

General Specification:

Polyurea Spray / Geotextile Composite Panel Installation

PART 1 - GENERAL

1.01 Related Documents

- A. Drawings and general provisions of the Scope of Work, including general and supplementary conditions apply to this section. This can be listed as an attachment in Appendix.

1.02 Description of Work

- A. This Section specifies the installation of special polyurea spray / geotextile composite panels. The primary panel joining coating material shall be a solvent free, fast-setting (< 30 minutes, as per ASTM D 1640), 100% Polyurea thick film elastomeric coating and lining system formulated to be used for applications requiring a seamless, flexible, waterproof, abrasion and impact resistant surface that may be applied on a variety of geotextile fabrics and polyurea spray / geotextile composite panels in low temperature and high humidity to produce the composite panels.
- B. Types of Polyurea Lining / Joining Systems required for the project include the following:
 - 1. Spray applied aromatic based Polyurea systems;
Including a fire retardant version
 - 2. Spray applied aliphatic based Polyurea systems.
 - 3. Brush / roller applied Polyurea systems for repair.
- C. Types of geotextile fabric required for the project include:
 - 1. non-woven / felt type with one treated / ironed side for application
 - 2. woven fabric of polyethylene, polypropylene or polyester
 - 3. spun-bonded type of polyethylene or polyester
- D. The geotextile fabric and polyurea spray / geotextile composite panels used must be dry and clean prior to installation / joining in the field. Application should not be done if the surface temperature is less than 5°F (3°C) above the dew point.

1.03 References and Standards

- A. All references and standards listed shall be the latest revisions.
- B. American Society for Testing and Materials (ASTM)
 - ASTM D 751: Standard Test Methods for Coated Fabrics
 - ASTM D 1186: Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base.
 - ASTM D 1640: Test Methods for Drying, Curing, or Film Formation of Organic Coatings at

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Room Temperature.

- ASTM D 1894: Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting.
- ASTM D 2047: Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
- ASTM D 2240: Standard Test Method for Rubber Property – Durometer Hardness
- ASTM D 4138: Test Method for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means.
- ASTM D 4787: Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
- ASTM D 6132: Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gauge.
- ASTM D 6289: Standard Test Method for Measuring Shrinkage from Mold Dimension of Molded Thermosetting Plastic (modified for spray application)
- ASTM E 162: Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- ASTM E 337: Test Method for Measuring Humidity with a Psychrometer.
- ASTM F 1869: Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub-floor Using Anhydrous Calcium Chloride

C. Society for Protective Coatings (SSPC)

- SSPC-Guide 12: Guide for Illumination of Industrial Painting Projects
- SSPC-PA 2: Measurement of Dry Coating Thickness with Magnetic Gages
- SSPC-PA 9: Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
- SSPC-SP 10 / NACE No. 2: Joint Surface Preparation Standard, Near-White Metal Blast Cleaning
- SSPC-SP 13 / NACE No. 6: Joint Surface Preparation Standard, Surface Preparation of Concrete
- SSPC-SP 16: Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

D. Polyurea Development Association (PDA)

- General Standard: Polyurea / Geotextile Elastomeric Lining Systems

E. National Association of Corrosion Engineers (NACE)

- NACE Standard RP0178: Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service.
- NACE Standard SP0188: Discontinuity (Holiday) Testing for Protective Coatings.
- NACE Standard RP0892: Linings Over Concrete for Immersion Service.
- NACE 6G197: Design, Installation and Maintenance of Coating Systems for Concrete Used in Secondary Containment.

F. International Concrete Repair Institute (ICRI)

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ICRI Technical Guidelines 03730: Surface Preparation Guidelines for the Repair of Deteriorated Concrete Resulting from Reinforced Steel Corrosion.

ICRI Technical Guidelines 03731: Guide for Selecting Application Methods for the Repair of Concrete Surfaces.

ICRI Guideline No. 310.2-1997: Guide for Selecting and Specifying Surface Preparation for Sealers, Coatings and Membranes.

