

Geo-Seal® Vapor Intrusion Barrier
02 56 19.13
Fluid-Applied Gas Barrier
Version 1.30

Note: If membrane will be subjected to hydrostatic pressure, please contact Land Science Technologies™ for proper recommendations.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 specification sections, apply to this section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Substrate preparation:
 - 2. Vapor intrusion barrier components:
 - 3. Seam sealer and accessories.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 2 Section "Earthwork", "Pipe Materials", "Sub-drainage Systems", "Gas Collection Systems":
 - 2. Division 3 Section "Cast-in-Place Concrete" for concrete placement, curing, and finishing:
 - 3. Division 5 Section "Expansion Joint Cover Assemblies", for expansion-joint covers assemblies and installation.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide a vapor intrusion barrier system that prevents the passage of methane gas and/or volatile organic compound vapors and complies with physical requirements as demonstrated by testing performed by an independent testing agency of manufacturer's current vapor intrusion barrier formulations and system design.

1.4 SUBMITTALS

- A. Submit product data for each type of vapor intrusion barrier, including manufacturer's printed instructions for evaluating and preparing the substrate, technical data, and tested physical and performance properties.
- B. Project Data - Submit shop drawings showing extent of vapor intrusion barrier, including details for overlaps, flashing, penetrations, and other termination conditions.
- C. Samples – Submit representative samples of the following for approval:
 - 1. Vapor intrusion barrier components.
- D. Certified Installer Certificates – Submit certificates signed by manufacturer certifying that installers comply with requirements under the "Quality Assurance" article.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has been trained and certified in writing by the membrane manufacturer, Land Science Technologies™ for the installation of the Geo-Seal® System.
- B. Manufacturer Qualification: Obtain vapor intrusion barrier materials and system components from a single manufacturer source Land Science Technologies.
- C. Field Sample: Apply vapor intrusion barrier system field sample to 100 ft² (9.3 m²) of field area demonstrate application, detailing, thickness, texture, and standard of workmanship.
 - 1. Notify engineer or special inspector one week in advance of the dates and times when field sample will be prepared.
 - 2. If engineer or special inspector determines that field sample, does not meet requirements, reapply field sample until field sample is approved.
 - 3. Retain and maintain approved field sample during construction in an undisturbed condition as a standard for judging the completed methane and vapor intrusion barrier. An undamaged field sample may become part of the completed work.
- D. Pre-installation Conference: A pre-installation conference shall be held prior to application of the vapor intrusion barrier system to assure proper site and installation conditions, to include contractor, applicator, architect/engineer, other trades influenced by vapor intrusion barrier installation and special inspector (if any).

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site as specified by manufacturer labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store materials as specified by the manufacturer in a clean, dry, protected location and within the temperature range required by manufacturer. Protect stored materials from direct sunlight. If freezing temperatures are expected, necessary steps should be taken to prevent the freezing of the Geo-Seal CORE and Geo-Seal CORE Detail components.
- C. Remove and replace material that cannot be applied within its stated shelf life.

1.7 PROJECT CONDITIONS

- A. Protect all adjacent areas not to be installed on. Where necessary, apply masking to prevent staining of surfaces to remain exposed wherever membrane abuts to other finish surfaces.
- B. Perform work only when existing and forecasted weather conditions are within manufacturer's recommendations for the material and application method used.
- C. Minimum clearance of 24 inches is required for application of product. For areas with less than 24-inch clearance, the membrane may be applied by hand using Geo-Seal CORE Detail.
- D. Ambient temperature shall be within manufacturer's specifications. (Greater than +45°F/+7°C.) Consult manufacturer for the proper requirements when desiring to apply Geo-Seal CORE below 45°F/7°C.
- E. All plumbing, electrical, mechanical and structural items to be under or passing through the vapor intrusion barrier system shall be positively secured in their proper positions and appropriately protected prior to membrane application.
- F. Vapor intrusion barrier shall be installed before placement of fill material and reinforcing steel. When not possible, all exposed reinforcing steel shall be masked by general contractor prior to membrane application.
- G. Stakes used to secure the concrete forms **shall not penetrate** the vapor intrusion barrier system after it has been installed. If stakes need to puncture the vapor intrusion barrier system after it has been installed, the necessary repairs need to be made by a certified Geo-Seal applicator. To confirm the staking procedure is in agreement with the manufacturer's recommendation, contact Land Science Technologies.

