

**QUALITY CONTROL MANUAL  
FOR FACTORY FABRICATION OF  
PVC AND UltraTech® GEOMEMBRANES**

**October 1, 2014**



**The Liner Company**

**Environmental Protection, Inc.**

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## Preface

EPI is committed to not only satisfying all appropriate industry and customer specifications, but also continuing to establish new standards of product and service excellence.

Our management and employees regularly assess all aspects of our design, fabrication, shipping, installation and testing procedures to assure we are meeting this commitment.

We are also committed to continuing to be an industry leader in the use of new technology and independent research and development.



The Liner Company



***"ENHANCING OUR ENVIRONMENT BY PRESERVING  
WATER RESOURCES FOR FUTURE GENERATIONS"***



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## **1. SCOPE**

This manual presents EPI's basic quality control system for the fabrication, packaging, and testing of its polyvinyl chloride (PVC) and UltraTech® liners. As appropriate, the policies and procedures are also applied for projects involving other geomembrane material.

### **1.01 QUALITY STANDARDS**

The products and services of EPI meet or exceed ASTM D7176 Standard Specification for Polyvinyl Chloride (PVC) Geomembranes Used in Buried Applications. EPI's specifications for PVC and UltraTech are included in the appendix.

The testing procedures are consistent with or exceed the requirements of the American Society for Testing and Materials (ASTM) as appropriate.

Laboratory testing equipment is certified and traceable to the standards of the National Institute of Standards and Traceability (NIST).

EPI shall also adhere to the standards as called for in site specific contract plans, specifications and CQC / CQA documents, consistent with ASTM D7176, D7177, D7408 and D4437 specifications.

### **1.02 ADHERENCE TO STANDARDS**

The procedures herein will be adhered to at all times. The material here supersedes all previous procedures relating to quality control.

The supply of these materials will be in strict accordance with the Engineer's specifications. Deviation from the standards and procedures described in this manual will only be as required for unique project specifications, according to the terms and conditions of the contract.

Conformance to the established policies and procedures described herein will be monitored by internal audits on a random basis.

### **1.03 WARRANTIES**

EPI will provide the OWNER, as part of the project documents, a specific written warranty. This document will warrant the quality of the fabricated geomembrane materials, factory seams and workmanship.

EPI will certify in writing that, when the material is installed properly, meets the requirements of the project and the specification and that, under normal soil covered conditions, the sheet material can be warranted by the material manufacturer for up to twenty years.



**1.04 DISPOSITION OF SAMPLES AND TESTED MATERIALS**

After testing, all samples, specimens and test reports are the property of EPI.

Additional samples and test material may be taken by EPI for testing at its own laboratory, for its own use and information.

Additional sample and test material may be made available to an independent testing laboratory or the OWNER's representative at the OWNER's expense.

**2. IN - FACTORY QUALITY CONTROL**

**2.01 RAW MATERIALS INSPECTION**

- a) EPI requires each manufacturer to furnish written certification that all material meets or exceeds EPI's specifications and ASTM D7176 Standard Specification for Polyvinyl Chloride (PVC) and UltraTech® Geomembrane Used in Buried Applications, as appropriate.
- b) Prior to factory seaming, all roll goods will be unwound and visually inspected for contaminants, defects, undispersed raw materials and edge uniformity.
- c) All defects or impurities will be removed from the roll prior to being fabricated into panels, or the roll will be rejected.
- d) Thickness measurements will be made at the beginning and end of each roll of material.
- e) Material will be rejected for poor "layflat" edges or "racetracking" caused by inconsistent sheet thickness.

**2.02 RAW MATERIALS TESTING**

Tests will be conducted by EPI on rolled goods from each 10,000 pound or geomembrane material received to verify compliance with ASTM D7176 specifications in the following areas:

<u>PROPERTY</u>	<u>TEST METHOD</u>
Surface Uniformity	Visual
Thickness (gauge, nominal)	Micrometer-ASTM D1593
Minimum Tensile Properties (minimum each direction)	
1. Breaking Factor (lbs/in.)	ASTM D882
2. Elongation at Break (percent)	ASTM D882



3. Modulus (force) at 100% Elongation (lbs./in.)

ASTM D882

**2.03 FABRICATION AND IN - FACTORY SEAMING**

The calendared sheets will be factory seamed into maximum sized panels, and custom designed for the specific project so as to minimize field seams. The following practices will be an integral part of the fabrication process:

- a) The factory seam process will typically be accomplished by the use of chemical fusion welding. The weld will have a minimum width of one inch.
- b) All factory seams will extend to the end of the sheet. No loose edges will be allowed.
- c) Each individual strip of material is numbered to correspond with shop fabrication drawings to assure accurate size.
- d) Each individual strip is marked at its centerline to assure "square" finished panels.
- e) A reinforcing patch is applied to the end of seams in "stepped" panels.
- f) Each panel fabricated is logged by serial number, size, date fabricated, material lot number, roll number and fabrication crew.

