



SAMPLE PROJECT SPECIFICATION

For

REINFORCED POLYPROPYLENE

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1. SCOPE OF WORK

The work covered by these specifications consists of installing a fabric reinforced polypropylene (RPP) geomembrane, in the areas shown on the project drawings. All work shall be done in strict accordance with the project drawings, these specifications and the fabricator's approved panel layout.

Sufficient material shall be furnished to cover all areas as shown on the drawings including seam areas, anchor trenches and appurtenances as required. The fabricator and the installer of the liner shall allow for any anticipated or planned shrinkage or wrinkles in the field panels, installing the membrane free of stress or tension.

2. PRODUCTS

The geomembrane material shall be 36 mil scrim-reinforced Polypropylene (RPP) as fabricated by AccuGeo Liner (321 Industrial St., Bakersfield, CA 93307; 661-321-0447) or approved equal, with the following physical specifications:

Thickness (mils nominal)		ASTM D751	36
Breaking Strength (lbs min)	Warp (MD)	ASTM D751, Method A	275
	Fill (TD)	ASTM D751, Method A	250
Tear Strength (lbs min)	Warp (MD)	ASTM D751, Tongue Tear	70 lbs
	Fill (TD)	ASTM D751, Tongue Tear	70 lbs
Wide Width Strength	Warp (MD)	ASTM D4885	150 lbs/in
	Fill (TD)	ASTM D4885	125 lbs/in
Low Temperature (Degrees F)		ASTM D2136 (1/8" Mandrel, 4hr)	-40°
Dimensional Stability (% Δ Max)		ASTM D1204 (180°F / 1 hour)	1%
Hydrostatic Resistance (psi min)		ASTM D751, Method A	350 psi
Ply Adhesion (lbs/in min)		ASTM D413	40 lbs / 2 in
Puncture Resistance		FTMS 101C, Method 2031	300 lbs
Abrasion Resistance (H18 / 1kg)		ASTM D3884	<1%
Stress Crack Resistance		ASTM D1693	3,000 Hours
UV Resistance (20,000 Hours)		ASTM G155	Pass
Resistance to Soil Burial (%Tensile Retention)		ASTM D3083 (Part. 9.5)	90% min
FACTORY SEAM PROPERTIES			
Bonded Seam Strength		ASTM D751	200 lb min
Peel Adhesion (lbs/in min)		ASTM D413	20 lbs/in

The geomembrane roll stock shall be manufactured by the extrusion calendaring process, consisting of first quality ingredients, suitably compounded with sufficient additives to ensure long-term durability. The finished membrane shall be uniform in color, thickness, size and surface texture.

The finished membrane shall consist of two (2) plies of polypropylene laminated over one (1) ply of reinforcing scrim. The scrim shall be fully encapsulated with the encapsulation extending a minimum of 1/8" beyond the scrim edges. Exposed fabric along the length of the roll stock shall not be permitted.

3. QUALIFICATIONS

- A. Manufacturers qualifications: The manufacturer of the RPP geomembrane of the type specified shall have at least five years of experience in the manufacture of RPP geomembranes. In addition, the geomembrane manufacturer shall have manufactured at least one million square feet of the specified type of geomembrane in the last five years.
- B. Fabricators qualifications: The fabricator of the proposed RPP geomembrane shall have a minimum of five million square feet of RPP fabrication experience.

4. SUBMITTALS

The fabricator shall furnish a proposed geomembrane panel layout to be approved in writing by the owner's representative prior to material shipment. The drawings shall show: the direction of factory seams, the size of panels, and the location of field seams, consistent with the requirements of the project drawing. These details shall include the recommended termination details of the geomembrane.