1.8 WARRANTY

- A. General Warranty: The special warranty specified in this article shall not deprive the owner of other rights the owner may have under other provisions of the contract documents, and shall be in addition to, and run concurrent with, other warranties made by the contractor under requirements of the contract documents.
- B. Special Warranty: Submit a written warranty signed by vapor intrusion barrier manufacturer agreeing to repair or replace vapor intrusion barrier that does not meet requirements or that does not remain methane gas and/or volatile organic compound vapor tight within the specified warranty period. Warranty does not include failure of vapor intrusion barrier due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in the attached to structures that exceed 1/16 inch (1.58 mm) in width.
 - 1. Warranty Period: 1 year after date of substantial completion. Longer warranty periods are available upon request to the manufacturer.
- C. Labor and material warranties are available upon request to the manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Geo-Seal; Land Science Technologies™, San Clemente, CA. (949) 481-8118
 - 1. Geo-Seal BASE sheet layer
 - 2. Geo-Seal CORE spray layer and Geo-Seal CORE Detail
 - 3. Geo-Seal BOND protection layer

2.2 VAPOR INTRUSION BARRIER SPRAY MATERIALS

- A. Fluid applied vapor intrusion barrier system – Geo-Seal CORE; a single course, high build, polymer modified, asphalt emulsion. Waterborne and spray applied at ambient temperatures. A nominal thickness of 60 dry mils, unless specified otherwise. Non-toxic and odorless. Geo-Seal CORE Detail has similar properties with greater viscosity and is roller or brush applied. Manufactured by Land Science Technologies.

B. Fluid applied vapor intrusion barrier physical properties.

Geo-Seal CORE – TYPICAL CURED PROPERTIES

Properties	Test Method	Results
Tensile Strength - CORE only	ASTM 412	32 psi
Tensile Strength - Geo-Seal System	ASTM 412	662 psi
Elongation	ASTM 412	4140%
Resistance to Decay	ASTM E 154 Section 13	4% Perm Loss
Accelerated Aging	ASTM G 23	No Effect
Moisture Vapor Transmission	ASTM E 96	.026 g/ft ² /hr
Hydrostatic Water Pressure	ASTM D 751	26 psi
Perm rating	ASTM E 96 (US Perms)	0.21
Methane transmission rate	ASTM D 1434	Passed
Adhesion to Concrete & Masonry	ASTM C 836 & ASTM C 704	11 lbf./inch
Hardness	ASTM C 836	80
Crack Bridging	ASTM C 836	No Cracking
Heat Aging	ASTM D 4068	Passed
Environmental Stress Cracking	ASTM D 1693	Passed
Oil Resistance	ASTM D543	Passed
Soil Burial	ASTM D 4068	Passed
Low Temp. Flexibility	ASTM C 836-00	No Cracking at –20°C
Resistance to Acids:		
Acetic		30%
Sulfuric and Hydrochloric		13%
Temperature Effect:		
Stable		248°F
Flexible		13°F

