

GEOMEMBRANE LINER

****From Highgate STP 0297(8) (Re-advertised)**

- xx. DESCRIPTION. This work shall consist of furnishing and installing a geomembrane liner at the locations indicated in the Plans and as directed by the Engineer.
- xx. MATERIALS. Geomembrane shall be textured, high-density polyethylene geomembrane.
- (a) Resin. Resin shall be new first quality, compounded polyethylene resin that is manufactured specifically for producing geomembrane. At no time shall the manufacturer intermix resin types. The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material.
- No post consumer resin (PCR) of any type shall be added to the formulation.
- (b) Geomembrane.
- (1) Geomembrane shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks or cuts on roll edges.
- (2) Geomembrane shall meet the requirements of Table 2. Samples shall be taken and tested by the manufacturer at a frequency of 1 sample per 4645 square meters (50,000 square feet), unless otherwise noted, to assure conformance with the requirements.

- (3) The Contractor shall furnish the geomembrane manufacturer's certified test results attesting that the geomembrane and all factory seams meet the requirements stated in these specifications.

A Type D Certification shall be furnished in accordance with Subsection 700.02, including minimum average roll values for each type of geomembrane used.

TABLE 2 - MINIMUM VALUES FOR COEXTRUDED TEXTURED HDPE GEOMEMBRANE

Property	Test Method	Values
Nominal Thickness ¹ mm (mil)	ASTM D5994	1.0 (40)
Density, g/cm ³ (lb/in ³)	ASTM D1505	0.940 (0.034)
Asperity Height, mm (mil)	GRI GM-12	See Note 3
Carbon Black Content, %	ASTM D1603	2.0-3.0
Carbon Black Dispersion	ASTM D5596	See Note 4
Tensile Properties (each direction) ²		
Strength @ Yield, g/cm (lb/in)	ASTM D6693; 2 ipm	15,002 (84)
Elongation @ Yield, %	33.0 mm (1.3 in) gauge length	2143 (12)
Strength @ Break, g/cm (lb/in)	50.8 mm (2.0 in) gauge length	10,716 (60)
Elongation @ Break, %		100
Tear Resistance, N (lb)	ASTM D1004	124.6 (28)
Puncture Resistance, N (lb)	ASTM D4833	266.9 (60)

- To be measured per roll. Minimum average = 0.97 mm (38 mils), lowest individual for 8 out of 10 values = 0.91 mm (36 mils), lowest individual for any of the values = 0.86 mm (34 mils).
- The combination of stress concentrations due to coextrusion texture geometry and the small specimen

size results in large variation of test results. Therefore, these tensile properties are minimum average roll values.

3. 0.25 mm (10 mil) average. 8 of 10 readings > 0.18 mm (7 mils). Lowest individual > 0.13 mm (5 mils).
4. Only near spherical agglomerates are considered. Nine of ten views shall be Category 1 or 2. No more than one view Category 3.

xx. SUBMITTALS.

- (a) Prior to Material Delivery. No material shall be delivered to the site until the material and performance documentation and certifications have been received and reviewed by the Engineer. Documentation shall include quality control test results on the manufactured materials.

xx. MATERIAL LABELING, DELIVERY, STORAGE, AND HANDLING.

- (a) Labeling. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall clearly state the manufacturer's name, product identification, thickness, length, width, and roll number. The label shall be found on either of the end caps, an inside edge of the core, and outside the core.
- (b) Delivery. The rolls shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.
- (c) Storage. The Contractor shall provide a suitable storage site which will protect the geomembrane from punctures, abrasions, excessive moisture, and dirt. The on-site storage location for the geomembrane material should be level, smooth, elevated, and dry. The storage place should be protected from theft and vandalism, and if possible should be adjacent to the area to be lined to facilitate installation and minimize handling.
- (d) Handling. The materials are to be handled so as to prevent damage. Instructions for moving rolls shall be provided by the manufacturer upon request.

xx. CONSTRUCTION REQUIREMENTS.

(a) Geomembrane Installation Preparation.

- (1) The Contractor and the Engineer shall approve the subgrade prior to geomembrane installation. No geomembrane shall be placed on unsuitable subgrade. No stones or sharp objects shall be present on the surface to be lined. Documentation of subgrade acceptance shall be provided to the Engineer prior to liner deployment.
- (2) Surface moisture shall not be excessively wet or dry or in any condition which will impede proper installation. Under no condition shall the geomembrane be placed over standing water on the subgrade. Dewatering will be incidental to the installation.
- (3) The geomembrane shall be installed without seams.

(4) Deployment.

- a. Visually inspect the geomembrane during deployment. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane. Such defects or suspect areas shall be marked and repaired, if necessary.
- b. Unroll the geomembrane panels using methods that will not damage the geomembrane and will protect the underlying surface from damage (i.e. spreader bar-protected equipment bucket). No equipment used shall be allowed to damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.
- c. Do not allow heavy vehicular traffic directly on the geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than 34 KPa (5 psi).
- d. The method used to place the geomembrane shall minimize wrinkles (especially differential wrinkles between adjacent panels or sheets).
- e. Adequate loading (such as sand bags, tires, or similar items that will not damage the geomembrane) shall be placed on the geomembrane to prevent uplift in case of high winds. Continuous loading is recommended along edges to minimize risk of wind flowing under the geomembrane.

- f. All penetrations (i.e. catch basin) through the geomembrane shall be sealed with a polyisoprene gasket (or approved equal) and batten strip as shown in the Contract Documents.
- g. Sufficient material (slack) shall be provided to allow for geomembrane expansion and contraction.