**2.04 FACTORY SEAM REQUIREMENTS**

Factory seams for PVC fabricated geomembrane will meet or exceed the following:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>VALUE</u>
<b>Shear Strength</b> (factory seam, breaking, lbs/in.) Test Speed 20 Inches per minute  Test Speed at 2 inches per minute	ASTM D7408	80% of specified tensile strength
<b>Peel Adhesion</b> (lbs/in min.)	ASTM D7408	10 Mil - 10 lbs/in or FTB* 20 Mil - 12.5 lbs/in or FTB* 30 Mil - 15 lbs/in or FTB* 40 Mil - 15 lbs/in or FTB* 50 Mil - 15 lbs/in or FTB* 60 Mil - 15 lbs/in or FTB* *FTB = Film Tearing Bond

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Test Speed at 20 inches per minute



Peel Adhesion (lbs/in min.)	ASTM D7408	10 Mil - 10 lbs/in or FTB*
		20 Mil - 15 lbs/in or FTB*
		30 Mil - 18 lbs/in or FTB*
		40 Mil - 18 lbs/in or FTB*
		50 Mil - 18 lbs/in or FTB*
		60 Mil - 18 lbs/in or FTB*
		<i>*FTB = Film Tearing Bond</i>

Factory seams for UltraTech membrane will meet or exceed the following requirements:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>VALUE</u>
Shear Strength (factory seam, breaking, lbs/in)	ASTM D7408	80% of specified tensile strength
Test Speed at 2 inches per minute		
Peel Adhesion (lbs/in min.)	ASTM D7408	15 lbs/in or FTB* <i>*FTB = Film Tearing Bond</i>

Test Speed at 20 inches per minute		
Peel Adhesion (lbs/in min.)	ASTM D7408	18 lbs/in or FTB* <i>*FTB = Film Tearing Bond</i>

## 2.05 IN - FACTORY SEAM TESTING

- a) **NON - DESTRUCTIVE TESTING**  
All completed factory seams are 100% visually inspected. Factory seams will be visually inspected for full seam continuity over their full length during the folding operation by tensioning the seam perpendicular to the seam length. Any areas that do not meet the specified requirements shall be removed and repaired per section 2.05 (c).
- b) **DESTRUCTIVE TESTING**  
Destructive tests will be performed to verify that the seam strength requirements of the specifications are met. Random samples shall be taken at a minimum of every 3,000 lineal feet of factory seam or once per factory panel fabricated, whichever is more frequent. The following quality assurance tests will be performed on each sample:
  - thickness
  - shear strength
  - peel adhesion
 The sample shall be cut into twelve one - inch wide specimens. For EPI's standard statistical program, seven peel and five shear specimens are



removed. Five specimens shall be tested for shear strength and five for peel adhesion. The additional two peel specimens are used for the Wolschon test specified in 2.07 (see figure 1 in appendix). To be acceptable, the average of five test specimens for peel and the average of five test specimens for shear strength must meet the minimum peak load requirements of factory seams as follows:

#### **Shear Strength**

One-inch strips cut with the weld centrally located are tested by stressing the weld in a "shear" configuration. That is, the top sheet is stressed in relation to the bottom sheet in a direction away from the weld. A pass result occurs when the specimen averages meet the minimum peak load requirements stated in the contract (usually 80% of specified sheet strength), also four (4) out of five (5) specimens must meet the minimum specification. A failure occurs when the weld separates or the material breaks at a peak load less than the minimum requirements. The test result to be reported will be the average of the peak loads recorded for each of the five specimens.

#### **Peel Adhesion**

One-inch strips cut with the weld centrally located are tested by stressing the top sheet in relation to the overlapped edge of the lower sheet in an effort to peel the weld away. Each specimen will be peeled two inches along the seam length. A pass result occurs when the specimen meets the minimum peak load requirements stated in the contract, also four (4) out of five (5) specimens must meet the minimum specification. A failure occurs when the weld peels at a peak load less than the specification without film tearing bond. The test result to be reported is the average of the peak loads recorded for each of the five specimens.

Peel test are typically run at 50.8 mm/min or 508 mm/min (2in. /min or 20 in./min) and must be noted on the report as to the speed of the test that was conducted. Test specimens until break and record the peak value for each specimen.

Each test will be identified by EPI serial number and the manufacturer's roll number. These tests shall be performed in EPI's laboratory.

Prior to installation of the fabricated geomembrane at the site, EPI will provide to the ENGINEER, manufacturer material certifications and/or a copy of quality control test results for all panels to be used, verifying conformance with this specification and the requirements as represented in ASTM D7176 and D7408 specifications. The location of any defects and repairs and all necessary retesting results will also be documented in the report.

#### c) REPAIRS





When a seam sample is removed from the panel being fabricated the resulting hole will be repaired with a patch with a minimum of a one inch bonded area around the patch and the patch will be rounded on all corners.

## **2.06 STATISTICAL PROCESS CONTROL (SPC)**

EPI follows a consistent Statistical Process Control (SPC) Program of inspection and testing throughout the factory fabrication process. The statistics developed through this program give EPI the ability to interpret information and predict changes needed in the fabrication process before unwanted results occur.