Geo-Seal CORE Detail – TYPICAL CURED PROPERTIES

Properties	Test Method	Results
Tensile Strength	ASTM 412	32 psi
Elongation	ASTM 412	3860%
Resistance to Decay	ASTM E 154 Section 13	9% Perm Loss
Accelerated Aging	ASTM G 23	No Effect
Moisture Vapor Transmission	ASTM E 96	.026 g/ft ² /hr
Hydrostatic Water Pressure	ASTM D 751	28 psi
Perm rating (US Perms)	ASTM E 96	0.17
Methane transmission rate	ASTM D 1434	Passed
Adhesion to Concrete & Masonry	ASTM C 836	7 lbf./inch
Hardness	ASTM C 836	85
Crack Bridging	ASTM C 836	No Cracking
Low Temp. Flexibility	ASTM C 836-00	No Cracking at –20°C
Resistance to Acids:		
Acetic		30%
Sulfuric and Hydrochloric		13%
Temperature Effect:		
Stable		248°F
Flexible		13°F

2.3 VAPOR INTRUSION BARRIER SHEET MATERIALS

- A. The Geo-Seal BASE layer and Geo-Seal BOND layer are chemically resistant sheets comprised of a 5 mil high density polyethylene sheet thermally bonded to a 3 ounce non woven geotextile.
- B. Sheet Course Usage
 1. As foundation base layer, use Geo-Seal BASE course and/or other base sheet as required or approved by the manufacturer.
 2. As top protective layer, use Geo-Seal BOND layer and/or other protection as required or approved by the manufacturer.

C. Geo-Seal BOND and Geo-Seal BASE physical properties.

Properties	Test Method	Results
Film Thickness		5 mil
Composite Thickness		18 mil
Water Vapor Permeability	ASTM E 96	0.214
Adhesion to Concrete	ASTM D 1970	9.2 lbs/inch ²
Dart Impact	ASTM D 1790	>1070 gms, method A 594 gms, method B
Puncture Properties Tear	ASTM B 2582 MD	11,290 gms
	ASTM B 2582 TD	13,150 gms

2.4 AXILLARY MATERIALS

- A. Sheet Flashing: 60-mil reinforced modified asphalt sheet good with double-sided adhesive.
- B. Reinforcing Strip: Manufacturer's recommended polypropylene and polyester fabric.
- C. Gas Venting Materials: Geo-Seal Vapor-Vent HD or Geo-Seal Vapor-Vent Poly, and associated fittings.
- D. Seam Detailing Sealant Mastic: Geo-Seal CORE Detail, a high or medium viscosity polymer modified water based asphalt material.
 - 1. Back Rod: Closed-cell polyethylene foam.

PART 3 – EXECUTION

3.1 AUXILIARY MATERIALS

- A. Examine substrates, areas, and conditions under which vapor intrusion barrier will be applied, with installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 SUBGRADE SURFACE PREPARATION

- A. Verify substrate is prepared according to manufacturer's recommendations. On a horizontal surface, the substrate should be free from material that can potentially puncture the vapor intrusion barrier. Additional protection or cushion layers might be required if the earth or gravel substrate contains too many jagged points and edges that could puncture one or more of the system components. Contact manufacturer to confirm substrate is within manufactures recommendations.
- B. Geo-Seal can accommodate a wide range of substrates, including but not limited to compacted earth, sand, aggregate, and mudslabs.
 - 1. Compacted Earth: Remove pieces of debris, gravel and/or any other material that can potentially puncture the Geo-Seal BASE. Remove any debris from substrate that can potentially puncture the Geo-Seal system prior to application.
 - 2. Sand: A sand subgrade requires no additional preparation, provided any material that can potentially puncture the Geo-Seal BASE layer is not present.
 - 3. Aggregate: Contact the manufacturer to ensure the aggregate layer will not be detrimental to the membrane. **The gravel layer must be compacted and rolled flat.** Ideally a ¾" minus gravel layer with rounded edges should be specified; however the Geo-Seal system can accommodate a wide variety of different substrates. Contact Land Science Technologies if there are questions regarding the compatibility of Geo-Seal and the utilized substrate. Exercise caution when specifying pea gravel under the membrane, if not compacted properly, pea gravel can become an unstable substrate.
 - 4. Mudslabs: The use of a mubslab under the Geo-Seal system is acceptable, contact Land Science Technologies for job specific requirements.
- C. Mask off adjoining surface not receiving the vapor intrusion barrier system to prevent the spillage or over spray affecting other construction.
- D. Earth, sand or gravel subgrades should be prepared and compacted to local building code requirements.