- G. Environmental Protection Agency
EPA Test Method 9090A: Standard Test Method for Compatibility Test for Wastes and Membrane Liners
- H. Other – Primeaux Associates LLC
Polyurea Spray / Geotextile Composite Panel Manufacture

1.04 Polyurea Definition

As per the Polyurea Development Association, the following is the definition of a Polyurea system:

A **pure polyurea** coating / elastomer is derived from the reaction product of a polyisocyanate component and an amine-terminated resin blend.

1.05 Submittals

- A. Submit manufacturer's technical data, MSDS and product literature indicating that the products comply with specified requirements. If submitted material is not as specified, submit complete test results from independent lab for all tests listed.
- B. Submit 2 sample coupons (6" x 6" / 15.2 cm x 15.2 cm) of the polyurea / geotextile composite panel that are representative of the finished polyurea coating surface, texture, and color. Approved samples shall serve as basis for acceptance of the panel work for the duration of the panel production.
- C. Submit Material Manufacturer's and Equipment Manufacturer's written certification of Approved Contractor, Contractor's qualifications, and list of project references.

1.06 Quality Assurance

- A. Single Source Responsibility:
Provide polyurea products and polyurea spray / geotextile composite panels produced by the same manufacturer, or recommended by manufacturer, for each type of Polyurea special coating / lining / joining material specified to ensure compatibility, and proper chemical and mechanical bond.
- B. Panel Installer Qualifications:

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Installer shall have completed an established qualification program in the use of plural-component equipment and the specified Polyurea material. Provide written certification from the equipment manufacturer and material manufacturer.

- C. Equipment Requirements:
For fast set spray systems, equipment shall be a plural component impingement spray machine capable of producing the Polyurea system suppliers published recommended processing characteristics.
- D. Substitutions:
Manufacturers seeking approval of products other than the specified system must supply cured samples, full product information, project histories and references, technical data with specifications, MSDS and certifications regarding conformity of performance properties from an independent testing laboratory. The product being submitted for approval must meet all requirements of the performance properties noted within this specification (Appendix A).

1.07 Delivery, Storage and Handling

- A. Deliver product in the manufacturer's original, new, unopened packages and containers, clearly marked with manufacturer's identification, printed instructions, lot numbers and shelf life expiration date for each component.
- B. Store and ship materials in tightly covered containers in a dry, well-ventilated area at an ambient temperature of 70° - 90° F (21°-32°C), away from hazards. Drums should not be stored directly on the concrete substrate. If lower temperatures are experienced, material must be effectively reconditioned according to Polyurea system supplier / manufacturer.
- C. Before use, material must be conditioned to a standard temperature as per the Polyurea system supplier / manufacturer.
- D. Pigmented resin blend components must be properly agitated prior to use as per Polyurea system supplier's / manufacturer's recommendations.
- E. Geotextile materials / fabric and manufactured polyurea spray / geotextile composite panels must be covered and protected from the weather until ready for panel installation. The geotextile must remain dry prior to and during installation.

1.08 Panel Installation Conditions

- A. For temperatures below 35°F (1.5°C), consult Polyurea system and polyurea spray / geotextile composite panel supplier / manufacturer.
- B. All surface preparation will depend upon the substrate involved.
- C. Provide proper safety equipment, adequate ventilation, lighting and clean, drinkable water supply. Refer to PDA Safety & Health Guidelines.

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- D. Do not apply polyurea material over water or wet geotextile fabric or composite panels. This will lead to disbondment / failure of the Polyurea coating / lining / joining system.
- E. Do not apply material over frozen or ice capped geotextile fabric or composite panels. This will lead to disbondment / failure of the Polyurea coating / lining / joining system.
- F. Do not apply material over oil soaked or chemically contaminated geotextile fabric or composite panel. This will lead to disbondment / failure of the Polyurea coating / lining / joining system.