EPI maintains Average and Range (X - BAR - R) process control charts on all results obtained from seam shear and peel tests conducted in EPI's laboratory. The results shown on these charts are reviewed regularly with EPI management personnel, each fabricator, and with the Quality Improvement Team.

EPI maintains histograms of the results of tests performed on samples taken from each lot of geomembrane material received. These tests include visual inspection, thickness, tensile strength, elongation and modulus of elasticity.

EPI's Quality Control Program requires written confirmation of the following, any time a test result is above or below statistical control limits:

- Cause Identification
- Effect Identification
- Corrective Action Taken

A report reviewed by the Quality Control Manager, shall be provided to the General Manager and reviewed by the production staff

## **2.07 CALIBRATION**

EPI's tensile test equipment is recalibrated annually by an independent testing laboratory. The test equipment calibration is verified weekly by EPI.

## **2.08 WOLSCHON TESTING**

A sample is removed from the actual factory fabrication process and, after five minutes, two specimens are tested for peel strength per ASTM D882. EPI refers to this procedure as the Wolschon Test, after it's developer Mark Wolschon, EPI's Quality Control Manager. The Wolschon Test data is then compared with previous data in correlation charting with standard ASTM D882 tests. A direct correlation exists between the peel strength of the Wolschon Test specimens compared to specimens from the same sample tested after forty hours. EPI has established lower limits for Wolschon Test results which will ensure minimum peel strength results after 40 hours per Section 2.04. If Wolschon Test lower limits are not met, corrective action procedures are in place which will rectify problems before production continues. All test results are analyzed in EPI's statistical process control program.



### **3. SHIPPING AND HANDLING**

#### **3.01 PREPARATION FOR SHIPMENT**

- a) Factory fabricated geomembrane panels are normally packaged accordion folded on a sturdy wooden pallet designed for fork lift truck access. Smaller panels (i.e. less than 500 lbs.) are rolled on a core, and placed on a pallet.
- b) Each panel will be prominently and indelibly marked with the material, panel size, unfolding instructions and serial number for proper deployment location according to shop drawings.
- c) Pallets have a protective layer (i.e.: cardboard or excess liner) on the surface of the pallet and between the liner and the banding to prevent damage to the liner.
- d) All panels will be packaged at a minimum with a protective, black stretch wrap cover to protect the panel from weather and ultraviolet light.

#### **3.02 TRANSPORTING PANELS TO THE JOB SITE**

The fabricated geomembrane panels will be packaged and shipped by appropriate means so that no damage is caused. Transportation is the responsibility of EPI, unless otherwise specified.

Materials will be shipped in either a closed trailer or on a flat bed trailer with adequate tarps, and delivered to the site only after the required submittals have been approved and received by EPI from the ENGINEER.

Any damage incurred during transit should be noted on the bill of lading and reported immediately to the freight company and EPI.



#### 4. SAFETY POLICY

Environmental Protection, Inc. is committed to the protection of the health and safety of its workers and will take all reasonable measures to achieve this goal. Therefore, the Company is committed to the prevention of personal injury, occupational disease and the protection from accidental loss of all of its resources, including employees, the environment and its physical assets.

In order to fulfill this commitment to protect both people and property, the Company will provide and maintain a safe and healthy work environment according to acceptable industry standards and in compliance with legislative requirements. The Company will strive to eliminate any foreseeable hazards which may result in fires, explosions, security losses, property damage, accidents, personal injuries and/or illnesses.

Environmental Protection, Inc. has the ultimate responsibility to ensure that every reasonable precaution is taken to protect its employee's health and safety by working in compliance with the law and with safe work practices and procedures established by the Company.

Managers and supervisors will be held accountable for the health and safety of the employees under their supervision. It is each supervisor's responsibility to comply with, and promote among their workers, the corporate philosophy of health and safety protection and loss control.

In addition to complying with established standards, striving for loss prevention is a company priority objective. Control of losses can only be achieved through the combined efforts of all the employees of Environmental Protection, Inc. Identification of areas where potential losses may occur is the responsibility of all managers, supervisors and employees. By working together, hazards which have the potential to result in fire, explosions, security losses, property damage or personal injuries / illnesses can be minimized and incidents can be avoided.