5. FACTORY SEAMS

The RPP roll stock shall be factory fabricated into the largest panels possible to minimize field seams. Field fabrication will not be allowed. Prior to factory seaming, all roll goods shall be inspected. All factory seams shall be made by thermal fusion methods. All factory seams shall have a minimum scrim-to-scrim overlap of one and one-half inches (1.5") when fabricated. Fabricated seams found to have less than the specified minimum overlap shall be repaired by adding an overlap or cap strip that provides the minimum specified overlap or it will be rejected. All seams shall be made so that thermal fusion bond extends fully along the width of the sheet so that no loose edges are present.

6. INSPECTION AND TESTING OF FACTORY SEAMS.

All sheets and seams shall be 100% visually inspected during fabrication. No defective seams or exposed scrim will be allowed. Upon discovery of any defective seam, production shall stop and the seam shall be repaired. Production personell shall determine and rectify the cause of the defect prior to continuation of the seaming process. All exposed scrim edges shall be sealed with an approved polypropylene edge caulk, capped with a strip of polypropylene or extrusion welded. All indicated repairs shall be made before the panels are packaged for shipment.

In addition to visual inspection, a 48-inch weld sample shall be made with each factory seam welding unit used in this work at the beginning of every work shift and every four hours of production thereafter. Sample shall be taken from a seam specifically made for quality testing and not taken from the fabricated panel itself. Test specimens shall be cut at quarter points from each 48-inch seam sample (a total of three places) and tested for seam strength and peel adhesion. The shear seam strength shall be tested in accordance with ASTM D751 as modified in Annex A of ANSI/NSF 54. The peel adhesion shall be tested in accordance with ASTM D413 as modified in Annex A of ANSI/NSF 54.

A log shall be maintained showing the date, time, panel number and test results. Failure of the material and/or seams to meet all the requirements of these specifications may be cause for rejection of the material and/or seams as appropriate. Test results shall be provided to the owner's representative upon request.

7. CERTIFICATION AND TEST REPORTS

Prior to installation of the panels, the fabricator shall provide the owner's representative with written certification that the factory seams were inspected in accordance with Section 6.

8. PANEL PACKAGING AND STORAGE

Each factory-fabricated panel shall be accordion-folded and placed onto a sturdy wooden pallet designed to be moved by a forklift or similar equipment. Each panel shall be given prominent and unique identifying markings indicating the proper direction of unfolding to facilitate layout and position in the field. The panels shall be suitably packaged, enclosed and protected to prevent damage during shipment and each package shall be prominently marked in the same fashion as the panels within. Until needed, packaged factory fabricated panels shall be stored in their original unopened wrapping, and protected from the direct heat of the sun, where possible. Pallets should not be stacked.

9. SUBGRADE PREPARATION

The surfaces on which the lining is to be placed shall be maintained in a firm, clean, dry and smooth condition during the lining installation. All surfaces shall be compacted and smooth graded with anchor trenches provided as required and detailed. All surfaces to be lined shall be free of rocks, roots, gravel, grade stakes or debris that may puncture the geomembrane. The subgrade shall be compacted to a minimum of 95% of the dry density (as determined by ASTM D398 Standard Proctor Method). Geotextiles may be used as a cushioning agent. All vegetation, if present, shall be removed and if required by the owner's representative, a soil sterilant applied. The soil sterilant shall be selected for the geographical area and native grasses and growth.

All subgrade damaged by construction equipment and deemed unsuitable for geomembrane deployment shall be repaired prior to placement of the geomembrane.

If groundwater is present within 12 inches below the surface to be lined, the general contractor shall dewater the area prior to and during installation of the liner. If the liner is to be installed at an elevation below the current or possible future ground water elevation, an adequate underdrain system shall be installed to prevent ground water pressure from developing beneath the geomembrane. Excessive ground water can force the geomembrane upward through the cover soil and any liquid contained in the impoundment.

Immediately prior to the installation of the geomembrane, the owner's representative and the geomembrane installer shall perform a complete and detailed inspection to determine acceptance of the finished subgrade and elevations. Any erosion or other damage to the subgrade that has occurred shall be corrected before geomembrane placement.

