

LIQUID BOOT®
Brownfield Membrane/Liner & Vent System

www.liquidboot.com

SUPERIOR TECHNOLOGY AND THE HIGHEST OF STANDARDS AND QUALITY ASSURANCE

designed by Dana McCombs

lbi technologies, Inc.

what is a brownfield?

Brownfields are areas the United States Environmental Protection Agency defines as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination."

In the face of society's increasing needs and limited space, the rehabilitation of America's Brownfields remains a necessary, complex and dynamic challenge. For the past 25 years, LBI Technologies, Inc., the manufacturers of *LIQUID BOOT*®, has offered an innovative and reliable solution to meet the challenge of gas vapor containment. With more than 25 years of proven performance, *LIQUID BOOT*® is the answer to providing an impermeable membrane for brownfield sites. With millions of square feet already in place, *LIQUID BOOT*® sets the industry standard to prevent potentially hazardous gases or vapors from entering a structure. The combination of the unsurpassed quality of *LIQUID BOOT*® along with the technical expertise of our in-house engineers has lead LBI Technologies, Inc., to the forefront of membrane brownfield redevelopment. We are ready to work with you in helping to revitalize, enhance and protect some of the best situated properties in your city.

LIQUID BOOT® product features & benefits

- Cold spray-applied membrane, provides excellent sealing of penetrations.
- Seamless, monolithic membrane. No battening required.
- Significant cost savings over conventional sheet membrane systems.
- Ability to function well in large-scale industrial applications as well as smaller residential applications.
- Rapid and simplified installation minimizes construction time.
- Over 25 years of proven performance and successful installations of millions of square feet of the *LIQUID BOOT*® Brownfield Membrane/Liner System.



LIQUID BOOT® representatives are available nationwide to help you design a cost-effective Brownfield membrane/liner that will meet the specific needs of your project. Contact LBI Technologies, Inc. to speak with a representative in your area:



Ph | 714.384.0111
e-mail | lbi@liquidboot.com
web | www.liquidboot.com

physical properties

warranty:

Contact LBI Technologies, Inc. for complete details regarding LIQUID BOOT® warranty at:

ph | 714.384.0111

e-mail | lbi@liquidboot.com

web | www.liquidboot.com

* Required tests for membranes installed in the City of Los Angeles methane zone

PROPERTY	TEST METHOD	VALUE
WATERPROOFING		
Soil Burial	ASTM E154-88	Passed
Water Penetration Rate	ASTM D2434	< 7.75 x 10 ⁻⁹ cm/sec
Water Vapor Permeability	ASTM E96	0.24 perms
Water Vapor Transmission	ASTM E96	0.10 grains/h-ft ²
GAS VAPOR MEMBRANE		
Hydrogen Sulfide Gas Permeability	ASTM D1434	None Detected
Benzene, Toluene, Ethylene, Xylene, Gasoline, Hexane, Perchloroethylene, Trichloroethylene, Vinyl Chloride	ASTM D543	< 1% weight change
Sodium Sulfate (2% water solution)	tested at 20,000 ppm	
Acid Exposure (10% H ₂ SO ₄ for 90 days)	ASTM D543, D412, D1434	< 1% weight change
Radon Permeability	ASTM D543	< 1% weight change
Chromate Exposure (10% Chromium ⁶⁺ salt for 31 days)	Tested by US Dept. of Energy	none (222 Rn)
Air Infiltration	ASTM E96	< 1% weight change
* Bonded Seam Strength Tests	ASTM E283-91	0 cfm/sq. ft.
* Micro Organism Resistance (Soil Burial)	ASTM D6392	Passed
<i>average weight change, average tensile strength change, average tensile stress change, average elongation change, bonded seams, methane permeability</i>	ASTM D4068-88	Passed
* Methane Permeability		
* Oil Resistance Test	ASTM 1434-82	Passed
<i>average weight change, average tensile strength change, average tensile stress change, average elongation change, bonded seams</i>	ASTM D543-87	Passed
* Heat Aging		
<i>average tensile strength change, average tensile stress change, average elongation change, bonded seams</i>	ASTM D4068-88	Passed
* Dead Load Seam Strength	City of Los Angeles	Passed
* Environmental Stress-Cracking	ASTM D1693-78	Passed
POTABLE WATER		
Toxicity Test	22 CCR 66696	Passed. CCR Bioassay
Potable Water Containment	ANSI/NSF 61	NSF Certified for tanks > 300,000 gallons
GENERAL INFORMATION		
Coefficient of Friction (with geotextile both sides)	ASTM D5321	0.72
Cold Bend Test	ASTM D146	Passed. No cracking at -25°F
Freeze-Thaw Resistance (100 Cycles)	ASTM A742	Meets criteria. No spalling/disbondment
Accelerated Weathering and Ultraviolet Exposure	ASTM D822	No adverse effect after 500 hours
Hydrostatic Head Resistance	ASTM D751	Tested to 138ft. or 60psi
Elongation	ASTM D412	1,332% no reinforcing 90% recovery
Elongation (8 oz. non-woven geotextile both sides)	ASTM D751	100% (Same as geotextile tested separately)
Tensile Strength	ASTM D412	58psi, no reinforcing
Tensile Strength (8 oz. non-woven geotextile both sides)	ASTM D751	196psi (Same as geotextile tested separately)
Tensile Bond Strength to Concrete	ASTM D413	2,556 lbs/ft ² uplift force
Puncture Resistance (8 oz. non-woven geotextile both sides)	ASTM D4833	286 lbs. travel of probe=0.756 in
Electric Volume Resistivity	ASTM D257	1.91 x 10 ¹⁰ ohms-cm

project profiles



Harbor Facility Center / 60,000 square feet
oakland, california

USE | Maintenance Storage Facility

SOIL CONDITION | Petroleum Hydrocarbons, VOCs, Methane Gas
MITIGATION SYSTEM | *LIQUID BOOT*® gas vapor membrane system and a “passive” venting system

APPLICATION | *LIQUID BOOT*® gas vapor membrane was spray-applied and provided an efficient and gas-tight seal to the footprint of the building as well as approximately 148 piles.

engineer | Treadwell & Rollo

applicator | Blue’s Roofing



Belgravia Redevelopment / 24,000 square feet
south haven, michigan

USE | New Townhomes on Former Manufacturing Site

SOIL CONDITION | Petroleum Hydrocarbons, Chlorinated Solvents
MITIGATION SYSTEM | *LIQUID BOOT*® gas vapor membrane and an “active” venting system

APPLICATION | *LIQUID BOOT*® spray-applied to existing slab and covered with topping slab for tennis court area. *LIQUID BOOT*® sprayed onto geotextile and protected with *LIQUID BOOT*® UltraShield P-150 in pool area.

engineer | MACTEC, Inc.

applicator | Quality Maintenance Contractors (QMC)



Public Storage / 32,000 square feet
salem, massachusetts

USE | Former Tannery Site

SOIL CONDITION | Metals, Petroleum Contaminants, PAHs
MITIGATION SYSTEM | *LIQUID BOOT*® gas vapor membrane and *LIQUID BOOT*® GeoVent “active” venting system

APPLICATION | 3,000 lineal feet of *LIQUID BOOT*® GeoVent trenchless venting system installed, followed by the spray-application of the *LIQUID BOOT*® gas vapor membrane.

engineer | ENSR

applicator | Terrafix Environmental



Playa Vista Carabela / 140,000 square feet
playa vista, california

USE | Subterranean Parking Structure for Housing

SOIL CONDITION | Methane Gas
MITIGATION SYSTEM | *LIQUID BOOT*® gas vapor membrane and a “passive” venting system

APPLICATION | *LIQUID BOOT*® gas vapor membrane spray-applied under the slab and on all below grade walls to block gases from migrating into the structures.