#### 4.01 SAFETY AND HEALTH PROGRAM

##### **EPI's comprehensive safety and health program includes:**

1. Monthly safety meetings for all employees covering:
  - a) Personal Protective Equipment
  - b) Hazardous Materials "Right to Know"
  - c) Emergency Action Plan
  - d) Lockout Tagout Procedures
  - e) Blood Borne Pathogens
  - f) Housekeeping
  - g) Communicable Disease
  - h) Accident Reporting
  - i) Fire Extinguishers/Fire Prevention, Safety
  - j) Lifting Back Safety
  - k) Vehicle & HI - LO Safety
  - l) OSHA/MIOSHA Inspections
  - m) Drugs & Alcohol
  - n) Safety Attitudes
  - o) Fire Drills
  - p) Natural Disasters
  - q) Environmental Emergencies
  - r) Slips and Falls
  
2. Specialized training as required, including
  - a) CPR \ Cardiopulmonary Resuscitation
  - b) First Aid Procedures
  - c) Hazardous Materials Handling Training
  
3. Documented and implemented policies covering:
  - a) Lockout Tagout
  - b) Safety Glass Requirements
  - c) Hazard Communication Plan "Right to Know"
  - d) Emergency Action Plan
  - e) General Housekeeping
  - f) Accident Reporting
  - g) Right to Know Center "MSDS"
  - h) Standard Operating Procedures
  - i) Hazardous Materials List
  
4. Designated safety program leadership and coordination including:
  - a) Company Safety Director
  - b) TQM / Safety team
  - c) New Employee Orientation
  - d) Monthly Safety Inspections and Follow Up
  - e) Safety Recognition Awards
  - f) Voluntary Government Agency Inspections and Environmental Testing
  - g) Preparation and Publication of Appropriate Safety Reports

###



## **REFERENCES**

1. Technical Guidance Document, "Inspection Techniques for the Fabrication of Geomembrane Field Seams", EPA/530/SW-91/051, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., May 1991.
2. Plastics World, "PVC Geomembranes", Wolschon Test, 275 Washington St., Newton, MA, October 1993.
3. Technical Recourse Document, "Lining of Waste Containment and Other Impoundment Facilities", EPA/600/2-88/052, U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory, Cincinnati, OH, September 1988.
4. Technical Guidance Document, "Construction Quality Management for Remedial Action and Remedial Design Waste Containment Systems." EPA / 540 / R - 92 / 073, U.S. Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., October 1992.
5. ASTM D882 Standard Test Method for Tensile Properties of Thin Plastic Sheeting<sup>1</sup>
6. ASTM D1593 Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting
7. ASTM D4437 Non-destructive Testing (NDT) for Determining the integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes
8. ASTM D7176 Standard Specification for Polyvinyl Chloride (PVC) Geomembranes Used for Buried Applications.
9. ASTM D7408 Standard Specification for Non Reinforced PVC (Polyvinyl Chloride) Geomembrane Seams



## APPENDIX A

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2.	UltraTech Physical Properties Specification .....	A-2
3.	Typical Factory Seam Sample Diagram .....	A-3
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## PVC: Polyvinyl Chloride Flexible Membrane Liners

PVC liners fabricated by EPI are a single-ply construction with Polyvinyl Chloride as the principle polymer. Only first quality virgin resins are used and all materials meet or exceed the ASTM D7176 Standard Specification for Polyvinyl Chloride (PVC) Geomembranes for Buried Applications.

PVC Liners are fabricated by EPI in panel sizes up to 40,000 square feet, accordion-folded in both directions, and packaged for shipment to your site for quick, easy installation to save you time and money.

EPI utilizes statistical process control (SPC) to ensure the integrity of each panel produced. Samples from actual factory seams are removed during the welding process for a rigorous, proven testing procedure that assures you of the highest quality factory-fabricated PVC geomembranes available.

### TYPICAL INSTALLATIONS:

Sewage Lagoons	Canals	Landfills	Decorative Ponds
Reservoirs	Golf Course Ponds	Industrial Waste Ponds	Recreation Ponds
Cooling Ponds	Farm Ponds	Tailings Ponds	Secondary Containment

*Applications suggested are not intended to be all inclusive. EPI does not warrant or guarantee the suitability, merchantability, fitness for a particular purpose, or longevity of this material for the uses listed. You may wish to consult your project engineer or installer/contractor to determine what physical properties are required for a synthetic liner. In some cases a chemical compatibility test may be required.*

### MINIMUM PHYSICAL PROPERTIES:

PROPERTY	TEST METHOD	REQUIREMENTS					
		10 mil	20 mil	30 mil	40 mil	50 mil	60 mil
Thickness	ASTM-D1593	±5%	±5%	±5%	±5%	±5%	±5%
Specific Gravity (min.)	ASTM-D792	1.20	1.20	1.20	1.20	1.20	1.20
100% Modulus (psi, min.)	ASTM-D882	1000	1000	1000	1000	1000	1000
lb. force/in. width, min.)		10	20	30	40	50	60
Tensile (psi, min.)	ASTM-D882	2400	2400	2400	2400	2400	2400
(lb. force/in. width, min.)		25	48	73	97	116	137
Elongation at Break (% min.)	ASTM-D882	250	360	380	430	430	450
Graves Tear (lb./in., min.)	ASTM-D1004	2.5	6	8	10	13	15
Resistance to Soil Burial (% change max.)	ASTM-D3083 (NSF Modified)						
1. Breaking Factor		5	5	5	5	5	5
2. Elongation At Break		20	20	20	20	20	20
3. Modulus at 100% Elongation		20	20	20	20	20	20
Impact Cold Crack (°C)	ASTM D-1790	-23	-26	-29	-29	-29	-29
Dimensional Stability (% change/max.)	ASTM D-1204 (212°F/15 min.)	4	4	3	3	3	3
Water Extraction (% max.)	ASTM D-3083	0.15	0.15	0.15	0.2	0.2	0.2
Volative Loss (% max.)	ASTM D-1203(A)	1.5	0.90	0.70	0.50	0.50	0.50
Hydrostatic Resistance (psi, min.)	ASTM D-751(A)	42	68	100	120	150	180