1.09 Warranty

Obviously, some form of program may be in place from the Polyurea system supplier. This information must be obtained from the Polyurea system supplier. Close communication is highly encouraged between the Polyurea system supplier, the polyurea / geotextile composite panel producer and owner.

1.10 Health and Safety

A. General:

Ventilation, electrical grounding, and care in handling paint, solvents, and equipment are important safety precautions that shall be observed. This is the sole responsibility of the composite panel fabricator.

B. Ventilation

It is essential that the vapors / overspray released during and after application of coatings be removed from all areas considered a confined space, so as not create any chance of a safety concern. During panel production operations all personnel shall wear proper respiratory and safety equipment.

C. Grounding:

Coating hoses shall be grounded to prevent accumulation of a charge of static electricity.

D. Lighting:

Explosion proof artificial lighting shall be provided for all work where and when required. Light bulbs shall be guarded to prevent breakage. Lighting fixtures and flexible cords shall comply with the requirements of NFPA 70 "National Electrical Code" for the atmosphere in which they will be used.

Refer to SSPC-Guide 12.

E. Toxicity:

Solvents may be used with some of the specified coatings and are explosive at low concentrations and are highly toxic. Because of toxicity, the maximum allowable concentration of vapor for several common solvents shall be not greater than the Immediately Dangerous to life or Health (IDLH) limits as shown in the NIOSH Registry of Toxic Chemical Substances.

F. Protective Clothing:

When handling or applying coatings, workmen shall wear gloves, eye shields and all other necessary

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protective clothing to assure workmen's safety.

G. Fire:

During mixing and application of coating, all spark producing material and smoking shall be prohibited in the vicinity. An appropriate type of fire extinguisher shall be kept nearby.

H. Material Safety Data Sheets (MSDS)

Fabricator shall maintain MSDS Reports on all specified coating materials on project site, accessible to employees.

PART 2 - PRODUCTS

2.01 System Performance Requirements

- A. Polyurea system must meet the definition of a polyurea system as per the Polyurea Development Association.
- B. Material Compatibility: Provide coating, repair materials, and related materials that are compatible with one another and the substrates indicated under conditions of service required as recommended by the Polyurea system supplier / manufacturer. This would include physical properties noted in Appendix A, adhesion and no adverse reaction between various systems.
- C. Polyurea lining system must meet or exceed all of the physical properties, test results, and certifications as noted in Appendix A for each specific application.
- D. All thermoset materials, polyurea included, experience linear shrinkage during set and cure. It is extremely important to understand the shrinkage value of the polyurea elastomer systems being used prior to panel installation work.

2.02 Acceptable Manufacturer

There are a number of Polyurea system suppliers that are members of the Polyurea Development Association. Each may have specific Polyurea systems designed for certain application areas. They should be consulted for types of products for the various application areas.

2.03 Polyurea Materials

- A. Special Coating / Lining / Joining Systems:
 - 1. Spray applied aromatic based Polyurea systems;
Including a fire retardant version.
 - 2. Spray applied aliphatic based Polyurea systems.
 - 3. Brush / roller applied Polyurea systems for repair work.
- B. Acceptable Polyurea Spray / Geotextile Composite Panel

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FlexTain, VersaFlex Incorporated

- C. Acceptable Polyurea Spray Elastomer System for Coating / Lining / Joining Panels
VF 380 from VersaFlex, Incorporated®

2.04 Geotextile

If also used, only special geotextiles which have been tested and approved by the Polyurea System supplier and polyurea spray / geotextile composite panel supplier are recommended. These geotextiles may be pre-treated on one side (ironed) to facilitate uniform coverage of the Polyurea elastomer lining system. These geotextile fabrics may include non-woven polyester, woven polyester, and / or spun bond polyester fabrics. Use of Polyethylene or polypropylene based geotextile fabrics should be reviewed as little to no adhesion will occur between the fabric and the polyurea elastomeric lining system, only penetration through.