engineer | Carlin Environmental

applicator | Gergen Construction

project profiles

Colony Park High School / 300,000 square feet
ontario, california

USE | School Built on Former Dairy Farm Land

SOIL CONDITION | Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and *LIQUID BOOT®* GeoVent “passive” venting system

APPLICATION | *LIQUID BOOT®* gas vapor membrane spray-applied onto a geotextile fabric under the slab provided an impermeable gas vapor barrier that will prevent methane gas intrusion.

engineer | GeoKinetics, Inc.

applicator | Advanced Construction Technologies (ACT)



Kendall Square / 80,000 square feet
boston, massachusetts

USE | Office Buildings on Former Manufacturing Site

SOIL CONDITION | Residual Organic Compounds, COCs

MITIGATION SYSTEM | Remediation of soil, *LIQUID BOOT®* gas vapor membrane, and an “active” venting system

APPLICATION | *LIQUID BOOT®* spray-applied under slab and onto geotextile fabric; attached onto piles, pile caps, grade beams and penetrations.

engineer | The RETEC Group

applicator | Terrafix Environmental



Home Depot / 150,000 square feet
oregon city, oregon

USE | Large Retail Store on Closed Landfill Site

SOIL CONDITION | Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and a geocomposite venting system

APPLICATION | Vent pipes used to direct methane gas to roof for release; *LIQUID BOOT®* membrane applied to provide barrier between the soil and structure to prevent intrusion of methane gas.

engineer | GeoSyntec Consultants, Inc.



Los Angeles Library / 400,000 square feet
los angeles, california

USE | New Public Library Situated 50 Feet Below Grade

SOIL CONDITION | Pressurized Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and waterproofing system

APPLICATION | *LIQUID BOOT®* spray-applied under the slab and up the walls to seal the entire building to prevent methane gas and water from migrating into the structure.

engineer | Methane Specialists



Project Profiles



Cedars-Sinai Medical Center | 80,000 square feet
Los Angeles, California

USE | Hospital Built on Former Oil Well Property

SOIL CONDITION | Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane

APPLICATION | *LIQUID BOOT®* gas vapor membrane spray-applied under the slab and on all below grade walls to block gases from migrating into the structures; membrane also used to provide ground water protection (*LIQUID BOOT®* UltraDrain 6200 used for water drainage).

engineer | Methane Specialists

applicator | Courtney Waterproofing



Wendy's Restaurant | 2,400 square feet
Chicago, Illinois

USE | Fast Food Restaurant on Former Service Station Site

SOIL CONDITION | Residual Petroleum Contaminants

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and *LIQUID BOOT®* GeoVent "active" venting system

APPLICATION | *LIQUID BOOT®* GeoVent used as a venting layer beneath the membrane; *LIQUID BOOT®* gas vapor membrane system spray-applied under the slab and sealed to all footings and pipe penetrations.

engineer | Giles Engineering

applicator | Streich Corporation



Express Ferry Terminal | 7,500 square feet
Milwaukee, Wisconsin

USE | Harbor Ferry Terminal Building

SOIL CONDITION | Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and *LIQUID BOOT®* GeoVent "active" venting system

APPLICATION | *LIQUID BOOT®* gas vapor membrane spray-applied atop the *LIQUID BOOT®* GeoVent system provided an efficient and gas-tight seal to the footprint of the building.

engineer | Giles Engineering

applicator | Quality Maintenance Contractors (QMC)



Queens Vocational School | 25,000 square feet
Queens, New York

USE | Addition to Existing School

SOIL CONDITION | Residual VOCs

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and a venting system

APPLICATION | *LIQUID BOOT®* gas vapor membrane spray-applied onto a geotextile fabric under the slab provided an impermeable gas vapor barrier that will block VOCs and gases.

engineer | Langan Engineering

applicator | EAI, Inc.

