Evaluation Report CCMC 14152-R
WALLTITE® CM01 (Radon Control)

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "WALLTITE® CM01," when used as a soil gas (radon) barrier in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code (NBC) of Canada 2015:

- Clause 1.2.1.1.(1)(a) of Division A, as an acceptable solution from Division B:
  - Sentence 9.13.4.2.(1), Protection from Soil Gas Ingress (air barrier system for floor assemblies)

- Clause 1.2.1.1.(1)(b) of Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
  - Sentence 9.25.3.6.(1), Air Barrier Systems in Floors-on-ground (6-mil polyethylene)

This opinion is based on CCMC's evaluation of the technical evidence in Section 4 provided by the Report Holder.

Ruling No. 21-01-364 (14152-R) authorizing the use of this product in Ontario, subject to the terms and conditions contained in the Ruling, was made by the Minister of Municipal Affairs and Housing on 12 March, 2021 pursuant to s.29 of the Building Code Act, 1992 (see Ruling for terms and conditions). This Ruling is subject to periodic revisions and updates.

2. Description

2.1 System Components

"WALLTITE® CM01" for radon control consists of spray-applied, rigid polyurethane foam of medium density (evaluated under CCMC 14100-L in compliance with CAN/ULC-S705.1-15, "Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material Specification"), meets the CCMC requirements below and is site-manufactured by qualified installers.

2.2 Qualified Installers and Site Quality Assurance Program (SQAP)

"WALLTITE® CM01" for radon control is a site-manufactured product, whereby BASF Canada Inc. requires that only specific qualified installers be authorized to install their proprietary spray polyurethane insulation in buildings. In accordance with the BASF Canada Inc. site quality assurance program (SQAP), the certification organization (CO) Caliber Quality Solutions Inc. (Caliber) has been commissioned to license the specified installers and issue them the requisite Caliber identification card. Note that the training and installer certification to install "WALLTITE® CM01" for radon control is in addition to the base Caliber/BASF Canada Inc. training for the spraying of polyurethane foam as a thermal insulation only in accordance with CAN/ULC-S705.2-05(R2016), "Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Application"). As part of their SQAP, BASF Canada Inc. also stipulates site audit inspections be conducted by site inspectors licensed by Caliber. Upon completion of the site audit, Caliber will report the product's conformity results and

any corrective action required, if necessary, to BASF Canada Inc. Building officials who would like site-audit inspections to be conducted on specific building sites can contact Caliber (see details in CCMC 14100-L).

All specified installers must present a Caliber identification card to the building official that indicates the installer is certified to install the spray foam for both intended functions; that is, as a thermal insulation (CAN/ULC-S705.2-05(R2016)) and as an air/radon barrier.

2.3 Thickness – Spray Foam and Gravel Drainage Layer

The "WALLTITE® CM01" for radon control requires a minimum of 50-mm spray polyurethane to be installed. The spray polyurethane may be sprayed directly over the NBC-specified 100-mm gravel bed or onto a geotextile. When applied directly over the gravel bed, the foam resin may penetrate up to 15 mm into the cavities between the surface gravel. For direct gravel applications, the gravel bed shall be increased to 115 mm to ensure a minimum 100-mm gravel bed as the gas-permeable layer to evacuate the radon gas.

2.4 Radon Resistance

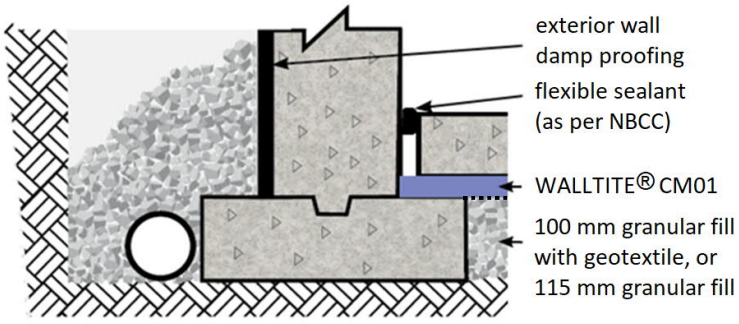
It should be noted that Sentence 9.13.4.2.(1) of Division B of the NBC 2015 requires an effective air barrier system be installed as a barrier to soil gas. "WALLTITE® CM01" has been evaluated beyond the qualification as an air barrier system required by the NBC 2015 for soil gas, as outlined in Section 5 of this Report, as "WALLTITE® CM01" has qualified as an effective barrier to, specifically, radioactive radon. "WALLTITE® CM01," when installed at 50 mm, shows better resistance to radon than 6-mil polyethylene (that is, the NBC 2015 benchmark acceptable solution).

