

# **LIQUID BOOT® Fluid-Applied Liner for Canals, Tanks, & Reservoirs**

## **Section 07100 | Version 4.4**

These Specifications may have changed. Please contact CETCO Remediation Technologies at 714.384.0111 for the most recent version.

### **PART 1 - GENERAL**

- 1.01 **DESCRIPTION-** General and Supplementary Conditions and Division 1 - General Requirements applies to this section. Provide fluid applied liner for canals, ponds, tanks, or reservoirs as indicated, specified and required.
- A. Work in this section - principal items include: Fluid applied liners for canals, ponds, tanks, reservoirs, ditches, etc.
- B. Related work NOT in this section: excavation and backfilling, flashing and sheet metal, parge coat on masonry to receive membrane, joint sealers, mortar beds or concrete toppings over membranes, soil sterilant, latex waterproofing, sand blasting, damp-proofing, and drainage.
- 1.02 **QUALITY ASSURANCE-** Liner contractor/applicator shall be trained and approved by liner manufacturer, CETCO. A pre-installation conference shall be held prior to application of liner to assure proper substrate and installation conditions, to include contractor, applicator, architect/engineer and special inspector (if any).
- 1.03 **SUBMITTALS** (Refer to section 01300 for procedures)
- A. Project Data - Submit manufacturer's product data and installation instructions for specific application.
- B. Samples - Submit representative samples of the following for approval: Liner material, protection board and/or protection mat, prefabricated drainage mat, and geotextiles.
- 1.04 **DELIVERY, STORAGE AND HANDLING-** Deliver materials to site in original unbroken packages bearing manufacturer's label showing brand, weight, volume and batch number. Store materials at site in strict compliance with manufacturer's instructions. Do not allow materials to freeze in containers.
- 1.05 **JOB CONDITIONS**
- A. Protect all adjacent areas not to be waterproofed. 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 product used.
- C. Minimum clearance of required for application of product: 90° degree spray wand – 2 feet. Conventional spray wand – 4 feet.
- D. Ambient temperature shall be within manufacturer's specifications. If winter conditions apply, we recommend the use of space heaters and necessary cover (i.e. visqueen) to bring the ambient temperature to at least +45°F until the protection course and structural slab rebar or a mudslab protection course has been placed.
- E. All plumbing, electrical, mechanical and structural items to be under or passing through the waterproof membrane shall be positively secured in their proper positions and appropriately protected prior to membrane application.
- F. Waterproof membrane shall be installed before placement of reinforcing steel. When not possible, all exposed reinforcing steel shall be masked by General Contractor prior to membrane application.
- G. Expansion joints must be filled with a conventional waterproof expansion joint material.
- H. Surface preparation shall be per manufacturer's specification.
- 1.06 **PRODUCT WARRANTY-** CETCO warrants its products to be free of defects. This warranty only applies when the LIQUID BOOT® is applied by CETCO Approved Applicators and that the required respective CETCO products (such as LIQUID BOOT® UltraDrain, LIQUID BOOT® UltraShield, and LIQUID BOOT® Geovent) are used. As factors, which affect the result obtained from this product, including weather, equipment utilized, construction, workmanship and other variables, are all beyond the manufacturer's control, CETCO warrants only that the material conforms to its product specifications. Under this warranty, CETCO will replace at no charge any product not meeting these specifications within 12 months of manufacture, provided it has been applied in accordance with CETCO written directions for use recommended as suitable for this product. Warranties are available for a longer period upon request and mutual written consent. This warranty is in lieu of any and all other warranties expressed or implied (including any implied warranty of merchantability or fitness for a particular use), and CETCO shall have no further liability of any kind including liability for consequential or incidental damages resulting from any defects or delays caused by replacement or otherwise.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. Fluid applied liner system - LIQUID BOOT®; a single course, high build, polymer modified asphaltic emulsion. Water borne and spray applied at ambient

temperatures. A minimum thickness of 80 dry mils, unless specified otherwise. Non-toxic and odorless. LIQUID BOOT® Trowel Grade has similar properties with greater viscosity and is trowel applied. Manufactured by CETCO, Santa Ana, CA (714) 384-0111.