Selection of a geotextile fabric for the composite panel system depends on the type and condition of the substrate placed, and on the end use of the system. For polyurea / geotextile elastomeric composite panel systems or environmental covers, the following may be used as a general guide:

<u>Service Conditions</u>	<u>Geotextile Fabric / Weight</u>
Light duty service	2 – 4 oz / sq. yd.
Standard Duty (most pond liners and secondary containment)	4 – 8 oz / sq. yd.
Heavy Duty	8 – 9 oz / sq. yd.

PART 3 – SITE PREPARATION

3.01 Soil

- A. After excavation, the soil shall be compacted to a smooth surface. If a layer of clay, sand, or gravel is specified under the membrane, it shall be placed at a uniform depth on the compacted soil and the slope established according to the design recommendations of the owner, specifier, or engineer. The polyurea spray / geotextile composite panel membrane system will not provide protection against dangerous conditions such as instability of the surrounding soil or prevention of the soil sliding under the liner.
- B. All surfaces in contact with the liner must be free of sharp stones, sticks, and other debris that can puncture or tear the liner. This may mean that soil removal, screening and replacement will be required to assure proper surface conditions. A layer of sand or gravel can be used if the native soil is unstable. Sterilize and remove areas of potentially harmful plant life and trees that could rupture the liner / membrane.
- C. Venting of the polyurea spray / geotextile composite membrane may be required
- D. For basins, ponds, etc., a 12” by 18” (30.5 cm X 45.7 cm) anchor trench around the perimeter of the excavation may be required to secure the liner and prevent damage to the liner from adverse

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weather or other service conditions. If the excavation is to contain liquid, this anchor trench must be above the water line.

3.02 Transition Areas

- A. Where the polyurea will form the basis of the liner without the composite membrane, follow the procedures in this section.
1. Concrete Surfaces
 - a. Allow concrete to cure 28 days. Concrete must be structurally sound and free of all voids and delamination. Follow ICRI Technical Guidelines 03730 and 03731, or manufacturer's recommendations.
 - b. Moisture tests:
 - i. Concrete surfaces shall be tested for moisture vapor emissions in accordance with ASTM F 1869, Standard Method for Measuring Moisture Vapor Emission Rate of Concrete Sub-floor Using Anhydrous Calcium Chloride Moisture Emissions Test.
 - ii. The presence of moisture on the concrete surface can be measured by the use of a Delmhorst ®, Tramex Concrete Moisture Encounter, or other suitable electronic meter. CAUTION: These meters do not measure the rate of moisture vapor emission, but only the presence of moisture on the concrete surface.
 - c. Cracks in excess of 1/16" (1.6 mm) shall be routed and sealed in accordance with Polyurea system supplier's / manufacturer's recommended details. Polyurea Joint Sealant / Filler system may be appropriate for use here.
 - d. Check for soluble salt contamination, such as chlorides, sulfates and/or nitrates, and remove as required.
 - e. The concrete shall be thoroughly cleaned to remove all dirt, oil, grease, form release chemicals and other contaminants. Refer to SSPC-SP 13.
 - f. Remove all laitance, contamination, (contamination will not be removed by abrasive blasting, only blast it into the profile) curing compounds, by abrasive blasting, grit blasting, or other method approved by Polyurea system supplier / manufacturer to achieve a profile equal to ICRI CSP 2-4.
 - g. Refer to the PDA General Standard: Polyurea Elastomeric Coating / Lining Systems.
 2. Concrete Block
 - a. Clean concrete block as noted above. Allow mortar to cure 28 days. The concrete shall be thoroughly cleaned to remove all dirt, oil, and other contaminants, Refer to SSPC-SP 13.
 - b. Remove all existing coatings and linings by best (acceptable) method available. Only well-bonded coatings and linings may remain. Consult Polyurea system supplier / manufacturer for full recommendations.
 - c. Remove all laitance, contamination, (contamination will not be removed by abrasive blasting, only blast it into the profile) curing compounds, by abrasive blasting, grit blasting, or other method approved by Polyurea system supplier / manufacturer to achieve a profile equal to ICRI CSP 2-4. Surface must be clean, sound, and dry prior to application.
 3. Steel