3.3 CONCRETE SURFACE PREPARATION

- A. Clean and prepare concrete surface to manufacturer's recommendations. In general, only apply the Geo-Seal CORE material to dry, clean and uniform substrates. Concrete surfaces must be a light trowel, light broom or equivalent finish. Remove fins, ridges and other projections and fill honeycomb, aggregate pockets, grout joints and tie holes, and other voids with hydraulic

cement or rapid-set grout. It is the applicator's responsibility to point out unacceptable substrate conditions to the general contractor and ensure the proper repairs are made.

- B. When applying the Geo-Seal CORE or Geo-Seal CORE Detail material to concrete it is important to not apply the product over standing water. Applying over standing water will result in the membrane not setting up properly on the substrate
- C. Surfaces may need to be wiped down or cleaned prior to application. This includes, but is not limited to, the removal of forming oils, concrete curing agents, dirt accumulation, and other debris. Contact form release agent manufacturer or concrete curing agent manufacturer for VOC content and proper methods for removing the respective agent.
- D. Applying the Geo-Seal CORE to "green" concrete is acceptable and can be advantageous in creating a superior bond to the concrete surface. To help reduce blistering, apply a primer coat of only the asphalt component of the Geo-Seal CORE system. Some blistering of the membrane will occur and may be more severe on walls exposed to direct sunlight. Blistering is normal and will subside over time. Using a needle nose depth gauge confirm that the specified mil thickness has been applied.

3.4 PREPARATIONS AND TREATMENT OF TERMINATIONS

- A. Prepare the substrate surface in accordance with Section 3.3 of this document. Concrete surfaces that are not a light trowel, light broom or equivalent finish, will need to be repaired.
- B. Terminations on horizontal and vertical surfaces should extend 6" onto the termination surface. Job specific conditions may prevent a 6" termination. In these conditions, contact manufacturer for recommendations.
- C. Apply 30 mils of Geo-Seal CORE to the terminating surface and then embed the Geo-Seal BASE layer by pressing it firmly into the Geo-Seal CORE layer. Next, apply 60 mils of Geo-Seal CORE to the BASE layer. When complete, apply the Geo-Seal BOND layer. After the placement of the Geo-Seal BOND layer is complete, apply a final 30 mil seal of the Geo-Seal CORE layer over the edge of the termination. For further clarification, refer to the termination detail provided by manufacturer.
- D. The stated termination process is appropriate for terminating the membrane onto exterior footings, pile caps, interior footings and grade beams. When terminating the membrane to stem walls or vertical surfaces the same process should be used.

3.5 PREPARATIONS AND TREATMENT OF PENETRATIONS

- A. All pipe penetrations should be securely in place prior to the installation of the Geo-Seal system. Any loose penetrations should be secured prior to Geo-Seal application, as loose penetrations could potentially exert pressure on the membrane and damage the membrane after installation.
- B. To properly seal around penetrations, cut a piece of the Geo-Seal BASE layer that will extend 6" beyond the outside perimeter of the penetration. Cut a hole in the Geo-Seal BASE layer just big enough to slide over the penetration, ensuring the Geo-Seal BASE layer fits snug against the penetration, this can be done by cutting an "X" no larger than the inside diameter of the penetration. There should not be a gap larger than a 1/8" between the Geo-Seal BASE layer and the penetration. Other methods can also be utilized, provided, there is not a gap larger than 1/8" between the Geo-Seal BASE layer and the penetration.
- C. Seal the Geo-Seal BASE layer using Geo-Seal CORE or Geo-Seal CORE Detail to the underlying Geo-Seal BASE layer.
- D. Apply one coat of Geo-Seal CORE Detail or Geo-Seal CORE spray to the Geo-Seal BASE layer and around the penetration at a thickness of 30 mils. Penetrations should be treated in a 6-inch radius around penetration and 3 inches onto penetrating object.
- E. Embed a fabric reinforcing strip after the first application of the Geo-Seal CORE spray or Geo-Seal CORE Detail material and then apply a second 30 mil coat over the embedded joint reinforcing strip ensuring its complete saturation of the embedded strip and tight seal around the penetration.
- F. After the placement of the Geo-Seal BOND layer, a cable tie should then be placed around the finished penetration. The cable tie should be snug, but not overly tight so as to slice into the finished seal.