B. Fluid-Applied Waterproofing Physical Properties:

POTABLE WATER	TEST METHOD	VALUE
Toxicity Test	22 CCR 66696	Passed. (CCR Bioassay—Flathead Minnow)
Potable Water Containment	ANSI/NSF 61	NSF Certified for tanks >300,000 gal
WATERPROOFING	TEST METHOD	VALUE
Soil Burial	ASTM E154-88	Passed
Water Penetration Rate	ASTM D2434	<7.75 x 10 <sup>-9</sup> cm/sec
Water Vapor Permeability	ASTM E96	0.24 perms
Water Vapor Transmission	ASTM E96	0.10 grains/h-ft <sup>2</sup>
GAS VAPOR MEMBRANE	TEST METHOD	VALUE
Hydrogen Sulfide Gas Permeability	ASTM D1434	None Detected
Benzene, Toulene, Ethylene, Xylene, Gasoline, Hexane,	ASTM D543, D412, D1434	Passed-gas permeability & weight change, tested at 20,000 ppm)
Sodium Sulfate (2% water solution)	ASTM D543, D412, D143	Passed-gas permeability & weight change
Acid Exposure (10% H <sub>2</sub> SO <sub>4</sub> for 90 days)	ASTM D543	Less than 1% weight change
Radon Permeability	Tested by US Dept. of Energy	Zero permeability to Radon (222Rn)
Bonded Seam Strength Tests	ASTM D6392	Passed
Micro Organism Resistance (Soil Burial)-Average weight change, average tensile strength and stress change, average elongation change, bonded seams, methane permeability	ASTM D4068-88	Passed
Methane Permeability	ASTM 1434-82	Passed
Oil Resistance Test- Average weight change, average tensile strength change, average tensile stress change, average elongation change, bonded seams, methane permeability	ASTM D543-87	Passed
Heat Aging- Average tensile strength change, average tensile stress change, average elongation change, bonded seams	ASTM D4068-88	Passed
Dead Load Seam Strength	City of Los Angeles	Passed
Environmental Stress-Cracking	ASTM D1693-78	Passed
PCE Diffusion Coefficient	Tested at 6,000 mg/m <sup>3</sup>	2.74 x 10 <sup>-14</sup> m <sup>2</sup> /sec
TCE Diffusion Coefficient	Tested at 20,000 mg/m <sup>3</sup>	8.04 x 10 <sup>-14</sup> m <sup>2</sup> /sec
GENERAL INFORMATION	TEST METHOD	VALUE
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 or disbondment
Accelerated Weathering & Ultraviolet Exposure	ASTM D822	No adverse effect after 500 hours
Hydrostatic Head Resistance	ASTM D751	Tested to 138 feet or 60 p.s.i
Elongation	ASTM D412	1,332% Ø reinforcement, 90%recovery
Elongation- 8oz. non-woven geotextile both sides	ASTM D751	100%- same as geotextile tested separately
Tensile Strength	ASTM D412	58 p.s.i. without reinforcement
Tensile Strength- 8oz. non-woven geotextile both sides	ASTM D751	196 p.s.i.- same as geotextile tested separately
Tensile Bond Strength to Concrete	ASTM D413	2,556 lbs/ft <sup>2</sup> uplift force
Puncture Resistance-8oz. non-woven geotextile both sides	ASTM D4833	286 lbs. (Probe Travel= .756 in., same as geotextile tested separately)
Flame Spread	ASTM E108	Class A with top coat (comparable to UL790)
Electric Volume Resistivity	ASTM D257	1.91 x 10 <sup>10</sup> ohms-cm

C. Agency Approvals:

- City of Los Angeles Research Report – RR 24860-Approved for “LIQUID BOOT® Spray Applied Membrane for Below-Grade Waterproofing”
- United States Navy-Approved for “LIQUID BOOT® for Use World Wide to Waterproof Earth-Covered Steel Ammunition Storage”
- County of Kern Environmental Health Services Department-Approved for “LIQUID BOOT® as a Methane Barrier”
- NSF International-NSF/61 approved for “Potable Water Tank Liner”
- Canadian Construction Materials Board-Approved for “Waterproofing and Dampproofing”
- County of Los Angeles Department of public works-Approved for “LIQUID BOOT® Application as a Methane Gas Barrier”

D. Base Geotextile- LIQUID BOOT® BaseFabric T-40 non-woven geotextile, unless otherwise specified and approved by membrane manufacturer. The heat-rolled side shall be used as the application surface. Some projects may require a heavier geotextile (LIQUID BOOT® BaseFabric T-60.).

- E. Cold Joints, Cracks, Form Tie Holes: Covered with Hardcast CRT 1602 Tape (3" or 6" wide).
- F. Protections- Use protections as approved by CETCO, project architect or engineer.

