

**SPEC NOTE: This guide specification is written for Western Engineered Containment with the intent that the design professional will research and incorporate appropriate edits applicable to the needs of the project.**

**SPEC NOTE: This document must be adapted to the requirements of each project; the design professional accepts all risks and responsibilities associated with document preparation. Please contact Western Engineered Containment to confirm any updates to this guide specification or to confirm technical performance criteria at **Western Engineered Containment** required for your project.**

**SPEC NOTE: The liquid applied, fiber reinforced membrane is designed for use where sub-slab conditions are subject to heavy traffic loads, or when durability requirements for projects are for permanent buildings (hospitals, schools, post-disaster occupancies).**

## 1 General

### 1.1 SUMMARY

- 1.1.1 Work of this Section forms a part of the sequence of construction associated with construction of the concrete slab and requires coordination for subgrade compaction, installation of depressurization layers and impermeable membranes, and procedures relating to installation of concrete slab.
- 1.1.2 This Section includes requirements for supply and installation of low permeance, high puncture resistant, geotextile reinforced, fluid applied soil gas containment membranes, including installation accessories and preparation of penetrations and openings through membranes required to prevent soil gases from entering building.

### 1.2 RELATED REQUIREMENTS

- 1.2.1 [Section 03 15 19 – Underslab Soil Gas Impermeable Vapour Suppression Membrane]
- 1.2.2 Section 03 20 00 – Concrete Reinforcing: Coordination of reinforcing steel supports having wide bearing base to reduce potential for puncturing soil gas containment membranes.
- 1.2.3 Section 03 31 00 – Structural Concrete: Coordination for prevention of damage to soil gas containment membranes during concrete placement, and coordination of concrete mix design compatible with placement in direct contact with impermeable membranes.

**SPEC NOTE: Include the following two related requirements when installing a sub-slab, coarse granular depressurization layer forming a part of radon mitigation measures required by the building code.**

- 1.2.4 [Section 20 05 10 – Mechanical Pipe and Pipe Fittings: Schedule 40 PVC piping and pipe fittings for rough in of underslab ventilation equipment.]
- 1.2.5 [Section 31 05 00 – Common Work Results for Earthwork: Coarse granular, gap-graded aggregate layer and grade separation geotextile materials.]

### 1.3 REFERENCE STANDARDS

- 1.3.1 American Association of State and Highway Transportation Officials (AASHTO):
  - 1.3.1.1 AASHTO M288-17, Standard Specification for Geotextile Specification for Highway Applications
- 1.3.2 American Concrete Institute International (ACI):
  - 1.3.2.1 ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
- 1.3.3 American Society for Testing and Materials (ASTM International):
  - 1.3.3.1 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension

**Project Name:**  
**Project Number:**  
**Date:**

**31 05 19.33**  
**Soil Gas Containment and Radon**  
**Mitigation Membranes**  
**Page 2**

- 1.3.3.2 ASTM D624-00 (2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
- 1.3.3.3 ASTM D751-6 (2011), Standard Test Method of Coated Fabrics
- 1.3.3.4 ASTM D4833-07 (2013e1, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- 1.3.3.5 ASTM D4541-17, Standard Test Method of Pull off Strength of Coatings Using Portable Adhesion Tester
- 1.3.3.6 ASTM D5514/D5514M-14, Large Scale Hydrostatic Puncture
- 1.3.3.7 ASTM D5617-04 (2015), Multi-Axial Tension Test for Geosynthetics
- 1.3.3.8 ASTM G160-12, Standard Practice for Evaluating Microbial Susceptibility of Non-metallic Materials by Laboratory Soil Burial

**SPEC NOTE: Include the following Reference Standard when Owner retains a Certified Professional for Radon Membrane Installations, conducting site review or membrane recommendations.**

- 1.3.4 [Canadian Association of Radon Scientists and Technologies ([CARST](#)):]
  - 1.3.4.1 [Canadian National Radon Proficiency Program \(C-NRPP\)](#)