OPTION: A final application of Geo-Seal CORE may be used to provide a finishing seal after the Geo-Seal BOND layer has been installed.

NOTE: Metal or other slick penetration surfaces may require treatment in order to achieve proper adhesion. For plastic pipes, sand paper may be used to achieve a profile, an emery cloth is more appropriate for metal surfaces. An emery cloth should also be used to remove any rust on metal surfaces.

3.6 GEO-SEAL BASE LAYER INSTALLATION

- A. Install the Geo-Seal BASE layer over substrate material in one direction with six-inch overlaps and the geotextile (fabric side) facing down.
- B. Secure the Geo-Seal BASE seams by applying 60 mils of Geo-Seal CORE between the 6" overlapped sheets with the geotextile side down.
- C. Visually verify there are no gaps/fish-mouths in seams.

- D. For best results, install an equal amount of Geo-Seal BASE and Geo-Seal CORE in one day. Leaving unsprayed Geo-Seal BASE overnight might allow excess moisture to collect on the Geo-Seal BASE. If excess moisture collects, it needs to be removed.

NOTE: In windy conditions it might be necessary to encapsulate the seam by spraying the Geo-Seal CORE layer over the completed Geo-Seal BASE seam.

3.7 GEO-SEAL CORE APPLICATION

- A. Set up spray equipment according to manufacturer's instructions.
- B. Mix and prepare materials according to manufacturer's instructions.
- C. The two catalyst nozzles (8001) should be adjusted to cross at about 18" from the end of the wand. This apex of catalyst and emulsion spray should then be less than 24" but greater than 12" from the desired surface when spraying. When properly sprayed the fan pattern of the catalyst should range between 65° and 80°.
- D. Adjust the amount of catalyst used based on the ambient air temperature and surface temperature of the substrate receiving the membrane. In hot weather use less catalyst as hot conditions will quickly "break" the emulsion and facilitate the curing of the membrane. In cold conditions and on vertical surfaces use more catalyst to "break" the emulsion quicker to expedite curing and set up time in cold conditions.
- E. To spray the Geo-Seal CORE layer, pull the trigger on the gun. A 42° fan pattern should form when properly sprayed. Apply one spray coat of Geo-Seal CORE to obtain a seamless membrane free from pinholes or shadows, with an average dry film thickness of 60 mils (1.52 mm).
- F. Apply the Geo-Seal CORE layer in a spray pattern that is perpendicular to the application surface. The concern when spraying at an angle is that an area might be missed. Using a perpendicular spray pattern will limit voids and thin spots, and will also create a uniform and consistent membrane.
- G. Verify film thickness of vapor intrusion barrier every 500 ft². (46.45 m²), for information regarding Geo-Seal quality control measures, refer to the quality control procedures in Section 3.9 of this specification.
- H. The membrane will generally cure in 24 to 48 hours. As a rule, when temperature decreases or humidity increases, the curing of the membrane will be prolonged. The membrane does not need to be fully cured prior the placement of the Geo-Seal BOND layer, provided mil thickness has been verified and a smoke test will be conducted.
- I. **Do not penetrate** membrane after it has been installed. If membrane is penetrated after the membrane is installed, it is the responsibility of the general contractor to notify the certified installer to make repairs.
- J. If applying to a vertical concrete wall, apply Geo-Seal CORE directly to concrete surface and use manufacturer's recommended protection material based on site specific conditions. If applying Geo-Seal against shoring, contact manufacturer for site specific installation instructions.