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- a. Steel substrate shall be structurally sound.
 - b. All welds shall be continuous and ground smooth or filled. Weld spatters, burrs, gaps, skip welds, slag, etc. shall be removed. Sharp edges shall be ground smooth. Adhere to NACE standard RP0178, latest revision.
 - c. Check for soluble salt contamination, such as chlorides, sulfates and/or nitrates. Remove all existing coatings and linings by best (acceptable) method available. Only sound well-bonded liners may remain. Consult Polyurea system supplier / manufacturer.
 - d. Degrease as necessary using high-pressure water and biodegradable detergents. Rinse thoroughly.
 - e. Generally, provide a minimum “Near White Metal” abrasive blast cleaning to SSPC-SP 10 or NACE 2, with a 2-3 mil anchor profile or according to the coating manufacturer. Determine profile per SSPC-VIS 1. (Note: Refer to NACE RP0287-87 and ASTM 4417, Method C for measuring surface profile by replica tape) Consult Polyurea system supplier for further instructions or specific preparation recommendations.
 - f. Avoid “flash rusting.” If “flash rust” occurs, all traces shall be removed such that the surface meets the requirements of SP 10 or by pre-treating procedure as per Polyurea system supplier.
 - g. Refer to the PDA General Guideline: Polyurea Elastomeric Coating / Lining Systems.
4. Other Substrates
- a. For substrates such as stainless steel, aluminum, or other metallic surfaces, refer to the polyurea system supplier’s recommendations before coating over these surfaces. Also see SSPC-SP 16.
 - b. PVC and other rigid plastic piping and surfaces shall be cleaned of dust, dirt, and other contaminants with a wet or dry stiff-bristle brush. Oil and grease on the surface shall be wiped with a suitable solvent. Abrasion of the area will be required followed by application of the recommended primer system or direct application of the polyurea elastomeric liner system. Refer to the installation diagram for more details on sealing pipe penetrations.

PART 4 - POLYUREA / GEOTEXTILE COMPOSITE PANEL INSTALLATION

4.01 Manufacturing of Panels

Composite panels will be supplied as manufactured per the General Specification: Polyurea Spray / Geotextile Composite Panel Manufacture, Primeaux Associates LLC. Approximately 4 inches (10 cm) on each edge of the polyurea spray / geotextile composite panel has been left uncoated for proper joining of the panels in the field.

4.02 Installation of Polyurea Spray / Geotextile Composite Panels

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- A. All surfaces shall be dry and cleaned of any foreign objects that may damage or inhibit uniform and consistent coverage the liner system.
- B. The composite panel rolls shall remain covered and protected from weather until ready for installation. Only composite panels for each day's spraying shall be spread. Do not place or roll onto wet substrates at any time. Plastic sheets may be used under the composite panels if this condition occurs.
- C. The composite panels shall be flat in place on the surface area. Uniform wrinkling of the geomembrane composite panels is considered normal and acceptable. However, excessive wrinkles must be avoided.
- D. Overlap the composite panels 4 to 6 inches (10.2 to 15.2 cm). Coat both side of the geotextile panel along the joining area and seal the lap together while the polyurea is still "wet".
- E. For use of uncoated geotextile, spray the polyurea elastomeric lining system with uniform multiple passes over the dry geotextile surface. Multiple pass application shall be in a criss-cross pattern to insure uniformity in coverage.
- F. Apply polyurea system at a minimum average 40 mils (1.0 mm). Heavy weight, non-woven geotextile may require a higher applied film thickness to achieve proper and complete coverage. Apply a stipple / texture finish following base build-up of polyurea.
- G. For use of uncoated geotextile, leave approximately 4 inches (10 cm) on each edge of the geotextile fabric uncoated for proper joining of the panels in the field.
- H. The geotextile composite panels may or may not be anchored in place depending upon service conditions and design requirements by the owner, specifier, or engineer. Anchoring nails may be U-shaped, or straight pin shaped and long enough to secure the liner. Care should be taken that the geotextile is positioned to conform to surface irregularities as much as possible. Uniform wrinkling of the geotextile is considered normal and acceptable, however excessive wrinkles must be avoided.
- I. Steps shall be taken to avoid more than three layers of geotextile in any area and minimizing the number of joints.
- J. Geotextile extending into an anchoring trench shall be completely coated with the polyurea elastomeric liner system to the specified thickness.
- K. "Fish mouths" or areas that are rounded at the seams and do not form a continuous liquid tight seal, are unacceptable and should be eliminated with a hand tool or patch system. Areas of incompletely coated geotextile fabric are not acceptable.
- L. At the end of the workday, approximately two feet of geotextile shall be left uncoated to form a point for the following day's work. It may be necessary to use and inter-coat adhesion promoter