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- 1.4.1 [Constructor]'s Quality Management Program: Establish standardized approach to managing quality of materials and workmanship during execution of the work associated with installation of soil gas suppression membranes [and radon mitigation system] the building enclosure including the following:
  - 1.4.1.1 Quality Assurance: Activities, actions, corrective remedies and procedures performed before and during execution of the Work by the [Constructor] to protect against defects and deficiencies and confirming that construction is consistent with specified regulatory and performance requirements, qualification statements and certification requirements listed within the Specification.
  - 1.4.1.2 Limitations: Quality management activities performed by the [Constructor] do not include contract administration and reporting performed by the Consultant or quality auditing activities performed by the [Owner].
- 1.4.2 Coordination: Coordinate delivery of materials specified in this section to coincide with placement of underslab [granular materials] [radon depressurization layer] and reinforcing steel.

**SPEC NOTE: Modify the terms [Constructor] and [Subcontractor] below to correspond with the contract language used for the project. Confirm Division 01 references listed in this section and coordinate with numbers and titles used for the project.**

- 1.4.3 Preconstruction Meetings: Arrange for a preconstruction meeting to confirm installation methods and materials in accordance with [[Section 01 31 19 – Project Meetings](#)], attended by [Constructor], installing [Subcontractor], Consultant and Owner.

**SPEC NOTE: Confirm with Owner that they will engage a quality auditing service to review installation of membranes. Review of membranes services are available from the Canadian Association of Radon Scientists and Technologies ([CARST](#)) and performed by Certified Professionals registered under the [Canadian National Radon Proficiency Program \(C-NRPP\)](#).**

- 1.4.4 [Owner]'s Quality Audit Program: [Owner] [may] [will] engage a third-party quality auditor in accordance with [[Section 01 45 00 – Quality Control](#)] to perform an observation and testing program to verify that specified performance requirements associated with the soil gas containment and radon mitigation are achieved.

#### 1.5 SUBMITTALS

- 1.5.1 Provide required information in accordance with [[Section 01 33 00 – Submittal Procedures](#)].

- 1.5.2 Action Submittals: Provide the following submittals before starting any work of this Section:
  - 1.5.2.1 Product Data: Submit copies of manufacturer's product literature indicating conformance with specified performance and life cycle requirements, technical information relating to specified materials, including listing of accessory materials required for complete installation and manufacturer's written installation instructions.
  - 1.5.2.2 Samples: Submit two (2), 200 mm x 300 mm sheets of membrane material proposed for use on project for verification of specification requirements.
- 1.6 DELIVERY, STORAGE AND HANDLING
  - 1.6.1 Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
  - 1.6.2 Storage and Handling Requirements: Store materials in a clean, dry area in accordance with manufacturer's instructions; protect materials during handling and application to prevent damage or contamination.
- 1.7 MOCK-UP
  - 1.7.1 Provide required Mock-Up in accordance with [Section 01 45 00 – Quality Control], and as follows:
    - 1.7.1.1 Construct fluid applied soil gas containment membrane to demonstrate surface preparation and priming of concrete, metal and plastic surfaces, junction with foundation, and protrusions through the plane of the membrane.
    - 1.7.1.2 Allow 48 hours for review of mock-up by Consultant before proceeding with gas containment membrane work.
    - 1.7.1.3 Mock-up may form a part of final construction when accepted by Consultant.

## **2 Products**

- 2.1 MANUFACTURERS
  - 2.1.1 Substitutions: Consultant may consider additional manufacturers having similar products to Basis-of-Design Products described in this Section provided they submit requests for substitution in accordance with [Section 01 25 00 – Substitution Procedures] before starting any work of this Section:
    - 2.1.1.1 Do not use substitute materials to establish Bid Price.
    - 2.1.1.2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected and replaced with specified materials.