#### Minimum Specifications for EPI Factory Fabricated Seams:

Peel Strength, lbs/in.	ASTM D7408	10	12.5	15	15	15	15
Shear Strength, lbs/in.	ASTM D7408	20	38.4	58.4	77.6	96	116

*These data are based on tests believed to be reliable. However, these are laboratory tests that may not simulate actual use conditions. They are provided for your informational purposes only. No warranty, express or implied, including any other further warranty of fitness for a particular purpose or merchantability, is made by this promotional literature.*



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## UltraTech® FLEXIBLE MEMBRANE LINERS

The UltraTech flexible membrane liner is a single-ply membrane compounded for hydraulic containment and possessing proven physical characteristics. By virtue of its unique composition, UltraTech offers excellent weatherability, resistance to chemicals, oils, and grease. It is noted for its high tensile strength and elongation properties, as well as its flexibility over a broad temperature range.

In general, UltraTech liners do not require earthen or other cover materials. They are ideally suited for a variety of applications, particularly where resistance to biodegradation and to a wide range of chemicals is advantageous.

UltraTech can be welded directly to a PVC liner, allowing the use of PVC on the pond bottom and UltraTech on the slopes, with no loss of integrity at the connection of the two liners.

### MINIMUM PHYSICAL PROPERTIES:

PROPERTY	TEST METHOD	REQUIREMENTS		
		20MIL	30MIL	40MIL
Thickness	ASTM D-2083	±5%	±5%	±5%
Specific Gravity (min.)	ASTM D-792	1.20	1.20	1.20
100% Modulus (psi, min.)	ASTM D-882	900	900	900
Tensile (psi, min.)	ASTM D-882	2300	2300	2300
Elongation at Break (% , min.)	ASTM D-882	290	290	290
Graves Tear (lbs./in., min.)	ASTM D-1004	280	280	280
Resistance to Soil Burial (%change,max.)	ASTM D-3083 (NSF modified)	5	5	5
1. Breaking Factor		20	20	20
2. Elongation at Break				
Impact Cold Crack (°F)	ASTM D-1790	-25	-25	-25
Dimensional Stability (%change/max.)	ASTM D-1204 (212°F/15min.)	5	5	5
Water Extraction (%loss,max.)	ASTM D-1239	0.35	0.35	0.35
Volatile Loss (%loss, max.)	ASTM D-1203	1.0	0.8	0.8
Hydrostatic Resistance (psi, min.)	ASTM D-751	55	75	110

*These data are based on tests believed to be reliable. However, these are laboratory tests that may not simulate actual use conditions. They are provided for your informational purposes only. No warranty, express or implied, including any other further warranty of fitness for a particular purpose or merchantability is made by this promotional literature.*

### CHEMICAL RESISTANCE:

Oil – Excellent	Acids - Fair/very good
Brine - Excellent	Hydrocarbons-Good/Excellent
Solvents - Poor/Fair	Bases - Excellent

### TYPICAL INSTALLATIONS:

Canals	Secondary Containments
Brine Pits	Landfill Linings/Covers
Oil Holding Pits	Wastewater Lagoons
Tailing Ponds	Heap Leach Pads
Solar Ponds	Industrial Waste Impoundments

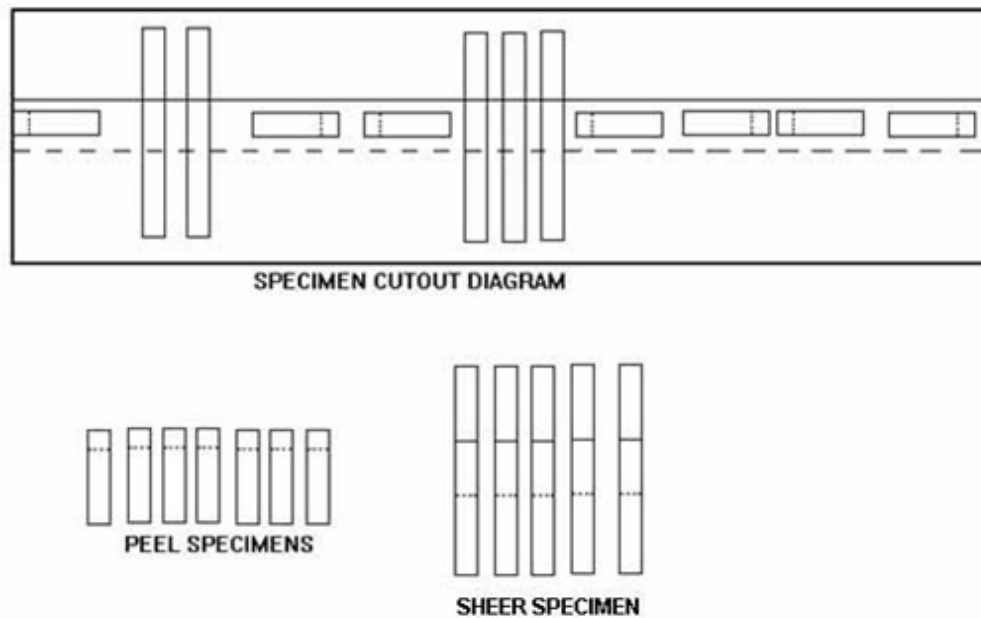
*Applications suggested are not intended to be all inclusive. EPI does not warrant or guarantee the suitability, merchantability, fitness for a particular purpose, or longevity of this material for the uses listed. You may wish to consult your project engineer or installer/contractor to determine what physical properties are required for a synthetic liner. In some cases a chemical compatibility test may be required.*