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or another recommended method by the Polyurea Systems Supplier when the recoat window has been exceeded. Caution must be taken to keep the geotextile free of debris at all times.

- M. On sites where gas or vapors may collect under the composite membrane liner, a vent system should be installed according to the owner, specifier, or engineer recommendation.
- N. Penetrations through the polyurea coated geotextile shall be treated according to Section 3.02.A.4 and the Appendix B. Other installation diagrams and details required for installing the polyurea spray / geotextile composite panel lining system must be approved by the polyurea system supplier / manufacturer.
- O. Footwear should be of the rubber sole type for walking on the liner system during installation without pulling up “hairs” of the geotextile fabric.

4.03 Composite Panel Quality Control

- A. Completed composite panel installation should be visually inspected for voids and defects. Repair as required.
- B. Adhesion Testing (if required): Per Polyurea system supplier’s recommendations following ASTM D 751 for the joining areas.
- C. Applied Thickness Testing: ASTM D 751, D 1186, D 4138, or D 6132. Thickness also may be verified by logging the volume of material sprayed through the automatic counter located on the special spray equipment.
- D. Shore Hardness Testing: monitor Shore Hardness (D 2240) of the applied polyurea joining system to insure proper mix and set.
- E. Water leak test: If required and practical, perform a leak test according the owner, specifier, or engineer required time period, or ACI 350.1-01 method.
- F. Complete daily log detailing all job conditions. Assign a batch number to each panel corresponding to application conditions, stroke count, material lot numbers, etc.

APPENDIX “A”

Polyurea / Geotextile Composite Panel Physical Testing

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>UNITS</u>
Tensile Elongation	ASTM D 638, Type IV	175 %
Tensile Strength	ASTM D 638, Type IV	1370 psi
Durometer Hardness	ASTM D 2240	80 – 85 Shore A 35 – 37 Shore D
Moisture Vapor Transmission	ASTM E 96, wet cup	< 0.02 perms
Tear Strength	ASTM D 624, Die C	445 pli
Trouser Tear	ASTM D 624	95 pli
Bursting Strength	ASTM D 751	410 ft-lbs 170 psi