Project Profiles

Manning Village by Ryan Homes | 60,000 square feet
 accokeek, maryland

USE | Housing Development on Soil with Gas Contamination

SOIL CONDITION | Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and an “active” venting system

APPLICATION | *LIQUID BOOT®* spray-applied beneath each home to ensure a safe and gas-tight living space.

engineer | Matson & Associates

applicator | Barrett & Sons



Rikers Island Jail Facility | 50,000 square feet
 new york, new york

USE | New Detention and Storage Facilities on Former Landfill Site

SOIL CONDITION | Hydrogen Sulfide Gas, Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and a venting system

APPLICATION | *LIQUID BOOT®* spray-applied under foundation slab and sprayed directly to all penetrations and protrusions to provide a gas-tight seal.

engineer | SCS Engineers



Costco Wholesale | 135,000 square feet
 ocean township, new jersey

USE | Large Retail Store on Former Landfill Site

SOIL CONDITION | Methane Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane

APPLICATION | *LIQUID BOOT®* gas vapor membrane spray-applied onto a geotextile fabric under the slab provided an impermeable gas vapor barrier that will keep methane out of the building.

engineer | Environmental Waste Management Association

applicator | Edgeboro International



Publix Supermarket | 45,000 square feet
 miami, florida

USE | Supermarket on Former Landfill Site

SOIL CONDITION | Methane Gas, Ammonia Gas

MITIGATION SYSTEM | *LIQUID BOOT®* gas vapor membrane and *LIQUID BOOT®* GeoVent “passive” venting system

APPLICATION | *LIQUID BOOT®* membrane spray-applied to a geotextile fabric and sealed directly to 1,400 penetrations and pile caps.

engineer | GeoSyntec Consultants, Inc.

applicator | Terrafix Environmental



LIQUID BOOT® GeoVent



Topanga Corporate Center,
Palm Bluffs | Fresno, Ca

Use | Situated on Closed Landfill Site Contamination | VOCs, Methane Gas Mitigation System | LIQUID BOOT® gas vapor membrane and LIQUID BOOT® GeoVent "active" venting system

engineer | Technicon Engineering
applicator | Gergen Construction

LIQUID BOOT® GeoVent is a low profile pressure relief, collection and venting system (PRCVS) that has been successfully utilized at hundreds of installations. LIQUID BOOT® GeoVent has several advantages over a trenched installation:

- Installed directly on subgrade; eliminates need for trenching and potential interference or damage to existing underground utilities.
- Placed in closer proximity to the gas vapor barrier, which allows for more effective venting of any accumulated gas.
- Has a greater opening area per lineal foot of pipe and integral filter fabric, which allows for higher ventilation efficiency.
- Penetrates interior footings or stiffener beams at a higher elevation than trenched piping; the higher penetration level occurs at a location where the footings are typically less heavily stressed and is therefore desirable from a structural perspective.
- Installed at a higher elevation and is therefore less susceptible to inundation from perched groundwater, which may accumulate beneath the building foundation from rain-fall or over-irrigation.
- Flow characteristics meet or exceed that of a typical trenched installation. The overall capacity of the system is far in excess of typical gas flux rates.

LIQUID BOOT® GeoVent

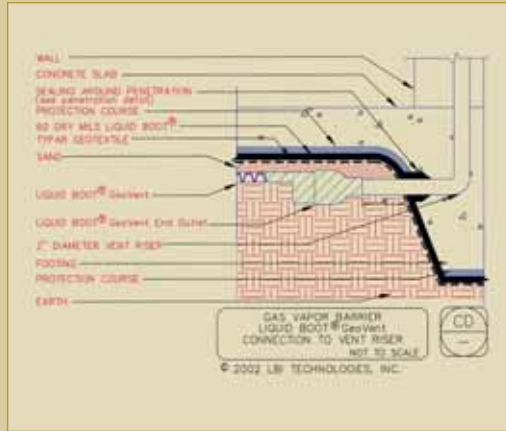
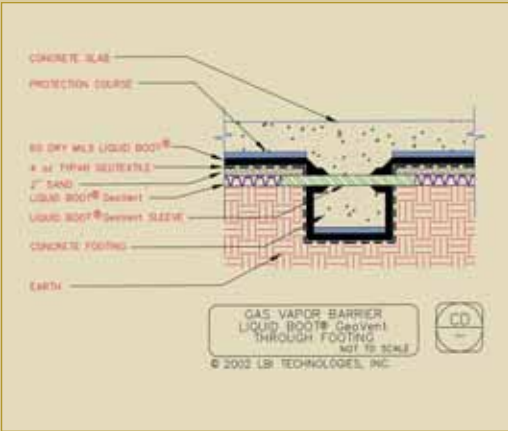
physical properties