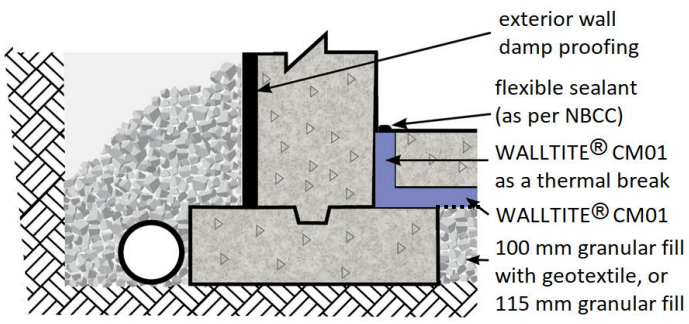
3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by "WALLTITE® CM01" for radon control being used in accordance with the conditions and limitations set out below.

- The system must be applied on site by qualified installers who are BASF-trained and Caliber-certified and who possess a Caliber identification card.(1) The SQAP and installation manual shall be available on site for review by the local authority having jurisdiction (AHJ).
- The thickness of the specified medium-density spray polyurethane foam shall be a minimum of 50 mm when installed over geotextile. When sprayed directly onto the gravel, the NBC-specified 100-mm gravel bed shall be increased to 115 mm. Per Sentence 9.16.2.1.(1), Required Installation of Granular Material, of Division B of the NBC 2015, the specified gravel shall consist of coarse, clean granular material containing not more than 10% of material that will pass a 4 mm sieve.
- A minimum of 24 hours shall pass before the installation of the 100-mm concrete floor slab.
- As with the 6-mil polyethylene sheet, care shall be taken to not damage the spray polyurethane surface during the installation of the concrete slab; in particular, damage from any reinforcement mesh.
- "WALLTITE® CM01" has shown ability to seal around penetrations of 100-mm ABS, PVC and steel pipes, and 6.35 mm copper pipes, without need for sealant. Other materials may require additional sealant (that is, polyethylene pipes).

(1) Periodic site-audit inspections of the installer are conducted by Caliber. Building officials may contact Caliber (telephone: 888-572-7435) and require an inspection for a specific job site if the building official deems it necessary.





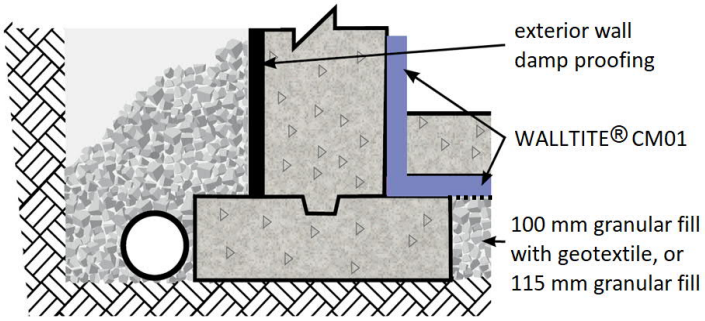


Figure 1. Application of "WALLTITE® CM01" for radon control beneath concrete slab, with geotextile/100 mm gravel or without geotextile/115 mm gravel bed.

4. Technical Evidence

The Report Holder has submitted technical documentation for CCMC's evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

4.1 Performance Requirements

The following were the key performance requirements for the evaluation:

1. **Material Qualification:** Medium-density spray polyurethane foam (SPUF) complying with CAN/ULC-S705.1, and installation as per CAN/ULC-S705.2. Confirmed through possession of active CCMC Listing;
2. **Air Barrier System:** The air barrier system for floors-on-ground qualification through testing. The NBC 2015 benchmark is 6-mil polyethylene as per Sentence 9.25.3.6.(1) of Division B of the NBC 2015;
3. **Soil Gas Barrier:** The barrier performance against soil gas, specifically radon, based on qualification testing, small-scale and large-scale. The NBC 2015 benchmark is 6-mil polyethylene as per Sentence 9.13.4.2.(1) of Division B of the NBC 2015, referring to Sentence 9.25.3.6.(1);
4. **Resistance to Mechanical Damage:** Repeat small-scale radon-barrier testing with indented SPUF by simulated concrete pour / workman load damage.
5. **Dampproofing:** The dampproofing function as a requirement for the SPUF beneath the slab is optional, as dampproofing is waived when 100 mm of coarse, clean granular material is installed beneath the slab as per Clause 9.13.2.1.(3)(c), Required Damproofing, of Division B of the NBC 2015. See Optional Testing in Section 5.1.1 of this Report.

Table 4.1.1 Material Qualification

SPUF Product CAN/ULC-S705.1 Compliance	Thermal Insulation in Field (CAN/ULC-S705.2) Site Quality Assurance Program (SQAP)	Radon Barrier in Field WALLTITE® CM01 Site Quality Assurance Program (SQAP)
CCMC 14100-L ("WALLTITE® CM01")	BASF-trained and Caliber-certified installers	BASF-trained and Caliber-certified installers

Table 4.1.2 Air Barrier System Performance

Material	Test Procedure	Unit	Requirement	Result
SPUF product CCMC 14100-L sealing around pipe penetrations[(1)]	ASTM D 2178/D 2178M-13[(1)]	L/(s·m^2)	0.02[(2)]	0.0074 – 0.0099[(3)]
6-mil polyethylene	NBC 2015 Table A-9.25.5.1.(1)	L/(s·m^2)	NBC-acceptable solution benchmark	negligible

Notes to Table 4.1.2:

(1) The tested 1 m × 1 m specimens of 50-mm-thick SPUF contained a 100-mm-diam ABS pipe and a 100-mm steel pipe to verify the SPUF sealing to elements that may penetrate "WALLTITE® CM01" in the field. The 6-mil polyethylene with a pipe penetration and tape/sealant was not tested.

(2) The derivation of the criterion is based on the permitted air leakage of a fixed window per length of seal/joint (that is, 0.068 L/s/m The circumference of the 100-mm pipe is 319 mm, resulting in a criterion of 0.319 m × 0.068 l/s/m = 0.0217 L/s.

(3) Although this air leakage performance is not as low as the negligible performance for a 6-mil polyethylene sheet without a pipe penetration, this air leakage performance is still extremely low. This testing used air as the medium to compare SPUF to 6-mil polyethylene, the comparison in Table 4.1.3 using radioactive radon (Rn) gas as the medium for comparison is the key performance indicator for evaluating/comparing the performance as a barrier to radon gas.

Table 4.1.3 Radon Barrier Performance for BASF SPUF product CCMC 14100-L at 50-mm thickness

Property	Unit	Requirement[(1)]	Result
Small-scale Tests			
Radon diffusion coefficient (D)[(3)]	m^2/s	< 8.05 × 10^{-12} m^2/s 6-mil polyethylene NBC benchmark	negligible[(2)]
Radon resistance (R_{radon})[(4)]	s/m	≥ 1.90 × 10^7 s/m 6-mil polyethylene NBC benchmark	-[(2)]
Radon diffusion coefficient (D) after mechanical damage	m^2/s	< 8.05 × 10^{-12} m^2/s 6-mil polyethylene NBC benchmark	1.59 × 10^{-10}[(5)]
Radon resistance (R_{radon}) after mechanical damage	s/m	≥ 1.90 × 10^7 s/m 6-mil polyethylene NBC benchmark	8.48 × 10^9
Large-scale Tests			
Radon infiltration (BASF "WALLTITE® CM01" and floor assembly)	%	< 6.6 % (Rn_R/Rn_D)[(6)] 6-mil polyethylene NBC benchmark	2.0

Notes to Table 4.1.3:

(1) The radon diffusion coefficient represents a material property that depends primarily on its chemical composition and is not affected by its thickness. A new product parameter known as radon resistance was defined in order to more accurately evaluate the effectiveness of material in reducing or preventing radon entry. Materials with higher radon resistance are considered less permeable to radon and therefore can prevent or reduce radon entry more effectively.