### UltraTech®

*is a registered trademark of Environmental Protection, Inc.*



## TYPICAL FACTORY SEAM SAMPLE DIAGRAM



**FIGURE 1**

Figure 1 is a picture of a typical sample cut from an EPI factory fabricated PVC or UltraTech seam. The sample is 10" X 30" with the seam running lengthwise. On the bottom left are seven specimens for testing peel adhesion. One specimen is cut from each end, while four are cut from the center. One inch of peel is initiated on each specimen at the time of fabrication. Each specimen is peeled a minimum of one inches. On the bottom right are five specimens cut for bonded seam strength testing. EPI's samples are cut from actual factory seams at a minimum sampling rate of one per 3,000 lineal feet of seam produced. This is equivalent to approximately each 20,000 square feet of material produced. These samples are tested in EPI's lab and the results are used in EPI's Statistical Process Control Program.



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# FACTORY SEAM Q. C. INSPECTION RECORDS AND SUMMARY IN-PROCESS INSPECTION AND WOLSCHON TEST

REV 08/01/2008  
FORM # Q-112-B

TEST DATE: ___/___/___ SERIAL NO.: _____ JOB NAME : _____ MATERIAL : _____ SOL APP : _____ TEMP : _____ TIME : ___:___      SHIFT : _____ LOT NO.: _____ LOCATION OF SAMPLE: _____ SIZE OF PANEL : _____ X _____ = _____ SQ.FT. 2 <sup>ND</sup> SOL APP : _____	FAB DATE: ___/___/___ DESC: _____ MANF : _____ ROLLER : _____ HUMIDITY : _____ % TABLE : _____ ROLL NO.: _____ FT. ON PANEL _____ ROLLER : _____	<b>WOLSCHON PEEL TEST</b>  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">RESULT</th> <th style="width: 50%;">TYPE SEP.</th> </tr> </thead> <tbody> <tr> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> </tr> </tbody> </table> SECONDS BETWEEN SOLVENT APPLICATOR & ROLLER: _____	RESULT	TYPE SEP.	_____	_____	_____	_____
RESULT	TYPE SEP.							
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<b>BSS TEST</b> ASTM D7408  DATE TESTED : ___/___/___  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">RESULT</th> <th style="width: 33%;">TEST SPEED</th> <th style="width: 33%;">TYPE SEP.</th> </tr> </thead> <tbody> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> </tbody> </table>	RESULT	TEST SPEED	TYPE SEP.	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	<b>PEEL TEST</b> ASTM D7408  DATE TESTED : ___/___/___  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">RESULT</th> <th style="width: 33%;">TEST SPEED</th> <th style="width: 33%;">TYPE SEP.</th> </tr> </thead> <tbody> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> </tbody> </table>	RESULT	TEST SPEED	TYPE SEP.	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
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Type Separation : AD = PEEL      AD-BRK = PEEL THEN TEAR      BRK = TEAR OR BREAK IN SHEET      SE = BREAK AT SEAM EDGE      CL = BREAK IN CLAMP

## EPI PVC GEOMEMBRANE LIMITED WARRANTY

Subject to the terms and conditions set forth below, Environmental Protection, Inc. (EPI), warrants that the factory seams of the liner material shown on the reverse of this invoice, if installed in accordance with the manufacturer's specifications and recommendations, shall be free from defects for a period of one (1) year:

The material is warranted by the manufacturer. The manufacturer's warranty shall be the only warranty applying to the material. The warranty of EPI of the seams shall be limited to confinement of an aqueous effluent rated as "excellent" or "A" as set forth in the chemical compatibility list published by the liner material manufacturer.