LIQUID BOOT® GeoVent consists of a 3-dimensional vent core, wrapped with a non-woven needle punched filter fabric. This product meets the following specifications:

TEST METHOD	TYPE OF TEST	MINIMUM VALUE
ASTM D-1621	Compressive Strength	7500 psf
ASTM D-1777	Thickness	1.0 in.
ASTM D-4716	Core Flow, Q@3600 psf & Hydraulic Gradient .1300 Hrs	30g/min/ft. width
ASTM D-4833	Puncture Strength	65 lbs.
ASTM D-4751	Apparent Opening Size (AOS)	70 US Sieve
ASTM D-4632	Grab Tensile Strength	100 lbs.
ASTM D-4632	Grab Tensile Elongation	50%
ASTM D-4533	Trapezoid Tear Strength	45 lbs.
ASTM D-4491	Permittivity	1.9 sec ⁻¹
ASTM D-4491	Permeability	0.21 cm/sec
ASTM D-4491	Flow Rate	140 gal. min. ft. ²
ASTM D-4355	U.V. Resistance (@500Hours)	70%
ASTM D-3786	Mullen Burst Strength	210 psi
ASTM D-5261	Mass/Unit Area	4.0 oz/yd ²

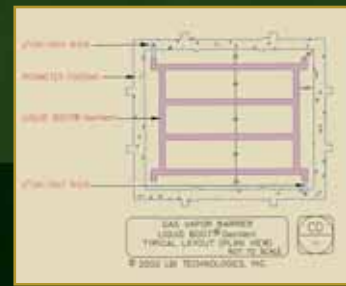
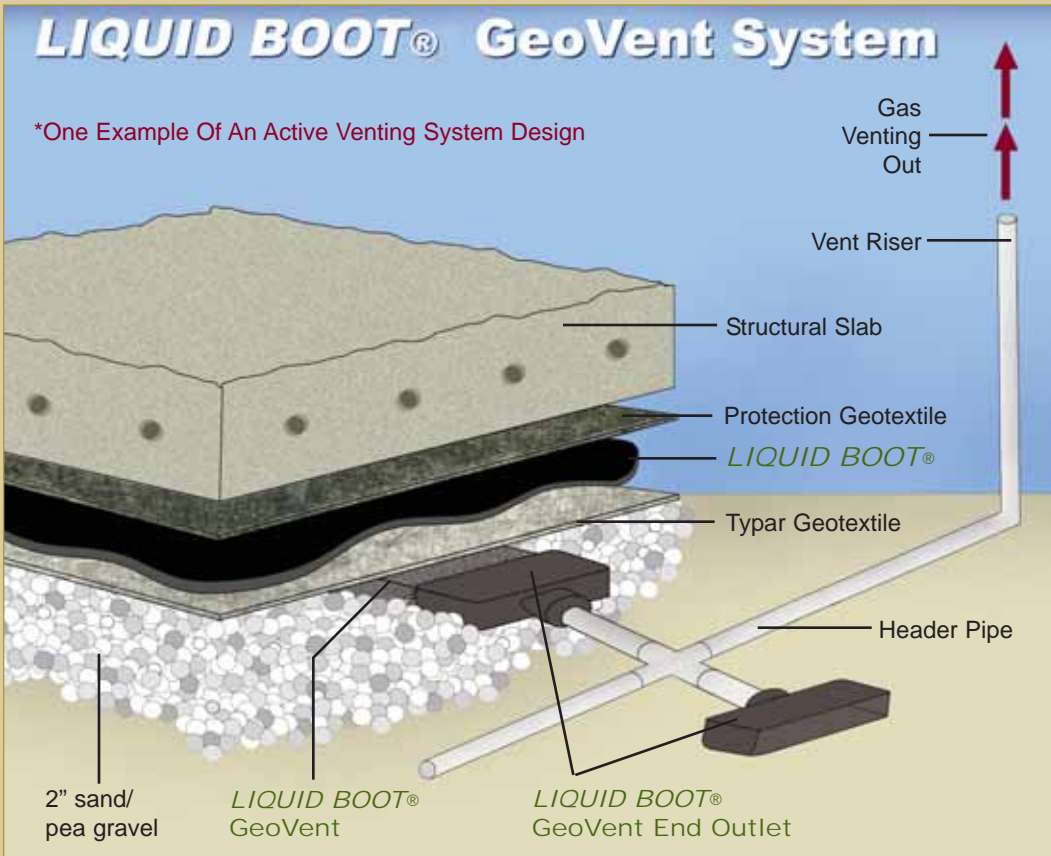