(2) The radon diffusion coefficient for the SPUF products could not be obtained, and, as such, the radon resistance could not be calculated, since no significant amount of radon diffused through the SPUF samples during the radon diffusion tests. Therefore, the SPUF at 50-mm thickness is better than the 6-mil polyethylene benchmark as a barrier to radon in this small-scale test.

(3) Testing was conducted using NRC Radon Diffusion Test Chamber (RDTC) (see Appendix A for schematic of test apparatus).

(4) Testing was conducted using NRC Radon Infiltration Building Envelope Test Systems (RIBETS) (see Appendix A for schematic of test facility).

(5) A comparison between the radon diffusion coefficients of material of different thicknesses may not represent the effectiveness of a material in reducing or preventing radon entry. The calculated radon resistance of the "WALLTITE® CM01" SPUF sample after mechanical damage is the preferred property for assessing the performance.

(6) The radon-measured levels ratio (Rn_R/Rn_D) is for comparison of the alternative solution to the benchmark acceptable solution. The numerator with subscript 'R' represents the radon in the receiving chamber. Therefore, the SPUF at 50-mm thickness is better than the 6-mil polyethylene benchmark as a barrier to radon in this large-scale test, which is representative of the installation in the field.

5. Other Technical Evidence

5.1 Additional Performance Data Requested by the Report Holder

Data in this section does not form part of CCMC's opinion in Section 1.

5.1.1 Dampproofing (Optional)

Table 5.1.1.1 Dampproofing Performance of SPUF(1)

Property	Unit	Test Procedure	Requirement	Result
Coefficient of water absorption @ 24-h(1)	$kg/(m^2 \cdot s^{1/2})$	ISO 15148:2002	< 0.0040	0.0002
Water vapour permeance	$ng/(Pa \cdot s \cdot m^2)$	ASTM E 96/E 96M, Procedure B (wet cup method)	≤ 43	46.08(2)(3)

Notes to Table 5.1.1.1:

(1) Minimum 24 hours as per ISO 15148:2002, "Hygrothermal performance of building materials and products – Determination of water absorption coefficient by partial immersion." The criterion has been met, which demonstrates that the polyurethane surface provides good water resistance.

(2) The ASTM E 96/E 96M-13, "Water Vapor Transmission of Materials," specimens were selected from three (3) 1 m × 1 m sprayed panels of 50-mm thick and tested with skins removed, resulting in 40-mm thick tested specimens with a water vapour permeance of 57.6 $ng/((Pa \cdot s \cdot m^2)$. As is it a homogenous material, the water vapour permeance of the 50-mm thick foam can be estimated to be approximately 46 $ng/(Pa \cdot s \cdot m^2)$.

(3) The criterion specified in Clause 9.13.2.2.(2)(b), Dampproofing Materials, of Division B of the NBC 2015 has not been met at the 50-mm thickness with the top and bottom skins removed. When the polyurethane is required to serve as dampproofing, the thickness shall be increased proportionally (i.e., add: [(46.08-43)/46.08] × 50 mm = 3.34 mm).

Report Holder

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CCMC was established in 1988 on behalf of the applicable regulator (i.e., the Provinces and Territories) to ensure—through assessment—conformity of alternative and acceptable solutions to regional building codes as determined by the local authority having jurisdiction (AHJ) as part of the issuance of a building permit.

It is the responsibility of the local AHJs, design professionals, and specifiers to confirm that the evaluation is current and has not been withdrawn or superseded by a later issue. Please refer to http://www.nrc-cnrc.gc.ca/ccmc or contact the Canadian Construction Materials Centre, Construction Research Centre, National Research Council of Canada, 1200 Montreal Road, Ottawa, Ontario, K1A 0R6. Telephone: 613-993-6189. Fax: 613-952-0268.

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Date modified:
2021-03-17

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In the case of any discrepancy between the English and French version of this document, the English version shall prevail.