### **PART 3 - EXECUTION**

- 3.01 **EXAMINATION-** All surfaces to be lined shall be inspected and approved by the applicator at least one day prior to commencing work.
- 3.02 **SURFACE PREPARATION-** Provide 24 inch minimum clearance out from surfaces to receive the liner. The application surface shall be prepared and provided to the applicator in accordance with manufacturer's specifications listed below:

**NOTE:** Before lining tank, canal or reservoir, determine that it is structurally sound and able to support the weight and pressure of its contents when full. All cracks, joints, and holes must be grouted with appropriate materials sufficient to support the weight and pressures of the contents.

- A. **Concrete/Shotcrete/Masonry/Asphalt-** Concrete surfaces shall be light broom finish or smoother, free of any dirt, debris, loose material, release agents or curing compounds. Fill all voids more than 1/4 inch deep and 1/4 inch wide. Masonry joints, cold joints, and form joints shall be struck smooth. All penetrations shall be prepared in accordance with manufacturer's specifications. Provide a 3/4 inch minimum cant of LIQUID BOOT®, or other suitable material as approved by manufacturer, at all horizontal to vertical transitions and other inside corners of 120° or less. **Allow to cure overnight before the application of LIQUID BOOT®.** All form ties holes must be completely grouted from the inside to outside of wall with non-shrink grout as approved by engineer. All cracks or cold joints greater than 1/16 inch wide must be completely grouted with non-shrink grout as approved by engineer. Install Hardcast reinforcing tape over all cold joints, cracks and form tie holes (after holes and cracks are grouted).
- B. **Dirt -** The sub-grade shall be moisture conditioned and compacted to a minimum relative compaction of 90 percent or as specified by civil/geotechnical engineer. The finished surface shall be smooth, uniform, free of debris and standing water. Remove all stones or dirt clods greater than 1/4 inch. (NOTE: Aggregate sub-base surfaces shall be rolled flat and free from protruding sharp edges.) Final sub-grade preparation shall not precede the membrane application by more than 72 hours. All penetrations shall be prepared in accordance with manufacturer's specifications. All form stakes that penetrate the membrane shall be of rebar which shall be bent over and left in the slab. Trenches shall be cut oversize to accommodate liner and protection course with perpendicular to sloped sides and maximum obtainable compaction. Adjoining grade shall be finish graded and compacted. Excavated walls shall be vertical to sloped back, free of roots and protruding rocks. Specific sub-grade preparation shall be designed by a qualified civil or geotechnical engineer. Soil sterilant must be sprayed onto dirt sub-base for all canals, ponds, and reservoirs before geotextile is rolled out. Spray-apply soil sterilant at the sterilant manufacturer's recommended rate.
- C. **Steel and Other Metal Surfaces-** Remove all rust and loose material from the surface with a wire brush or brush blast. Repair all weak and/or perforated areas. Remove all factory oils from new substrates.

### **3.03 INSTALLATION**

#### **3.03.10 INSTALLATION ON CONCRETE/SHOTCRETE/MASONRY (Follow the procedures below carefully)**

- B. Refer to section 3.03.40, "Sealing Around Penetrations", for procedures to seal around penetrations.
- B. Provide a 3/4 inch minimum cant of LIQUID BOOT®, or other suitable material as approved by manufacturer, at all horizontal to vertical transitions and other inside corners of 120° or less. **Allow to cure overnight before the application of LIQUID BOOT®.**
- C. Delineate a test area on site with a minimum dimension of 10 feet by 10 feet (3m by 3m). Apply LIQUID BOOT® to a thickness of 80 mils and let it cure for 24 hours. Observe for blisters. If minor or no blistering occurs, proceed to the next step. (See note regarding blisters). If significant blistering does occur, apply a thin (10 mil) tack coat of LIQUID BOOT® "A" side without catalyst to the entire concrete surface and allow to cure before proceeding. (See also information regarding blister repair).
- D. Spray-apply LIQUID BOOT® to an 80 mil minimum dry thickness. Increase thickness to 100 dry mils if shotcrete is to be applied directly to membrane. If a second coat is required, remove any standing water from the membrane before proceeding with the second application.
- E. **Do not penetrate membrane.** Keep membrane free of dirt and debris and traffic until a protective cover is in place. It is the responsibility of the General Contractor to insure that the membrane and the protection system are not penetrated.
- F. At all inlet and outlet locations the membrane must be protected from splashing or turbulent water. Install appropriate protection as designed by the project engineer.
- G. After membrane has cured and checked for proper thickness and flaws, if required, install protection material pursuant to manufacturer's instructions.
- H. Do not fill canal, pond, tank, or reservoir until membrane has completely cured.