LIQUID BOOT® GeoVent



LBI's Technical Experts Will Design Your Membrane and Venting System with Custom Details & Specifications.

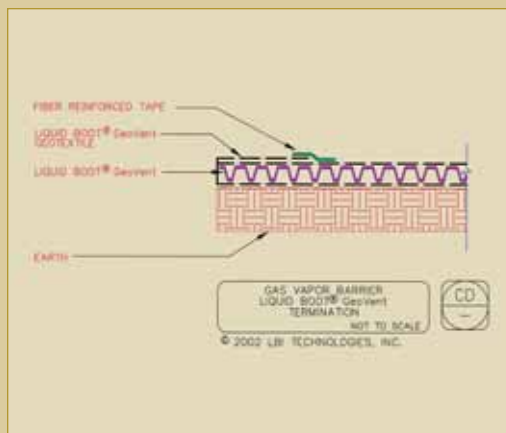
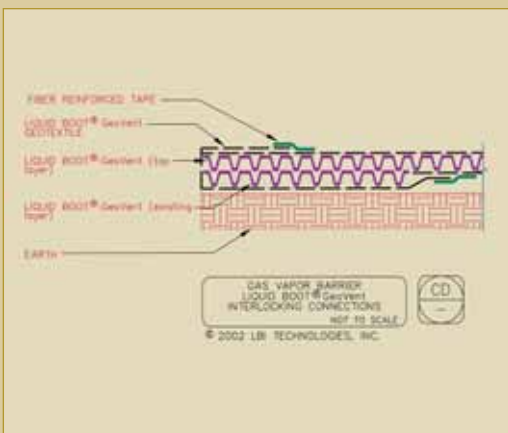
LBI has worked with architects, environmental engineers and contractors in the design of thousands of various membrane systems. For custom CAD details and specifications, contact your LIQUID BOOT® representative or e-mail us at lbi@liquidboot.com



warranty:

Contact LBI Technologies, Inc. for complete details regarding LIQUID BOOT® warranty at:

Ph | 714.384.0111
 e-mail | lbi@liquidboot.com
 web | www.liquidboot.com



LIQUID BOOT® Smoke Test



what is a smoke test?

A smoke test is a method of ensuring that a membrane is impermeable and free of holes. Smoke is pumped under the membrane for a specified period of time while the surface of the membrane is observed for minute holes where the smoke is clearly visible. One of the benefits of this is that the applicator is present during the smoke test and can immediately repair any holes detected.

This process has been field tested under hundreds of buildings and found to be highly successful. The smoke testing process assures engineers, developers, and owners alike that they are getting a fully tested, gas-tight membrane installation.

LIQUID BOOT® smoke testing process



1. Equipment set-up for smoke test



2. Starting smoke test procedure



3. Puncture detected by smoke



4. Close-up of smoke exiting through puncture



5. Applicator patching puncture



6. Patched membrane