## 2.2 SYSTEM DESCRIPTION

- 2.2.1 Sustainable Performance Requirements: Design practices for this Project encourage the use of Products and system components that minimize impact on the environment and promote sustainable construction as follows:

**SPEC NOTE: Durability is a key indicator for sustainable performance, both during installation to prevent early failure of installed materials due to punctures arising from subsequent construction, and after long-term exposure to soil organisms and microbes that can cause rapid breakdown of polyethylene materials that are commonly used for under-slab vapour barriers.**

**Key point for consideration by the Specifier when presented with requests for substitution is that the Canadian Standards governing the use of polyethylene sheets as under-slab vapour barriers specifically prohibits these materials from use in this configuration and exposure condition.**

- 2.2.1.1 Durable Materials: Materials listed in this Section have been specified to minimize materials degradation and waste over a building's design service life forming a part of the building envelope materials [for the Predicted Service Life indicated in [Section 01 45 26.23 – Site Quality Control Procedures: Durable Building Quality Management Program](#)].

**SPEC NOTE: This Section is written with the intent to describe System Rough-in Only. Modify the following description when site conditions indicate that an active extraction system is required based on existing conditions identified in a retrofit or experienced on adjacent sites.**

- 2.2.1 System Performance Requirements: Products specified in this Section are required to control the ingress of soil gases such as water vapour, [radon,] carbon-dioxide, methane and other noxious gases that are deleterious to the health of building occupants:
- 2.2.1.1 System Compatibility: Use only Products that have proven compatibility with each other, following manufacturers written instructions and recommended products.
- 2.2.1.2 System Rough-in: [Contractor] [Subcontractor] is only responsible for specified system rough-in components specified in this Section:
- 2.2.1.2.1 Post Occupancy Testing: Post occupancy testing will be conducted by the [Owner].
- 2.2.1.2.2 System Activation: Conversion of system rough-in to active depressurization system will be conducted by the [Owner] when measurements of soil gases [and radon] show concentrations above prescribed safety limits.
- 2.2.1.2.3 Responsibility for Activation: Installation of active depressurization components does not form a part of the Work of the Contract and is the [Owner]'s responsibility.
- 2.2.2 Impermeable Membrane Properties: As described below; forming a part of the work of this Section.

- 2.2.3 Additional System Components: Following components are required for a functional soil gas containment and radon mitigation system are not installed by work described in this Section; coordinate with RELATED REQUIREMENTS for installation by other [Subcontractor]s:

**SPEC NOTE: Aggregate properties described by ASTM C33 or ASTM D448 #5 Sieve represent Clean, coarse aggregate having a minimum of 90% broken faces, measured by particle mass in accordance with ASTM D5821.**

- **Aggregates must be suitable for interlocking and structural stability as a working platform for subsequent construction, and have a predictable void content allowing for placement of a reasonable number of suction pits.**
- **Specifier must make themselves aware of limitations of locally available granular materials and adjust the numbers of suction pits based on reduction of void content.**

**SPEC NOTE: Other geo-composite and premanufactured materials are available for use as the depressurization layer. These materials are suitable when suitable aggregate materials are not readily available, or where greater assurance for performance is required for the depressurization layer. Many geo-composite materials can have an equivalent void content 3 to 5 times better than the aggregate described below.**

- 2.2.3.1 Depressurization Layer Properties: Aggregate-based gas-permeable layer providing performance attributes based on [ASTM C33](#) or [ASTM D448 #5 Sieve \(25 mm to 12.5 mm\)](#). Refer to [Section 31 05 00 – Common Work Results for Earthwork](#) for supply and installation requirements.
- 2.2.3.2 Suction Pit (Depressurization Sump) Properties: Centralized depressurization field suction pit, based on 1-1.5 m<sup>2</sup> x 200 mm (0.3 m<sup>3</sup>) deep pit for each 9300 m<sup>2</sup> of building area or within each area divided by foundation elements, based on aggregate properties described above.
- 2.2.3.3 Grade Separation Properties: Geotextile fabric laid over prepared subgrade to prevent fines from diminishing transmissivity of aggregate depressurization layer.
- 2.2.3.4 Accessories: Accessory materials required for complete and functional system including collector pipes, headers and extension pipes, and riser pipes roughed-in and left accessible ready for future connection to active systems when required. Refer to [Section 20 05 10 – Mechanical Pipe and Pipe Fittings](#).