Appendix A - NRC Construction Research Centre Radon Testing Facilities

1) Small-scale Tests
   Radon Diffusion Test Chamber (RDTC)

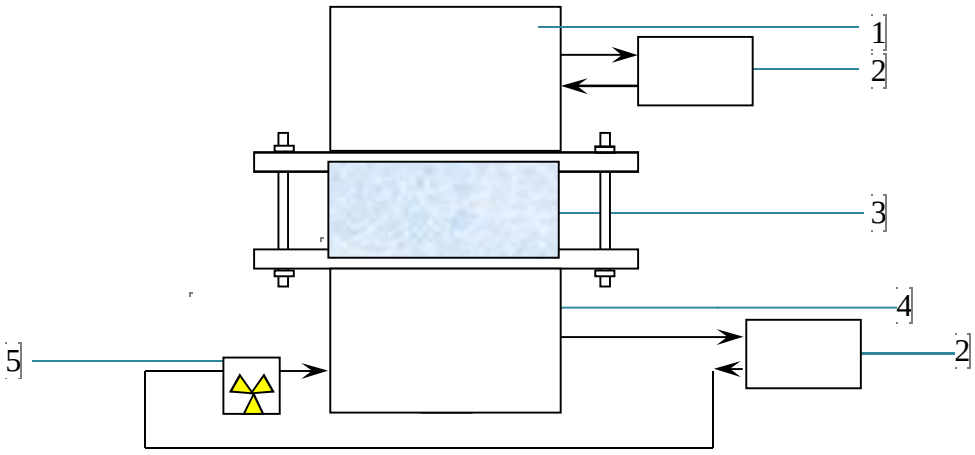

Figure A1: Schematic of RDTC

1. **Receiving compartment**
2. **Radon monitor**
3. **Test sample**
4. **Dosing compartment**
5. **Radon source**

2) Large-scale Tests
Radon Infiltration Building Envelope Test Systems (RIBETS)

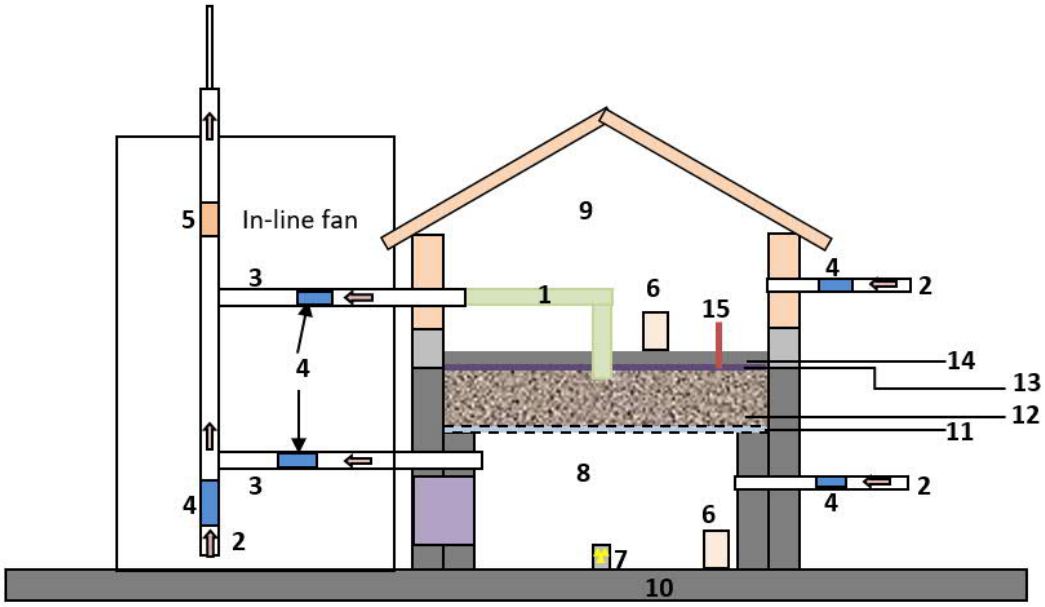

Figure A2. Conceptual design of the RIBETS

1. **Sub-slab radon (Rn) exhaust stack (100mm PVC pipe)**
2. **Make-up air stack**
3. **Exhaust stack**
4. **Control damper**
5. **In-line fan**
6. **Baseboard heater**
7. **Radon source**
8. **Dosing compartment**
9. **Receiving compartment**
10. **Concrete pad**
11. **Perforated stainless steel plate**
12. **Gravel (100 mm), specification as per NBC 2015**
13. **Air barrier (6-mil polyethylene or spray foam products)**
14. **Concrete slab (101.6 mm)**
15. **Copper tubing for pressure measurement**