safety*.

1.10 Appendix X1 is *Principles of Operation for Fan-Powered Soil Depressurization Radon Reduction*.

1.11 Appendix X2 is a *Summary of Practice Requirements for Installation of Radon Reduction Systems in New Low Rise Residential Building*.

1.12 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.13 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C29/C29M Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
C33 Specification for Concrete Aggregates
C127 Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
D1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2241 Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
D2282 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (Withdrawn 2006)[4]
D2466 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
D2661 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
D2665 Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
D2729 Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D2751 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings (Withdrawn 2014)[4]
E631 Terminology of Building Constructions
E1643 Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
E1745 Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
E2121 Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings
F405 Specification for Corrugated Polyethylene (PE) Pipe and Fittings (Withdrawn 2015)[4]
F628 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core
F891 Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core

2.2 *Other Publications:*

ACI 332 Requirements for Residential Concrete Construction and Commentary[5]
ACI 530/ASCE 5/TMS 402 Building Code Requirements for Masonry Structures[5]
ASME B36.10M "Welded and Seamless Wrought Steel Pipe," March 2001[6]
International One- and Two-Family Dwelling Code, Appendix D[7]
International Residential Code (IRC), Chapter 4 and Appendix F[7]
NCMA TEK 3-11 Concrete Masonry Basement Wall Construction[8]
NCMA TEK 15-1B Allowable Stress Design of Concrete Masonry Foundation Walls[8]
NCMA TEK 15-2B Strength Design of Reinforced Concrete Masonry Walls[8]
NFPA 5000 Building Construction and Safety Code, Chapters 36, 41, 43 and 49, 2003[9]
One and Two Family Dwelling Code[7]
Uniform Building Code, Chapters 18, 19 and 21[7]

3. Terminology

3.1 Definitions for standard terminology can be found in Terminology E631.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *acceptable radon concentration*—unless determined otherwise by statute, is the new building's maximum allowable in indoor radon concentration. The acceptable radon concentration is that to which the buyer and the seller agree, provided that the agreed to radon concentration is less than the U.S. Environmental Protection Agency's (EPA) recommended action level for radon in indoor air. When there has been no agreement about the building's acceptable indoor radon

[2] The boldface numbers in parentheses refer to the list of references at the end of this standard.

[3] 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.

[4] The last approved version of this historical standard is referenced on www.astm.org.

[5] Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.aci-int.org.

[6] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Avenue, New York, NY 10016-5990, http://www.asme.org.

[7] Available from International Code Council (ICC), 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041-3401, http://www.intlcode.org.

[8] Available from the National Concrete Masonry Association, (NCMA), 13750 Sunrise Valley Drive, Herndon, VA 20171-466, http://www.ncma.org.

[9] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.