## 2.3 MATERIALS

**SPEC NOTE: Robotic pre-spray application is important to prevent defects within the film composition and to provide a uniform thickness.**

- 2.3.1 Pre-Manufactured Polyurea/Geotextile Membrane: Pre-manufactured soil gas containment composite membrane prepared by robotic application of polyurea elastomer to geotextile as follows:
- 2.3.1.1 Polyurea elastomer membrane material comprised of 100% solids, high performance, two-component polyurea.
- 2.3.1.2 Geotextile reinforcement comprised of spun bonded nonwoven polypropylene geotextile.
- 2.3.1.3 Vapour Permeance: Nominal 0.7 to 1.3 perms.
- 2.3.1.4 Chemical Resistance: Membrane will be chemically compatible with subgrade including acidic/alkaline conditions and residual organic matter which may exist.

**SPEC NOTE: Microbial resistance is often site specific, and additional testing can be provided when site testing forms a part of the specification. Most polyurea tests will show a 0 Trace (less than 10% coverage) to 1 Light (10 to 30% coverage) with no change to the physical or mechanical properties of the materials being specified to the project.**

- 2.3.1.5 Microbial Resistance: Observed Growth or Stain [0] [1] when tested in accordance with ASTM G160 [using site specific soil sample], with no change to physical or mechanical properties of the composite membrane.
- 2.3.1.6 Physical Properties:
  - 2.3.1.6.1 Critical Cone Height: Composite membrane having a large-scale hydrostatic puncture of 5.0 cm (size of protrusion required to cause failure) or greater in accordance with ASTM D5514.
  - 2.3.1.6.2 Traditional Puncture Resistance: Composite membrane having a minimum puncture resistance of 470 N in accordance with ASTM D4833.
  - 2.3.1.6.3 Tensile Strength: Composite membrane having a minimum tensile strength of 1600 N in accordance with ASTM D751, Grab Method.
  - 2.3.1.6.4 Tear Strength: Composite membrane having a minimum tear strength of 53 N/mm (Newtons per mm thickness required to initiate a tear in a 90-degree die cut angle of membrane) in accordance with ASTM D624 (Die C).
- 2.3.1.7 Thickness: Minimum thickness of 1 mm (40 mil) applied to geotextile fabric.
- 2.3.2 Polyurea Sealant and Panel Joining Material:
  - 2.3.2.1 Spray applied fast curing polyurea attachment system will be used to join panels of Membrane/Geotextile composite, as well as sealing around penetrations and joining to foundation walls and other edge details.
  - 2.3.2.2 Physical Properties: Polyurea attachment material will have the following properties:

**SPEC NOTE: Strength of Polyurea Attachment Material and hence panel joints will exceed strength of Polyurea Membrane.**

- 2.3.2.2.1 Tensile Strength: Nominal 15 to 25 N/mm<sup>2</sup> in accordance with ASTM D412, Die C
  - 2.3.2.2.2 Elongation: Minimum 400% in accordance with ASTM D412, Die C
  - 2.3.2.2.3 Tear Strength: Minimum 70 N/mm ((Newtons per mm thickness required to initiate a tear in a 90-degree die cut angle of membrane) in accordance with ASTM D624, Die C.
  - 2.3.2.2.4 Joints between panels will have a minimum Axisymmetric Strain at Break of 76.5%, with a Vessel Pressure at Rupture of 0.10 N/mm<sup>2</sup> in accordance with ASTM D5617.
  - 2.3.2.2.5 Adhesion strength to concrete structures will exceed the surface strength of the concrete.
- 2.3.3 Primer: Seal and prime concrete, metal, and plastic surfaces to be sealed with polyurea with manufacturer approved two component polyurethane primer to ensure proper adhesion.
- 2.3.4 Basis-of-Design Products: Quantum Chemical, Precidium ECS Polyurea Soil Gas Containment System, Precidium Fusion Polyurea Attachment System.