NOTE: Care should be taken to not trap moisture between the layers of the membrane. Trapping moisture may occur from applying a second coat prior to the membrane curing. Repairs and detailing may be done over the Geo-Seal CORE layer when not fully cured.

3.8 GEO-SEAL BOND PROTECTION COURSE INSTALLATION

- A. Install Geo-Seal BOND protection course perpendicular to the direction of the Geo-Seal BASE course with overlapped seams over nominally cured membrane no later than recommended by manufacturer and before starting subsequent construction operations.
- B. Sweep off any water that has collected on the surface of the Geo-Seal CORE layer, prior to the placement of the Geo-Seal BOND layer.
- C. Overlap and seam the Geo-Seal BOND layer in the same manner as the Geo-Seal BASE layer.
- D. To expedite the construction process, the Geo-Seal BOND layer can be placed over the Geo-Seal CORE immediately after the spray application is complete, provided the Geo-Seal CORE mil thickness has been verified.

3.9 QUALITY ASSURANCE

- A. The Geo-Seal system must be installed by a trained and certified installer approved by Land Science Technologies.
- B. For projects that will require a material or labor material warranty, Land Science Technologies will require a manufacturer's representative or certified 3rd party inspector to inspect and verify that the membrane has been installed per the manufacturer's recommendations.

The certified installer is responsible for contacting the inspector for inspection. Prior to application of the membrane, a notice period for inspection should be agreed upon between the applicator and inspector.

- C. The measurement tools listed below will help verify the thickness of the Geo-Seal CORE layer. As measurement verification experience is gained, these tools will help confirm thickness measurements that can be obtained by pressing one's fingers into the Geo-Seal CORE membrane.

To verify the mil thickness of the Geo-Seal CORE, the following measurement devices are required.

1. Mil reading caliper: Calipers are used to measure the thickness of coupon samples. To measure coupon samples correctly, the thickness of the Geo-Seal sheet layers (18 mils each) must be taken into account. Mark sample area for repair.
2. Wet mil thickness gauge: A wet mil thickness gauge may be used to quickly measure the mil thickness of the Geo-Seal CORE layer. The thickness of the Geo-Seal sheet layers do not factor into the mil thickness reading.

NOTE: When first using a wet mil thickness gauge on a project, collect coupon samples to verify the wet mil gauge thickness readings.
3. Needle nose digital depth gauge: A needle nose depth gauge should be used when measuring the Geo-Seal CORE thickness on vertical walls or in field measurements. Mark measurement area for repair.

To obtain a proper wet mil thickness reading, take into account the 5 to 10 percent shrinkage that will occur as the membrane fully cures. Not taking into account the thickness of the sheet layers, a freshly sprayed membrane should have a minimum wet thickness of 63 (5%) to 66 (10%) mils.

Methods on how to properly conduct Geo-Seal CORE thickness sampling can be obtained by reviewing literature prepared by Land Science Technologies.

- D. It should be noted that taking too many destructive samples can be detrimental to the membrane. Areas where coupon samples have been removed need to be marked for repair.
- E. Smoke Testing is highly recommended and is the ideal way to test the seal created around penetrations and terminations. Smoke Testing is conducted by pumping non-toxic smoke underneath the Geo-Seal vapor intrusion barrier and then repairing the areas where smoke appears. Refer to smoke testing protocol provided by Land Science Technologies. For projects that will require a material or labor material warranty, Land Science Technologies will require a smoke test.
- F. Visual inspections prior to placement of concrete, but after the installation of concrete reinforcing, is recommended to identify any punctures that may have occurred during the installation of rebar, post tension cables, etc. Punctures in the Geo-Seal system should be easy to identify due to the color contrasting layers of the system.