10. GEOMEMBRANE PLACEMENT

RPP geomembrane shall not be deployed until all applicable submittals and certifications listed in Sections 4 and 7 of this specification are submitted and approved by the owner's representative. Should the RPP geomembrane be deployed prior to approval of the owner's representative, it will be at the sole risk of the geomembrane installer and/or general contractor. If the material does not meet the specification it shall be removed from the site at no cost to the owner.

Only those panels of lining material that can be anchored and seamed together the same day shall be unpackaged and placed into position. In areas where high wind is prevalent, the lining installation should begin on the upwind side of the project and proceed downwind. The leading edge of the liner shall be secured at all times with sandbags sufficient to hold it down during high winds. The leading edges of the liner material left exposed after the day's work shall be anchored with sand bags spaced no less than 10 feet to prevent damage or displacement due to wind.

The geomembrane shall be placed over the prepared surfaces in such a manner as to insure minimum handling and in accordance with the approved shop drawings. The lining shall be sealed to all concrete structures and other openings in accordance with details shown on the plans and shop drawings. The geomembrane shall be closely fitted and sealed around all inlets, outlets and other projections through the lining, using prefabricated pipe boots as shown in the

construction details. Liner panels, damaged from any cause, shall be repaired in accordance with Section 14 of this specification.

Geomembrane placement shall not be performed if moisture present prevents proper subgrade preparation, panel placement or panel seaming.

The geomembrane shall not be allowed to “bridgeover” voids or low areas in the subgrade. In these areas the RPP geomembrane shall be installed with sufficient slack as to allow material to remain in intimate contact with the subgrade or the subgrade repaired.

In general, field seams shall be oriented parallel to the line of the maximum slope, i.e., the seam should run down the slope. In corners and odd geometric locations, the total length of the field seam shall be minimized. If at all possible, seams shall not be located at low points in the subgrade unless geometry requires seaming to be done at these locations.

No vehicles will be allowed on the geomembrane. Small rubber tired equipment with a ground pressure not exceeding 5 psi and a total weight not exceeding 750 lbs will normally be allowed. Typical equipment that is usually used during installation and testing and allowed on the geomembrane include air compressors, generators, etc. Materials, equipment or other items shall not be dragged across the geomembrane surface or be allowed to slide down slopes on the lining. All parties walking or working on the liner shall wear soft-sole shoes. No smoking shall be permitted on the liner.

11. FIELD SEAMS

A capable hot air welder or a wedge welder shall be used to seal factory-fabricated panels together in the field.

These seams shall be made as a lap joint formed by lapping the edges of the sheets four (4) to six (6) inches in accordance with the recommendations of the welder manufacturer. The contact surfaces of the sheets shall be wiped clean of all dirt, moisture, and other foreign matter. A minimum of one and one half inch (1.5”) bond shall apply to all liner field seams. A minimum of two inches (2”) bond shall apply to all floating cover field seams.

Avoid fishmouths, wrinkles, folds or pleats in the same area. Where fishmouths do occur, they should be slit out far enough from the seam to dissipate them, lapped, seamed together in the lapped area and patched. Any necessary repairs to the RPP geomembrane shall be done using an additional piece of the specified parent material applied as stated in Section 14 of this specification. All patching material shall have rounded edges.

Seams shall be welded only when ambient temperature is between 32°F and 110°F as measured six inches above the geomembrane surface unless the Engineer approves other limits, in writing. For temperatures below 32°F, the following procedures shall be utilized:

When the weather is clear and sunny with gentle winds (10 mph or less) welding can normally be performed at an ambient temperature between 32°F and 15°F (liner temperature is usually warmer than ambient due to the sun) without additional provisions other than adjusting the welding machine. Welding temperatures and machine speeds are adjusted to compensate for cloudy weather and higher winds (up to 25 mph).