### **3 Execution**

#### 3.1 EXAMINATION

- 3.1.1 Verification of Conditions: Verify that base materials are placed level and compacted and have been accepted by Consultant before starting installation of products specified in this Section.
  - 3.1.1.1 Installation of products specified in this Section will denote acceptance of site conditions.

#### 3.2 PREPARATION

- 3.2.1 Subgrade Preparation: Prepare subgrade in accordance with [Section 31 05 00] ready for installation of soil gas mitigation materials specified in this Section.

**SPEC NOTE: Include the following three paragraphs when radon depressurization and remediation forms a part of the project specification.**

- 3.2.2 [Grade Separation Geotextile: Install geotextile in accordance with manufacturer's written instructions and requirements of Section 31 05 00.]
- 3.2.3 [Depressurization Layer: Install granular radon depressurization layer in accordance with requirements of Section 31 05 00.]
- 3.2.4 [Gas Extraction Pit: Install gas extraction pit and roughed-in PVC ventilation piping as indicated on Drawings where % Void Content of granular is within the tolerances described in this Section:]
  - 3.2.4.1 Increased Pits: Numbers of gas extraction pits increases exponentially for each 5% reduction in granular Void Content.
  - 3.2.4.2 Decreased Pits: Numbers of gas extraction pits decreases exponentially for each 5% improvement in granular Void Content.
  - 3.2.4.3 Consultant will confirm actual number of gas extraction pits based on review of Sieve Analysis report.

#### 3.3 INSTALLATION

- 3.3.1 Soil Gas Containment Membrane: Install soil gas containment membrane in accordance with manufacturer's written instructions and generally as follows:
  - 3.3.1.1 Install soil gas containment membrane immediately under and in direct contact with concrete slab.
  - 3.3.1.2 Prime concrete, metal, and plastic attachment areas, such as foundation walls, penetrations and other components transiting the membrane.
  - 3.3.1.3 Place polyurea/geotextile panel with longest dimension parallel to direction of concrete placement.

**SPEC NOTE: Select one or both following items depending on the type of foundation system required for the project.**

- 3.3.1.4 Lap membrane onto face of grade beams [and foundation walls]; and adhere using manufacturer's recommended Polyurea Attachment System.

**- OR -**

- 3.3.1.5 [Lap membrane over footings and adhere to foundation walls using manufacturer's recommended sealant materials].
  - 3.3.1.6 Seal penetrations including pipe and conduit risers in accordance with manufacturer's written instructions.
  - 3.3.1.7 Make no additional penetrations except as required for placing of reinforcing steel and permanent utilities; repair new penetrations in accordance with manufacturer's written instructions.
- 3.3.2 Repairs: Repair damaged areas by applying the Polyurea Attachment System over the damaged area.

3.4 SITE QUALITY CONTROL

- 3.4.1 [Constructor]'s Quality Management Activities: Coordinate activities of [Subcontractor]s contributing to construction of the soil gas containment and radon mitigation membrane installation, to prevent damage to installed system and provide a method for reporting and repairing of any damage arising from ongoing construction activities.
- 3.4.2 [Subcontractor]'s Quality Control Activities: Submit quality control documentation to [Constructor] and Consultant describing installation requirements for membranes, and procedures for confirming that membrane materials and detailing are installed as a continuous and sealed membrane.

**SPEC NOTE: Confirm with Owner that they will engage a quality auditing service to review installation of membranes. Review of membranes services are available from the Canadian Association of Radon Scientists and Technologies (CARST) and performed by Certified Professionals registered under the [Canadian National Radon Proficiency Program \(C-NRPP\)](#).**

- 3.4.3 [Owner]' Quality Auditor: [Owner] will prepare a final report verifying materials used, any extensive repairs or modifications to installation arising from site conditions confirming that installed soil gas containment and radon mitigation membranes were installed in accordance with performance requirements described in this Section.

**END OF SECTION**