

Appendix A

REINFORCED POLYETHYLENE GEOMEMBRANE SPECIFICATION

Reinforced Polyethylene Geomembranes serve as liners and covers to contain water, leachate or other liquids. As a liner they can contain the liquid to prevent leakage or environmental impact and as a cover to minimize evaporation or contamination. It is of great importance that the Reinforced Polyethylene Geomembrane be free from defects and installed without damage.

A. DESCRIPTION

1. General:

The purpose of this specification is to provide details of Manufacturing Quality Control (MQC), Manufacturing Quality Assurance (MQA), Construction Quality Control (CQC), and Construction Quality Assurance (CQA) for the manufacture and pre-assembly of geomembrane products. The Contractor shall furnish all labor, material, and equipment to install the Reinforced Polyethylene Geomembrane including all necessary and incidental items as detailed or required to complete the installation in accordance with the Contract Drawing and these Specifications

2. Related Work:

Related Contract Work is described in the following section of the specification as approved by the CQA Engineer.

3. Reference Standards:

ASTM D5199 *Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.*

ASTM D5261 *Standard Test Method for Measuring Mass per Unit Area of Geotextiles.*

ASTM D6636 *Standard Test Method for Determination of Ply Adhesion Strength of Reinforced Geomembranes.*

ASTM D7003 *Standard Test Method for Strip Tensile Properties of Reinforced Geomembranes.*

ASTM D5884 *Standard Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes.*

ASTM D7004 *Standard Test Method for Grab Tensile Properties of Reinforced Geomembranes.*

ASTM D4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

ASTM D4833 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.

4. Quality Assurance:

Quality Assurance during installation of Reinforced Polyethylene Geomembrane will be provided by the Owner as described in the accompanying Project CQA Manual.

5. Manufacturers Qualifications:

- a. The Manufacturer shall have previously demonstrated his ability to produce the required Reinforced Polyethylene Geomembrane by having successfully manufactured a minimum of 10,000,000 ft² of scrim reinforced Polyethylene Geomembrane.
- b. Manufacturer must be ISO 9001 certified

6. Installer Qualifications:

The Reinforced Polyethylene Geomembrane Installer shall have installed a minimum of 500,000 ft² of Reinforced Polyethylene Geomembrane (or similar material).

7. Warranties:

The manufacturer of the Reinforced Polyethylene Geomembrane will warrant the material to the installer on a pro rata basis for up to 20 years after the final acceptance of the work, based on thickness of product, the application and location of the installation. This warranty shall include but not be limited to defects related to workmanship and manufacturing.

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of first-quality 100% virgin products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

2. Reinforced Polyethylene Geomembrane Materials:

- a. Reinforced Polyethylene Geomembrane shall be manufactured to meet the following requirements:
 - (1) Provide finished product free from holes, pin holes, bubbles, blisters, excessive gels, undispersed resins and/or carbon black, or contamination by foreign matter.
 - (2) Reinforced Polyethylene Geomembrane shall be a Linear Low Density Polyethylene Geomembrane composed of a heavy encapsulated 1300 denier polyester bi-directional reinforcement for the 30 mil, 36 mil, and 45 mil geomembranes.

- b. Approved Reinforced Polyethylene Geomembrane:
 - (1) Dura-Skrim K30B
Dura-Skrim K36B
Dura-Skrim K45B

As manufactured by Raven Industries of Sioux Falls, SD.
 - (2) Equal material, as approved by the Engineer.

C. FACTORY FABRICATION

- 1. The Reinforced Polyethylene Geomembrane shall be supplied in panels which shall be of maximum size to provide the largest manageable sheet for the fewest seams.
- 2. Factory seams are produced by thermal sealing methods and shall have a minimum seam width of 1 ½ inch scrim to scrim.
- 3. Factory seams are 100% visually inspected and destructive testing is done to verify quality compliance.
- 4. Labels on the panels shall identify the thickness, length, width, lot and panel numbers, and name of Manufacturer.
- 5. Factory pre-assembled panels are accordion folded and rolled on a cardboard core. Rolled panels are wrapped in a protective layer for shipment.

D. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Pre-Installation Requirements:

Prior to Reinforced Polyethylene Geomembrane installation the Contractor shall submit the following:

- a. Certificate of Conformance and Sample: Prior to shipping to the site, the Contractor shall submit a certificate or affidavit signed by a legally authorized official of the Manufacturer for the Reinforced Polyethylene Geomembrane attesting that the Reinforced Polyethylene Geomembrane meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of the Reinforced Polyethylene Geomembrane to be used (sample may be of different color). The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.
- b. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.
- c. Installation Procedures:

Submit installation procedures for carrying out the work. Installation procedures to be addressed shall include but not be limited to material installation, repair, and protection to be provided in the event of rain or strong winds. With regard to protection, the Contractor shall provide a plan of anchoring the Reinforced Polyethylene Geomembrane sufficient to satisfy the Contractor's Performance Warranty. This plan shall be approved by the Engineer prior to construction.
- d. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

2. Post-Installation Requirements:

Upon completion of the Reinforced Polyethylene Geomembrane installation, the Contractor shall submit the following:

- a. Completed material performance warranty.

E. SITE PREPERATION AND INSTALLATION

1. Installation shall be in done in accordance with the manufactures Geomembrane Installation Guidelines.

**TABLE 1:
REQUIRED REINFORCED POLYETHYLENE GEOMEMBRANE
PROPERTIES 30 MIL.**

PROPERTY	TEST METHOD	UNITS	MIMIMUM ROLL AVERAGES	TYPICAL ROLL AVERAGES
Thickness	ASTM D5199	Mils	28	30
Weight	ASTM D5261	Lbs.	120	125
Ply Adhesion	ASTM D6636	Lbs.	20	26
1" strip tensile	ASTM D7003	Lbf.	165 MD 153 TD	183 MD 170 TD
Tongue Tear	ASTM D5884	Lbf.	214 MD 186 TD	238 MD 207 TD
Grab Tensile Strength	ASTM D7004	Lbf.	267 MD 268 TD	297 MD 298 TD
Puncture Resistance	ASTM D4833	Lbf.	109	121

MD Machine Direction TD Transverse Direction

**TABLE 2:
REQUIRED REINFORCED POLYETHYLENE GEOMEMBRANE
PROPERTIES 36 MIL.**

PROPERTY	TEST METHOD	UNITS	MIMIMUM ROLL AVERAGES	TYPICAL ROLL AVERAGES
Thickness	ASTM D5199	Mils	32	36
Weight	ASTM D5261	Lbs.	157	179
Ply Adhesion	ASTM D6636	Lbs.	24	30
1" strip tensile	ASTM D7003	Lbf.	178 MD 171 TD	198 MD 190 TD
Tongue Tear	ASTM D5884	Lbf.	115 MD 113 TD	128 MD 126 TD
Grab Tensile Strength	ASTM D7004	Lbf.	25 MD 25 TD	31 MD 30 TD
Puncture Resistance	ASTM D4833	Lbf.	129	143

MD Machine Direction DD Diagonal Direction

**TABLE 3:
REQUIRED REINFORCED POLYETHYLENE GEOMEMBRANE
PROPERTIES 45 MIL.**

PROPERTY	TEST METHOD	UNITS	MIMIMUM ROLL AVERAGES	TYPICAL ROLL AVERAGES
Thickness	ASTM D5199	Mils	40	45
Weight	ASTM D5261	Lbs.	190	202
Ply Adhesion	ASTM D6636	Lbs.	24	43
1" strip tensile	ASTM D7003	Lbf.	182 MD 180 TD	202 MD 200 TD
Tongue Tear	ASTM D5884	Lbf.	104 MD 99 TD	116 MD 110 TD
Grab Tensile Strength	ASTM D7004	Lbf.	25 MD 25 TD	27 MD 28 TD
Puncture Resistance	ASTM D4833	Lbf.	130	145

MD Machine Direction DD Diagonal Direction

Notes:

1. The Engineer may allow alternates to these requirements.