The warranty is subject to the following:

1. During the period of the one (1) year of which this warranty applies, an earthen cover shall be maintained on top of the liner at all times. The maximum effluent temperature shall not exceed 100° F and the Ph of the effluent shall be maintained between 5 and 9.
2. This warranty shall not cover damage caused by mechanical, physical or other external forces caused by persons or entities other than EPI or damages caused by solutions of greater concentrations than the chemicals as defined below, excessive pressure or stress from any sources or acts of God, casualty or catastrophe, such as, but not limited to, floating debris, insects and animals.
3. This warranty is conditioned upon
  - a) normal use and service of the liner for the purpose and in the manner for which it is designed and manufactured;
  - b) installation of the liner on preconsolidated soil free of sharp protrusions,
  - c) proper field seaming, and installation of the liner material, and
  - d) payment in full for all materials and services.

Deviation from any of these conditions shall void this warranty.

EPI guarantees to replace or repair, at its option; defective factory seams caused by poor workmanship for up to one (1) year after the date of the invoice. This warranty is limited to the repair or replacement of the affected membrane area and does not include the cost of earthwork or other activities not originally performed by EPI. **IN NO EVENT SHALL EPI'S LIABILITY EXCEED THE ORIGINAL SELLING PRICE OF THE DEFECTIVE AREA OF THE LINER.**

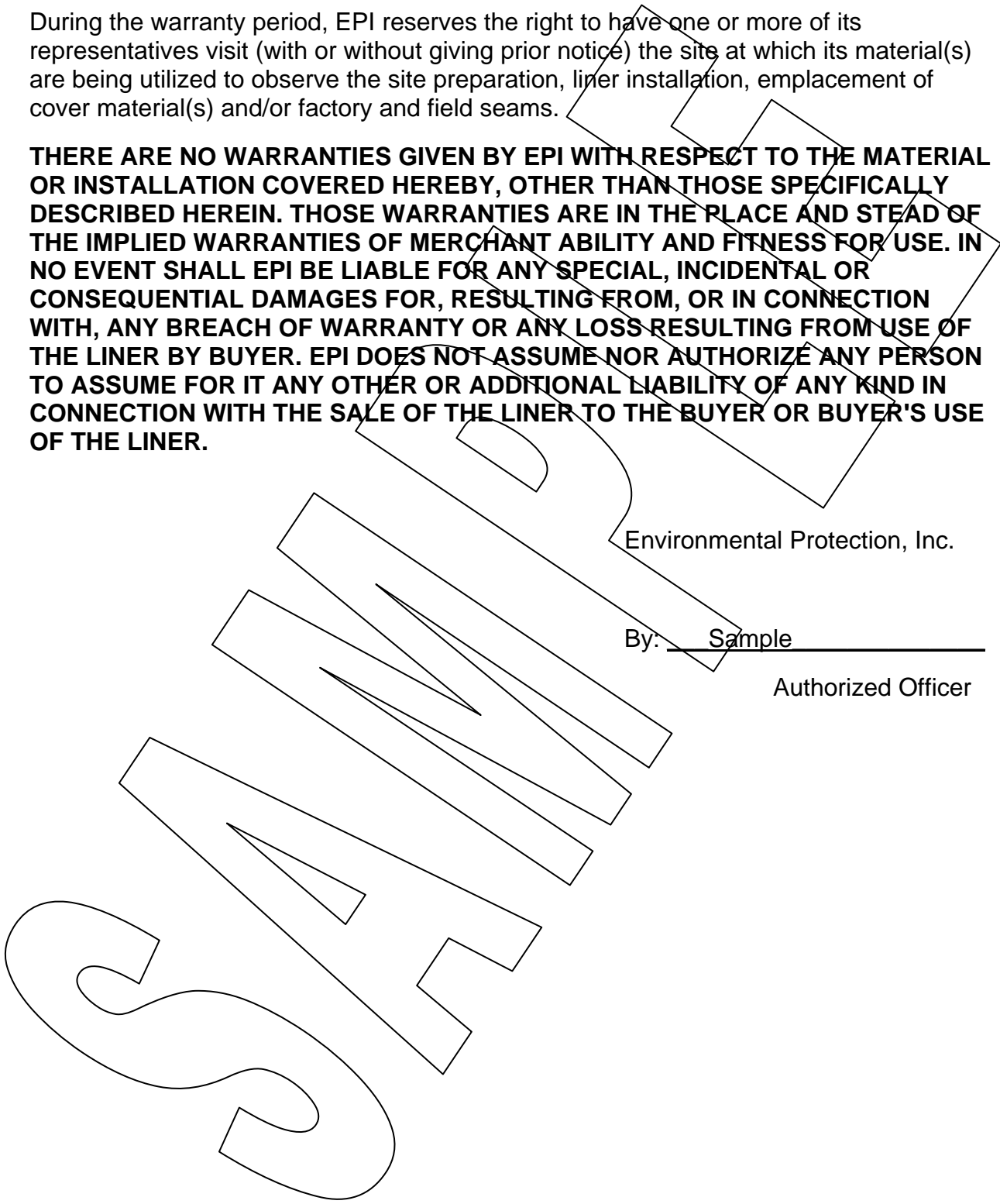
To enable EPI's technical staff to properly determine the cause of any alleged defect and to take appropriate steps to effect timely corrective measures if such defect is within the warranty, any claim for alleged breach of warranty must be made and presented to EPI within thirty (30) days after the alleged defect was first noticed or all warranties will be deemed to have been waived by the buyer.