For temperatures between 15°F and 5°F some means of preheating the liner other than that provided by the welding machine is needed. Details of the preheat (space heaters, temporary shelters and combinations of the two) will be determined by the individual job conditions. The following variables are measured and recorded:

- Liner Temperature (surface contact thermometer)
- Ambient Temperature (6” above liner)
- Wedge Temperature During Welding
- Wedge Speed

- Temperature Set Point of Wedge

The wedge temperature during welding must be observed and recorded. After starting a seam the temperature is observed and recorded every 20 feet for the first 60 feet or until the wedge temperature appears to have stabilized. After the temperature has stabilized the wedge temperature is observed and recorded every 15 minutes.

No welding can take place when it is snowing, sleeting, or raining. Snow and ice must be moved from the liner prior to welding. Snow removal is the responsibility of the owner or general contractor. Snow blowers are typically used to remove the top portion of snow leaving the lower 2 to 3 inches above the liner to be carefully removed by hand using plastic shovels or brooms.

12. INSPECTION AND TESTING OF FIELD SEAMS

Upon completion of the liner installation, all seams shall be visually inspected for compliance with these specifications. In addition to visual inspection, all field seams shall be checked using an air lance nozzle directed on the upper edge and surface to detect any loose edges or ripples indicating unbonded areas within the seam (ASTM D 4437).

All field seams shall be tightly bonded on completion of the work. Any geomembrane surface showing injury due to scuffing, penetration by foreign objects, or distress from other causes shall be replaced or repaired. All exposed scrim edges shall be sealed with an extrusion weld or capped with a strip of polypropylene.

Destructive test seams are to be made by each seaming crew, at the beginning of the seaming process and every four (4) hours thereafter, or every time equipment is changed. Test seams shall be made under the same surface and environmental conditions as the production welds (i.e., in contact with geomembrane subsurface and similar ambient temperature). These seams are to be made of like materials provided for the purpose of testing and not cut from the seamed panels. Each seaming crew and the materials they are using must be traceable and identifiable to their test seams. The samples shall be numbered, dated and identified as to the personnel making the seam, and location made by appropriate notes on a print of the panel layout for the project. The completed field seam sample shall measure not less than 14 inches in width and 24 inches in length.

The field test seams are to be tested for seam strength and peel adhesion using equipment suitable for this purpose. Seam shear strength shall be tested in accordance with ASTM 0751 (modified to use one inch wide specimens and a test speed of 2 in/min). Peel adhesion strength shall be tested in accordance with ASTM 0413, Method A. The geomembrane installer shall provide a punch press or other suitable means for the on-site preparation of specimens for testing. The geomembrane installer shall provide a tensiometer for on-site shear and peel testing of geomembrane seams. The tensiometer shall be in good working order, built to ASTM specifications, and accompanied by evidence of recent calibration.

If a test seam fails to meet the field seam design specification, then the seaming crew shall make additional test seam samples, using the same tools, equipment, environmental conditions and seaming materials and retested.

13. PIPES AND STRUCTURE PENETRATION SEALING SYSTEM

Penetrations shall be sealed using the same RPP geomembrane material, prefabricated boots, and accessories as shown on the project drawings. The prefabricated or field fabricated assembly shall be field welded to the main RPP geomembrane as shown on the project drawings so as to prevent leakage.

These areas can be welded with any of the methods listed in Section 11.

All sealed areas shall be air lance tested using ASTM D4437 and verified to be leak free.

14. REPAIRS

Any repairs made to the liner shall be made with parent material supplied by AccuGeo Liner. For the best welding performance, the repair should be made with newly manufactured material. Patches shall be cut with rounded corners and shall extend a minimum of four 4 inches in each direction from the damaged area. The entire surface of the patch shall be bonded to the RPP lining material. If reinforced patches are used, the cut edges of the patch should be coated with an approved sealant or sealed with an extrusion weld.

15. WARRANTY

The Geomembrane Manufacturer shall confirm in writing, that the furnished material to will be free of defects in materials and workmanship at the time of sale, and against deterioration due to the effects of ozone, ultraviolet and other normal weathering on a pro-rata basis for up to 20 years from the date of completed installation.