TECHNICAL DROP-IN SPECIFICATION

 Absolute Barrier® Y-Series
7-Layer Co-extruded Gas/VOC LLDPE Barrier

The following technical drop-in specifications are provided as guidelines to be customized and finalized by the design engineer for preparing specific project specifications. This information is provided for reference purposes only and is not intended as a warranty or guarantee. Viaflex Inc. assumes no liability in connection with the use of this information. Please visit the Viaflex website at www.viaflex.com for current product specification sheets.

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**7-LAYER CO-EXTRUDED LLDPE BARRIER GEOMEMBRANE SPECIFICATION**

The 7-layer laminated membrane consists of very flexible, linear, low-density polyethylene (LLDPE) and an inner core of chemically resistance EVOH barrier resin. The 7-layer laminated geomembranes serve as covers for the repelling of water and infiltration of oxygen into the landfill as well as containment of methane/H2S and other harmful VOC gases into the environment. The inner core of the barrier layer is designed specifically to act as a barrier to VOCs such as radon, methane, and hydrocarbons. As a cover, they can repel liquids to prevent leakage into the landfill, prevent leachate buildup, and provide a barrier to harmful methane and other VOC migration out of the landfill into the environment. It is of great importance that the 7-layer laminated reinforced geomembrane be free from defects and installed without damage.

1. **DESCRIPTION**
2. 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 7-layer co-extruded barrier geomembrane including all necessary and incidental items as detailed or required to complete the installation in accordance with the Contract Drawing and these Specifications

1. Related Work:

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

1. reference standards:

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

ASTM D6693 *Standard Test Method for Determining Tensile Properties of Non-Reinforced Polyethylene and Non-Reinforced Flexible Polypropylene Geomembranes*.

ASTM D1004 *Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting*.

ASTM D4218 *Standard Test Method for Determining Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique*.

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

ASTM D3895 *Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry*.

ASTM D5885 *Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry*.

ASTM D6392 *Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods*.

4. Quality Assurance:

Quality Assurance during installation of 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane will be provided by the Owner as described in the accompanying Project CQA Manual.

5. Manufacturers Qualifications:

* 1. The Manufacturer shall have previously demonstrated his ability to produce the required 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane by having successfully manufactured a minimum of 10,000,000 ft2 of 7-layer co-extruded barrier geomembrane
1. Manufacturer must be ISO 9001 certified
	1. Installer Qualifications:

The 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane Installer shall have installed a minimum of 500,000 ft2 of LLDPE Geomembrane (or similar material).

7. Warranties:

The manufacturer of the 7-layer co-extruded Gas/VOC LLDPE barrier 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, 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. 7-LAYER CO-EXTRUDED GAS/VOC LLDPE BARRIER GEOMEMBRANE MATERIALS:

1. 7-layer co-extruded Gas/VOC LLDPE barrier 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. 7-layer co-extruded barrier geomembrane shall be a very flexible Linear Low-Density Polyethylene Geomembrane with an EVOH inner core as well as containing carbon black and stabilizers for resistance to degradation
2. Approved 7-layer Co-Extruded Gas/VOC LLDPE Barrier Geomembrane:
	* 1. Absolute Barrier Y30BAC Absolute Barrier Y40BAC
		 As manufactured by Viaflex of Sioux Falls, SD.
		2. Equal material, as approved by the Engineer.

**C. FACTORY FABRICATION**

1. The 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane shall be supplied in panels which shall be of maximum size to provide the largest manageable sheet for the fewest possible field seams.

2. Factory seams are produced by thermal sealing methods and shall have a minimum seam width of 1 ½ inch.

3. Factory seams are produced in accordance with ASTM D7982 and 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.

1. **SUBMITTALS**

The Contractor shall submit the following to the CQA Engineer:

1. Pre-Installation Requirements:

Prior to 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane installation the Contractor shall submit the following:

* 1. 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 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane attesting that the 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of the 7-layer co-extruded Gas/VOC LLDPE barrier 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.
	2. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage will be submitted for review.
	3. 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 sufficiently anchoring the 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane to satisfy the Contractor’s Performance Warranty. This plan shall be approved by the Engineer prior to construction.
	4. 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 7-layer co-extruded Gas/VOC LLDPE barrier geomembrane installation, the Contractor shall submit the following:

* 1. Completed material performance warranty.
1. **SITE PREPARATION AND INSTALLATION**