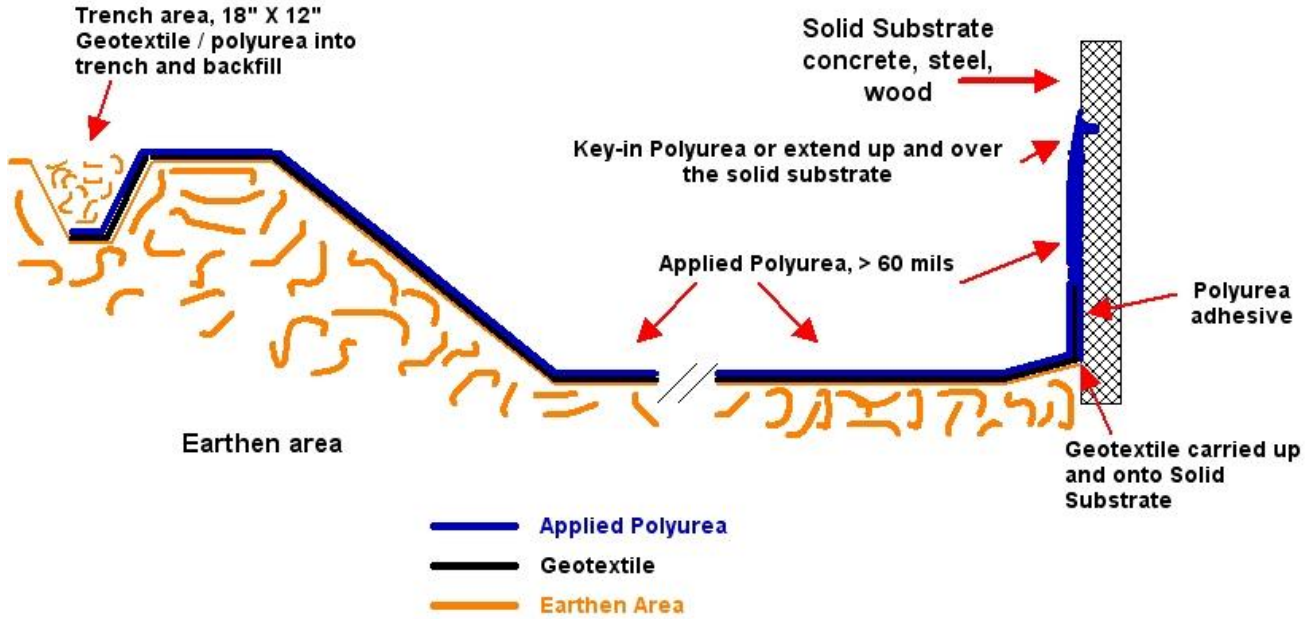
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Puncture Resistance	ASTM D 751	65 ft-lbs 25 psi
Coefficient of Linear Thermal Expansion	ASTM C 531	2 – 6 $\mu\text{in./in./}^{\circ}\text{F}$
Cure Shrinkage	ASTM D 6289	< 0.5 %
Mandrel Bend Conical bend (Applied to geotextile fabric)	ASTM D 522	Pass
Mandrel Bend 1/4" mandrel, 25° C 1/4" mandrel, -20° C (Free film - 35 - 50 mils)	ASTM D 522	Pass Pass

APPENDIX B

Installation Diagram:

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Penetrations Detail:

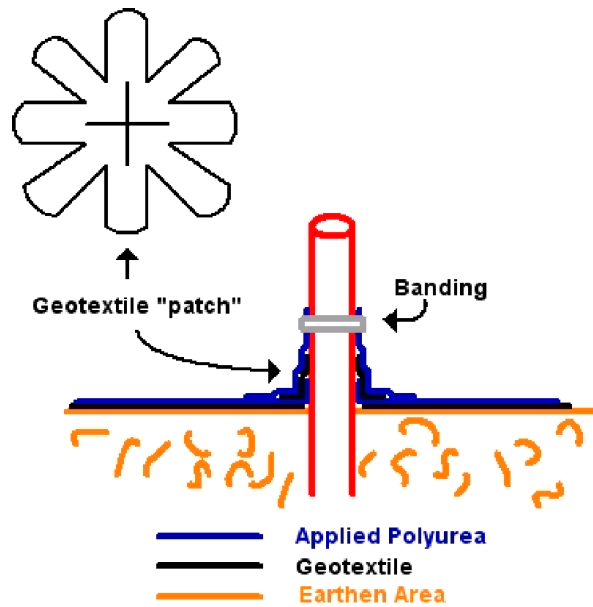


Diagram & detail courtesy of Primeaux Associates LLC