During the warranty period, EPI reserves the right to have one or more of its representatives visit (with or without giving prior notice) the site at which its material(s) are being utilized to observe the site preparation, liner installation, emplacement of cover material(s) and/or factory and field seams.

**THERE ARE NO WARRANTIES GIVEN BY EPI WITH RESPECT TO THE MATERIAL OR INSTALLATION COVERED HEREBY, OTHER THAN THOSE SPECIFICALLY DESCRIBED HEREIN. THOSE WARRANTIES ARE IN THE PLACE AND STEAD OF THE IMPLIED WARRANTIES OF MERCHANT ABILITY AND FITNESS FOR USE. IN NO EVENT SHALL EPI BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR, RESULTING FROM, OR IN CONNECTION WITH, ANY BREACH OF WARRANTY OR ANY LOSS RESULTING FROM USE OF THE LINER BY BUYER. EPI DOES NOT ASSUME NOR AUTHORIZE ANY PERSON TO ASSUME FOR IT ANY OTHER OR ADDITIONAL LIABILITY OF ANY KIND IN CONNECTION WITH THE SALE OF THE LINER TO THE BUYER OR BUYER'S USE OF THE LINER.**

Environmental Protection, Inc.

By: Sample  
Authorized Officer





## CANADIAN GENERAL-TOWER LIMITED CONTAINMENT LINER MATERIAL LIMITED WARRANTY

PROJECT: \_\_\_\_\_

APPROXIMATE SIZE: \_\_\_\_\_

INSTALLATION DATE: \_\_\_\_\_

Canadian General-Tower Limited (CGT) warrants that the liner material to be used in the above referenced project will perform satisfactorily when incorporated into a liner to be used for the containment of the aqueous solution which is defined as follows according to the conditions set forth in any additional pages of the agreement:

CGT further warrants that the material, if properly fabricated and installed, will have a useful service life for a period of 20 years. In addition, the maximum solution temperature is not to exceed \_\_\_F° and the pH of the solution is to be maintained between 5 and 9.

This warranty does not cover damage caused by mechanical, physical or other external forces or damage caused by solutions of greater concentrations than the one defined above.

This warranty is subject to the following:

1. This warranty is conditional upon (a) normal use and service of the liner for the purpose and in the manner for which it is designed and manufactured, (b) installation of the liner on preconsolidated soil, free of sharp protrusions, (c) proper sealing, fabricating and installation of the liner. Deviation from any of these conditions will void this warranty.
2. CGT shall not be responsible for damage to the liner due to external agents, including but not limited to, damage resulting from exposure of the liner to harmful chemicals; abuse by machinery, equipment or people; excessive pressure or stress from any sources; or acts of God, casualty or catastrophe, such as, but not limited to, unusual storms or other weather conditions, flooding, earthquakes, floating debris, insects or animals.
3. Upon breach of warranty, CGT's sole liability shall be, at its option, either to (a) repair the defective material or (b) supply the owner with repair or replacement material, charging the owner only for a portion of that material (at the then-current price) in proportion to the portion of the \_\_\_ year warranty period that has elapsed since the installation date. In no event, however, shall CGT's liability under this warranty exceed an amount equal to the sales price of the defective portion of the liner multiplied by a fraction, the numerator of which shall be the number of years remaining in the \_\_\_ year warranty period and the denominator of which shall be \_\_\_.
4. To enable CGT technical staff to properly determine the cause of any alleged defect and to take appropriate steps to effect timely corrective measures, if such defect is within the warranty, any claim for alleged breach of warranty must be made and presented to CGT

within 30 days after the alleged defect is first noticed, or all warranties will be deemed to have been waived by the owner.

- 5. This warranty shall come into effect only upon payment in full to CGT of the purchase price of the original liner material.
- 6. **THERE ARE NO WARRANTIES GIVEN BY US TO YOU WITH RESPECT TO THE MERCHANDISE COVERED HEREWITH OTHER THAN THOSE SPECIFICALLY DESCRIBED HEREIN. THOSE WARRANTIES ARE IN THE PLACE AND INSTEAD OF THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE. IN NO EVENT SHALL CGT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR, RESULTING FROM, OR IN CONNECTION WITH, ANY BREACH OF WARRANTY OR ANY LOSS RESULTING FROM USE OF THE LINER BY THE OWNER.**

CGT does not assume nor authorize any person to assume for it, any other or additional liability of any kind in connection with the sale of the liner to the owner or the owner's use of the liner.

CANADIAN GENERAL-TOWER LIMITED  
TECHNICAL APPROVAL

CANADIAN GENERAL-TOWER LIMITED

BY: \_\_\_\_\_

BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE: \_\_\_\_\_

DATE: \_\_\_\_\_

ACKNOWLEDGED AND ACCEPTED

\_\_\_\_\_  
(NAME OF OWNER)

BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE: \_\_\_\_\_

SAM