(5) Field Seaming.

- a. Field seaming of the geomembrane shall not be permitted.

(6) Field Quality Control.

- a. The Contractor and the Engineer shall visually inspect in place the geomembrane for holes, blemishes, pores, penetrations, or other detrimental defects.

- b. No repairs shall be made until the contractor submits and the engineer approves a repair plan for the damaged areas. The plan shall include details on how each area will be repaired and non-destructively tested to ensure geomembrane integrity. The geomembrane shall not be covered at locations which have been repaired until test results with passing values are available.

- c. The geomembrane shall be replaced in its entirety when the total damage area exceeds three square feet. Repair of a maximum two damaged areas will be permitted. If the number of damaged areas exceeds two, the entire geomembrane shall be replaced.

d. Non-Destructive Testing.

1. Vacuum Test.

- i. The equipment shall consist of the following:

- a. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft gasket attached to the bottom or valve assembly, and a vacuum gauge.

- b. A vacuum pump assembly.

- c. A soapy solution.

- ii. The test procedure is completed as follows:
 - a. Apply soapy solution to the seam.
 - b. Place vacuum box assembly over the entire wetted seam area ensuring that a leak tight seal is created.
 - c. Apply a vacuum of at least 34.5 KPa (5 psig).
 - d. Examine the extrusion seam through the viewing window for the presence of soap bubbles in rapid succession for a minimum of ten seconds. The presence of soap bubbles in rapid succession is indicative of a leak.
 - e. All areas where soap bubbles appear in rapid succession shall be marked, repaired, and retested. Repairs to be completed in accordance with these provisions.
- 2. The Contractor shall complete vacuum tests on all extrusion welds (i.e. patches, pipe boots, etc). Vacuum testing shall conform to ASTM D 5641 and be completed as specified. In addition, the Contractor shall repair and test all repairs resulting from any unsatisfactory geomembrane or seam area which failed the vacuum testing.
- 3. Air Pressure Test.
 - i. The equipment shall consist of the following:
 - a. An air pump or tank equipped with pressure gauge capable of generating and sustaining pressure over 206.8 KPa (30 psig).
 - b. A sharp, hollow needle, or other approved pressure feed device, equipped with a pressure gauge.
 - c. Utility knife with hook blade, hot air gun, or other device and clamp to seal the ends of the air channel. Utility knife will also be used to puncture opposite end of seam after testing.

- ii. The test procedure is completed as follows:
 - a. Delineate seam to be tested by making cuts through the seam at both ends with the hook blade utility knife.
 - b. Seal both ends of seam to be tested, insert air needle into the air channel, and pressurize to at least 241.3 KPa (35 psig).
 - c. Allow pressure in air channel to stabilize, at no lower than 206.8 (30 psig). Once stabilized, pressure in air channel can be reduced to a minimum of 206.8 (30 psig) to start the test. Test period is a minimum of five minutes.
 - d. If the pressure loss is greater than 20.7 KPa (3 psig) in five minutes or does not stabilize after five minutes, locate faulty area where leak is occurring, repair, and retest.
 - e. If the pressure loss is less than or equal to the 20.7 KPa (3 psig) within the five minute test period, puncture the opposite end of seam to release the air, confirming that the entire seam length had been tested. If air is not released once channel has been punctured a blockage is present. Locate faulty area where the blockage is and retest seam on both sides of blockage. A pressure gauge at both ends of the seam will also be acceptable.
 - f. Remove needle or other approved pressure feed device and seal penetration holes by extrusion welding.
 - g. All leaks, holes made by the needle, or other damage resulting from the testing procedure shall be repaired in accordance with these provisions.

4. The Contractor shall complete air pressure tests on all field seams constructed using a double seam fusion wedge welder. The double seam fusion wedge welder creates two fusion welds separated by a channel. This channel is used for air pressure testing the field seam. Air pressure testing shall conform to ASTM D 5820 and be completed as specified. In addition, the Contractor shall repair and test all repairs resulting from any unsatisfactory geomembrane or seam area which failed the air pressure testing.

(7) Repair Procedures.

- a. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
- b. The Contractor shall be responsible for repair of damaged or defective areas and shall provide a written plan for repair. Procedures available include the following:
 1. Patching. Used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
 2. Abrading and Re-welding. Used to repair small seam sections.
 3. Spot Welding. Used to repair pinholes, other localized flaws (minor), or where geomembrane thickness has been reduced.
 4. Capping. Used to repair large lengths of failed seams.
 5. Flap Welding. Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
- c. Surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded with disc grinder or equivalent to assure cleanliness.
- d. All geomembrane surfaces shall be clean and dry at the time of repair.
- e. Extend patches or caps at least 152 mm (6 inches) for extrusion weld and 102 mm (4 inches) for wedge weld beyond the edge of the defect. Round all corners of patch material.
- f. Non-destructively test each repair using methods specified in these provisions.

- xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Geomembrane Liner) to be measured for payment will be the number of square meters (square yards) placed in the complete and accepted work. Slope measurements will be used in computing the area. Measurement will not be made for material used for repairs, seams, or overlaps. Measurement will not be made for material used to replace an installation of geomembrane that has become damaged, destroyed, lost, washed away, or otherwise ineffective unless authorized by the Engineer.
- xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Geomembrane Liner) will be paid for at the Contract unit price per square meter (square yard). Payment will be full compensation for furnishing, transporting, storing, handling, maintaining, placing, and removing the materials specified; for making required submittals; for providing required testing, monitoring, and inspection services; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.675 Special Provision (Geomembrane Liner)	Square Meter (Square Yard)