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

**TABLE 1:**

Required 7-layer co-extruded gas/VOC LLDPE barrier geomembrane properties 30 mil

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **PROPERTY** | **TEST METHOD** | **IMPERIAL UNITS** | **METRIC UNITS** | **IMPERIAL MIN. ROLL AVERAGES** | **METRIC MIN. ROLL AVERAGES** |
| Thickness  | ASTM D5199 | mils | mm | 30 | .76 |
| Weight  |  | lbs/msf | g/m² | 150 | 732 |
| Tensile Strength  | ASTM D6693 | lbs | N/cm | 85 | 148 |
| Tensile Elongation  | ASTM D6693 | % | 500 |
| Tear Resistance  | ASTM D1004 | lbs | N | 18 | 80 |
| Puncture Resistance  | ASTM D4833 | lbs | N | 60 | 267 |
| Standard OIT  | ASTM D3895 | min | 100 |
| High Pressure HPOIT  | ASTM D5885 | min | 400 |
| Carbon Black  | ASTM D4218 | % | 2 |
| Bonded Seam Strength  | ASTM D6392  | lbs/inch width  | N/cm width  | 57 | 100 |
| Seam Peel Adhesion  | ASTM D6392  | lbs/inch width  | N/cm width  | 45 | 79 |
| Benzene Permeance | See Note3 | 2.13 x 10-10 m²/sec or 1.93 x 10-13 m/s |
| Toluene Permeance | See Note3 | 2.95 x 10-10 m²/sec or 7.77 x 10-14 m/s |
| Ethylbenzene Permeance | See Note3 | 2.31 x 10-10 m²/sec or 1.78 x 10-14 m/s |
| M & P-Xylenes Permeance | See Note3 | 2.19 x 10-10 m²/sec or 2.03 x 10-14 m/s |
| O-Xylene Permeance | See Note3 | 2.07 x 10-10 m²/sec or 1.83 x 10-14 m/s |
| Methane Permeance | ASTM D1434 | < 4.93E-13 m/s |
| Hydrogen Sulfide | See Note3 | 1.45E-09 m/s |
| Trichloroethylene (TCE) | See Note3 | 1.44 x 10-10 m²/sec or 5.60 x 10-15 m/s |
| Perchloroethylene (PCE) | See Note3 | 1.35 x 10-10 m²/sec or 5.57 x 10-15 m/s |

**TABLE 2:**

Required 7-layer co-extruded gas/VOC LLDPE barrier geomembrane properties 40 mil

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **PROPERTY** | **TEST METHOD** | **IMPERIAL UNITS** | **METRIC UNITS** | **IMPERIAL MIN. ROLL AVERAGES** | **METRIC MIN. ROLL AVERAGES** |
| Thickness  | ASTM D5199 | mils | mm | 40 | .76 |
| Weight  |  | lbs/msf | g/m² | 205 | 1001 |
| Tensile Strength  | ASTM D6693 | lbs | N/cm | 125 | 166 |
| Tensile Elongation  | ASTM D6693 | % | 550 |
| Tear Resistance  | ASTM D1004 | lbs | N | 22 | 80 |
| Puncture Resistance  | ASTM D4833 | lbs | N | 70 | 267 |
| Standard OIT  | ASTM D3895 | min | 100 |
| High Pressure HPOIT  | ASTM D5885 | min | 400 |
| Carbon Black  | ASTM D4218 | % | 2 |
| Bonded Seam Strength  | ASTM D6392  | lbs/inch width  | N/cm width  | 80 | 140 |
| Seam Peel Adhesion  | ASTM D6392  | lbs/inch width  | N/cm width  | 60 | 105 |
| Benzene Permeance | See Note3 | 2.27 x 10-10 m²/sec or 1.81 x 10-13 m/s |
| Toluene Permeance | See Note3 | 3.15 x 10-10 m²/sec or 7.28 x 10-14 m/s |
| Ethylbenzene Permeance | See Note3 | 2.47 x 10-10 m²/sec or 1.67 x 10-14 m/s |
| M & P-Xylenes Permeance | See Note3 | 2.33 x 10-10 m²/sec or 1.91 x 10-14 m/s |
| O-Xylene Permeance | See Note3 | 2.20 x 10-10 m²/sec or 1.71 x 10-14 m/s |
| Methane Permeance | ASTM D1434 | < 3.70E-13 m/s |
| Hydrogen Sulfide | See Note3 | 1.09E-09 m/s |
| Trichloroethylene (TCE) | See Note3 | 1.53 x 10-10 m²/sec or 5.25 x 10-15 m/s |
| Perchloroethylene (PCE) | See Note3 | 1.44 x 10-10 m²/sec or 5.22 x 10-15 m/s |

Notes:

1. The Engineer may allow alternates to these requirements.
2. Seam testing performed at 20” per minute
3. Aqueous Phase Film Permeance
	1. Permeation of Volatile Organic Compounds through EVOH Thin Film Membranes and Coextruded LLDPE/EVOH/LLDPE Geomembranes, McWatters and Rowe, Journal of Geotechnical and Geoenvironmental Engineering© ASCE/September 2015. (Permeation is the Permeation Coefficient adjusted to actual film thickness - calculated at 1 kg/m³.) The study used to determine PCE and TCE is titled: Evaluation of diffusion of PCE & TCE through high-performance geomembranes by Di Battista and Rowe, Queens University 8 Feb 2018.