**NOTE:** If water testing or inspection is to be performed, conduct before placing protection course.

**NON-HORIZONTAL SURFACES:** Spray on non-horizontal surfaces should begin at the bottom and work towards the top. This method allows the product to adhere to the surface before hitting catalyst runoff.

NOTE: Due to the nature of concrete as a substrate, it is normal for some blistering to occur. This is caused by either concrete's tendency to off-gas when sealed, or water that is temporarily trapped between the concrete and the membrane. With time and the applied pressure of backfill or over-slab, blisters will absorb into the concrete without detriment to the membrane. A small number of blister heads should be sampled and checked for proper membrane thickness. If the samples have the required membrane thickness (80 mils minimum), then the remaining blisters should not be punctured or cut. If the samples have less than the minimum 80 mils, then the area can either be re-sprayed to obtain the proper thickness, or the blisters can be cut out and the area re-sprayed or patched with LIQUID BOOT® Trowel Grade.

### 3.03.20 INSTALLATION ON DIRT SURFACES AND MUDSLABS

- A. Provide a continuous trench at least one foot (1') wide by one foot (1') deep at perimeter.
- B. Roll out LIQUID BOOT® BaseFabric geotextile on sub-grade with the heat-rolled side facing up. Overlap seams a minimum of six inches (6"). Lay geotextile tight at all inside corners. Spray LIQUID BOOT® within the seam overlap to a thickness of 80 mils minimum.
- C. Refer to section 3.03.40, "Sealing Around Penetrations", for procedures to seal around penetrations.
- D. Spray apply LIQUID BOOT® onto LIQUID BOOT® BaseFabric (including trench area) to an 80 mils minimum dry thickness. Increase thickness to 100 dry mils if shotcrete is to be applied directly to membrane. If a second coat is required, remove any standing water from the membrane before proceeding with the second application.
- E. Do not penetrate membrane. Keep membrane free of dirt, debris and traffic until a protective cover is in place. It is the responsibility of the General Contractor to insure that the membrane and the protection system are not penetrated.
- F. At all inlet and outlet locations the membrane must be protected from splashing or turbulent water. Install appropriate protection as designed by the project engineer.
- G. After membrane has cured and checked for proper thickness and flaws, if required, install protection material pursuant to manufacturer's instructions.
- H. Do not fill canal, pond, tank, or reservoir until membrane has completely cured.

### 3.03.30 INSTALLATION ON STEEL (TANKS AND SIMILAR SURFACES)

- A. Refer to section 3.03.40, "Sealing Around Penetrations", for procedures to seal around penetrations.
- B. Provide a 3/4 inch minimum cant of LIQUID BOOT®, or other suitable material as approved by manufacturer, at all horizontal to vertical transitions and other inside corners of 120° or less. Allow to cure overnight before the application of LIQUID BOOT®.

NOTE: WALLS AND CEILINGS SHOULD BE COMPLETED A MINIMUM OF 24 HOURS AND ALL RESIDUAL WATER REMOVED PRIOR TO COMMENCING APPLICATION ON FLOORS.

- C. WALLS & CEILINGS: Spray apply a thin 10 mil tack coat of LIQUID BOOT® "A" side only (no catalyst). Let it cure until tacky. Proceed to the next step.
- D. WALLS & CEILINGS: Spray apply LIQUID BOOT® to an 80 mils minimum dry thickness. Increase thickness to 100 dry mils if shotcrete is to be applied directly to membrane. Spray on non-horizontal surfaces should begin at the bottom and work towards the top.

NOTE: WALLS AND CEILINGS SHOULD BE COMPLETED A MINIMUM OF 24 HOURS AND ALL RESIDUAL WATER REMOVED PRIOR TO COMMENCING APPLICATION ON FLOORS.

- E. FLOORS: Spray apply a thin (10 mil) tack coat of LIQUID BOOT® "A" side only (no catalyst). Let it cure until tacky, then proceed to the next step.
- F. FLOORS: Spray apply LIQUID BOOT® to an 80 mils minimum dry thickness. Increase thickness to 100 dry mils if shotcrete is to be applied directly to membrane.
- G. Remove all residual moisture from the floor and continue to ventilate for a minimum of 72 hours following the application to allow the membrane to cure completely.
- H. Take steps to insure that any initial blast of material, which may hit the membrane during the fill process is adequately dissipated so that membrane is not damaged.
- I. Do not penetrate membrane. Keep membrane free of dirt, debris and traffic until a protective cover is in place. It is the responsibility of the General Contractor to insure that the membrane and the protection system are not penetrated.

### 3.03.40 SEALING AROUND PENETRATIONS

- A. Clean all penetrations. All metal penetrations shall be sanded clean with emery cloth.

- B. For applications requiring geotextile, roll out LIQUID BOOT® BaseFabric on sub-grade with the heat-rolled side facing up, overlapping seams a minimum of six inches (6"). Cut the geotextile around penetrations so that it lays flat on the sub-grade. Lay geotextile tight at all inside corners. Spray LIQUID BOOT® within the seam overlap to a thickness of 80 mils minimum.
- C. At the base of penetration Install a minimum 3/4 inch thick membrane cant of LIQUID BOOT®, or other suitable material as approved by manufacturer. Extend the membrane at an 80 mil thickness three inches (3") around the base of penetration and up the penetration a minimum of three inches (3"). **Allow to cure overnight before the application of LIQUID BOOT® membrane. (SEE MANUFACTURER'S STANDARD DETAIL)**
- D. Spray apply LIQUID BOOT® to an 80 mils minimum dry thickness around the penetration, completely encapsulating the collar assembly and to a height of one and one half inches (1 1/2") minimum above the membrane as described in 3.03.40 C above. Spray apply LIQUID BOOT® to surrounding areas as specified for the particular application. (SEE MANUFACTURER'S STANDARD DETAIL)
- E. Allow LIQUID BOOT® to cure completely before proceeding to step "F".
- F. Wrap penetration with polypropylene cable tie at a point two inches (2") above the base of the penetration. Tighten the cable tie firmly so as to squeeze the cured membrane collar.

**3.04 FIELD QUALITY CONTROL-** Field Quality Control is a very important part of all LIQUID BOOT® applications. Applicators should check their own work for coverage, thickness, and all around good workmanship before calling for inspections. Applicators and Inspectors should check membrane for holes, shadow shrinkage, and any other membrane damage when reviewing the membrane.

When thickness or integrity is in question the membrane should be tested in the proper manner as described below. However, over-sampling defeats the intent of inspections. Inspectors should always use visual and tactile measurement to guide them. Areas suspected of being too thin to the touch should be measured with the gauges to determine the exact thickness. With practice and by comparing tactile measurements with those of the gauges, fingers become very accurate tools.

#### **3.04.10 ON CONCRETE/SHOTCRETE/MASONRY & OTHER HARD SURFACES**

- A. Membrane may be checked for proper thickness with a blunt-nose depth gauge. Record the minimum reading. Mark the test area for repair, if necessary.
- B. If necessary, test areas are to be patched over with LIQUID BOOT® to an 80 mils minimum dry thickness, extending a minimum of one inch (1") beyond the test perimeter.

**NOTE:** Due to the nature of concrete as a substrate, it is normal for some blistering to occur. This is caused by either concrete's tendency to off-gas or by water temporarily trapped between the concrete and the membrane. With time and the applied pressure of backfill or over-slab, blisters will absorb into the concrete without detriment to the membrane. A small number of blister heads should be sampled and checked for proper membrane thickness. If the samples have the required membrane thickness (80 mils minimum), then the remaining blisters should not be punctured or cut. If the samples have less than the minimum 80 mils, then the area can either be re-sprayed to obtain the proper thickness, or the blisters can be cut out and the area re-sprayed or patched with LIQUID BOOT® Trowel Grade.

#### **3.04.20 ON DIRT AND OTHER SOFT SUBSTRATES**

- A. Samples may be cut from the membrane and geotextile sandwich to a maximum area of 2 square inches. Measure the thickness with a mil-reading caliper. Deduct the plain geotextile thickness to determine the thickness of LIQUID BOOT® membrane. Mark the test area for repair.
- B. Voids left by sampling are to be patched with geotextile overlapping the void by a minimum of two inches (2"). Apply a thin tack coat of LIQUID BOOT® under the geotextile patch. Then spray or trowel apply LIQUID BOOT® to an 80 mils minimum dry thickness, extending at least three inches (3") beyond geotextile patch.

#### **3.04.30 SMOKE TESTING FOR HOLES (Optional)**

Holes or other breaches in the membrane can be detected by conducting a smoke test. This involves pumping smoke under the membrane for a specified period of time, under a specified pressure, which varies from project to project. Contact CETCO Technologies for information about this test.